

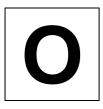
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A – Z School's Preliminary Papers 4 Express Chemistry

Paper 1 (6092/01)

	School		School
Α	Anderson Secondary School	Ν	Nanyang Girls' High School
В	Beatty Secondary School	0	Orchid Park Secondary School
С	Chung Cheng High School (Main)	Р	Paya Lebar Methodist Girls' School
D	Damai Secondary School	Q	Queensway Secondary School
Ε	Edgefield Secondary School	R	Riverside Secondary School
F	Fuhua Secondary School	S	Singapore Chinese Girls' School.
G	Geylang Methodist School (Secondary)	Т	Temasek Secondary School
Н	Hillgrove Secondary School	U	VU ying Secondary School
l	Holy Innocents' High School	V	Victoria School
J	Juying Secondary School	W	West Spring Secondary School
K	CHIJ Katong Convent School	X	Xinmin Secondary School
L	Loyang View Secondary School	У	Yuhua Secondary School
М	Montfort Secondary School	Ζ	Zhonghua Secondary School

Paper 1 40 MCQ total	
Duration = 1 hour Weighting = 30%	Marks = 40



ANDERSON SECONDARY SCHOOL Preliminary Examination 2022 Secondary Four Express



INDEX NUMBER:

CANDIDATE NAME:

CLASS:

CHEMISTRY

Paper 1

6092/01

22 August 2022 1 hour 0800 – 0900 h

Additional Materials : Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

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Write your name, class and index number on the Question Paper and Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

A copy of Periodic Table is printed on page 19.

The use of an approved scientific calculator is expected, where appropriate.

The R_f values for the dyes P, Q, R and S, in four different solvents are shown in the table.

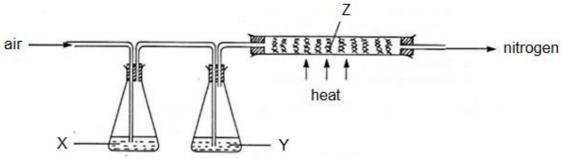
	solvent			
	water	ethanol	propanone	tetrachloromethane
dye P	0.3	0.9	0.7	0.5
dye Q	0.0	0.8	0.6	0.2
dye R	0.5	0.7	0.6	0.1
dye S	0.0	0.6	0.4	0.2

Which solvent could be used to separate a mixture of all the four dyes?

A ethanol

1

- B propanone
- **C** tetrachloromethane
- D water
- 2 The diagram below shows an apparatus that can be used to obtain a stream of nitrogen from air.



Using this apparatus, which set of substances labelled X, Y and Z gives the purest sample of nitrogen?

	Х	Y	Z
A	aqueous calcium hydroxide	calcium chloride solution	sulfur
В	concentrated sulfuric acid	aqueous calcium hydroxide	carbon
с	sodium hydroxide solution	concentrated sulfuric acid	copper
D	concentrated sulfuric acid	sodium hydroxide solution	carbon

3 The information on two substances P and Q are given below.

substance	Р	Q
arrangement of particles	close and not orderly	regularly arranged and very close
movement of particles	sliding around randomly	vibrating about their fixed positions

Four substances are given below.

substance	description
1	copper at 100 °C
2	ethanol at 25 °C
3	oxygen at 10 °C
4	water at 200 °C

Which row shows substances P and Q?

	Р	Q
Α	1	2
В	2	1
С	3	4
D	4	1

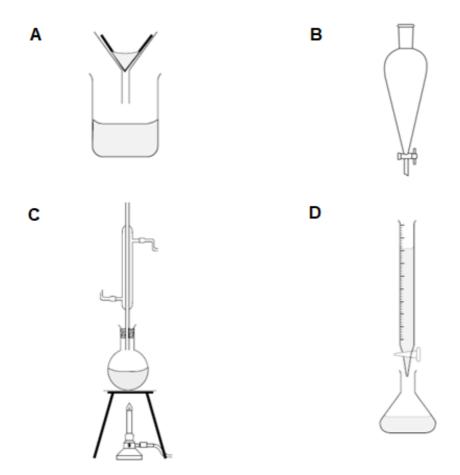
4 A student conducted an experiment to determine how much hydrochloric acid is exactly required to neutralise 25.0 cm³ of aqueous potassium hydroxide.

Without the use of an indicator, which piece of apparatus does he require to determine the end-point of the reaction?

- **A** electronic balance
- B gas syringe
- **C** stopwatch
- **D** thermometer

5 A student prepared an ester by heating ethanoic acid and ethanol for thirty minutes.

Which apparatus is most suitable for the student to separate the ester formed from the reaction mixture at the end of the reaction?



6 A newly discovered element, Preliminarium (Pm) has a proton number of 123 and a nucleon number of 248.

Which row shows the correct number of sub-atomic particles in a Preliminarium ion, Pm^{3+} ?

	number of electrons	number of neutrons	number of protons
Α	120	120	123
В	120	123	120
С	120	125	123
D	123	125	120

7 Element M exists as 3 stable isotopes and has a relative atomic mass of 65.0.

	⁶⁴ M	⁶⁶ M	⁶⁷ M
Α	32.1%	56.4%	11.5%
в	54.6%	6.6%	38.8%
С	56.3%	31.1%	12.6%
D	53.3%	25.5%	21.2%

Which row shows the correct compositions of isotopes?

8 Four balloons W, X, Y and Z, were inflated to the same size with four different gases: argon, chlorine, carbon dioxide and ammonia.



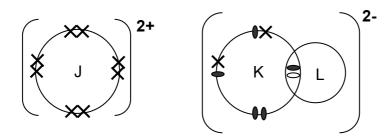
After several hours, all four balloons became smaller.

What is the correct order of balloon size?

	largest \rightarrow smallest			
Α	Х	Y	W	Z
в	Х	W	Y	Z
С	W	Z	Y	Х
D	Z	W	Y	Х

The formula of an ionic compound, containing elements J, K and L is shown below.

The letters J, K and L are **not** the chemical symbols of the elements.



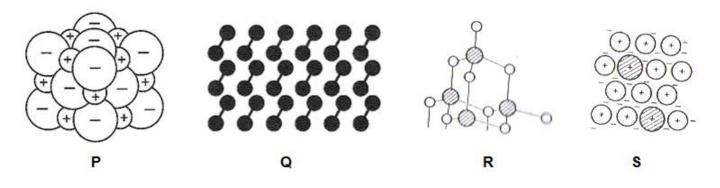
Which statements are correct?

- 1 Element K belongs to Group V of the Periodic Table.
- 2 Element J could be magnesium.
- 3 Element K and element L are bonded together by covalent bond.
- 4 Element L is a metal.
- A 1 and 2 only

9

- **B** 1, 2 and 3 only
- C 3 and 4 only
- **D** 2, 3 and 4 only

The structures of four substances P, Q, R and S at room conditions, are represented as follows. Use the structures to answer questions 10, 11 and 12.



- 10 Which statement about the four substances is **not** correct?
 - **A** All the substances are pure.
 - **B** All the substances are solids at room conditions.
 - **C** One of the substances is an element.
 - **D** Substance Q has a simple molecular structure.
- 11 Which property describes substance P correctly?
 - A low melting point
 - B hard
 - **C** poor electrical conductivity in all states
 - **D** soluble in organic solvent
- 12 Which row shows the correct identities for the four substances P, Q, R and S?

	Р	Q	R	S
Α	brass	dry ice	diamond	calcium oxide
В	calcium oxide	iodine	sand	brass
С	sand	poly(ethene)	sodium chloride	iodine
D	sodium chloride	oxygen	poly(ethene)	brass

13 Element R reacts with water producing a solution which turns red litmus paper to blue. The solution also reacts with dilute sulfuric acid to form a colourless liquid.

In which group or section of the Periodic Table is R found?

- A Group I
- **B** Group VII
- **C** Group 0
- **D** transition metals
- **14** A student is given five reagents as shown below to make salts.

dilute hydrochloric acid dilute sulfuric acid dilute nitric acid solid lead(II) oxide solid copper(II) oxide

How many soluble salts can be prepared?

- **A** 3
- **B** 4
- **C** 5
- **D** 6
- **15** Study the reaction shown below.

 $2\mathsf{KMnO_4}(aq) + 5\mathsf{SO_2}(g) + 2\mathsf{H_2O}(l) \rightarrow \mathsf{K_2SO_4}(aq) + 2\mathsf{MnSO_4}(aq) + 2\mathsf{H_2SO_4}(aq)$

Which pair of oxidising and reducing agents is correct?

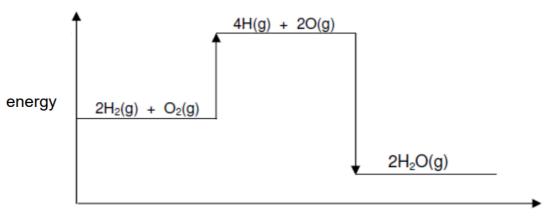
	oxidising agent	reducing agent
Α	H ₂ SO ₄	MnSO ₄
В	KMnO4	H ₂ O
С	KMnO4	SO ₂
D	SO ₂	KMnO ₄

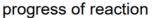
16 Which row correctly shows the salts that are prepared by each method?

	titration	precipitation	adding excess solid reactants
Α	ammonium nitrate	lead(II) sulfate	sodium chloride
В	calcium carbonate	calcium sulfate	calcium chloride
С	copper(II) sulfate	ammonium chloride	lead(II) nitrate
D	potassium sulfate	silver chloride	zinc sulfate

17 Pentane can be converted into carbon dioxide and water in the following stages:

- **A** 1 and 2
- **B** 1 and 3
- **C** 2 and 3
- **D** 1, 2 and 3
- **18** The energy level diagram for burning hydrogen gas in oxygen to form steam is shown in the diagram.

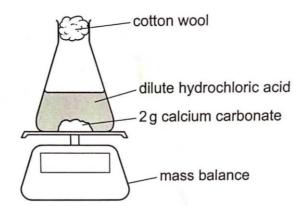




Which statement about the reaction is correct?

- **A** The enthalpy change of the reaction has a negative value.
- **B** The reaction is endothermic.
- **C** The temperature of the reaction mixtures decreases.
- **D** The volume of the reactants is equal to the volume of the products.

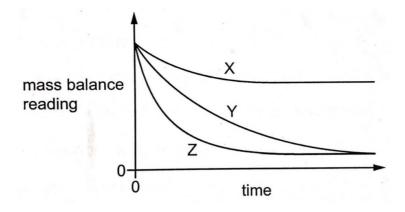
19 The rate of reaction between calcium carbonate and hydrochloric acid is measured in three separate experiments.



The conditions at which each experiment is performed are as follows:

experiment	particle size of calcium carbonate	moles of hydrochloric acid provided for reaction				
1	powdered	in excess				
2	lumps	in excess				
3	lumps	insufficient				

The results of these experiments are shown.



Which statement is correct?

- **A** Experiment 1 is shown by curve X.
- **B** Experiment 1 is shown by curve Y.
- **C** Experiment 2 is shown by curve Y.
- **D** Experiment 3 is shown by curve Z.

20 An aqueous solution contains the same amount of Al^{3+} and Cu^{2+} ions. Aqueous sodium hydroxide is added until in excess. After shaking, the mixture is filtered.

What would be left on the filter paper?

- **A** a blue solid
- **B** a blue solid and a white solid
- **C** a white solid
- **D** no solid residue
- **21** A student carried out the following reactions on a sample of ammonium nitrate.

reaction 1	warming with aqueous sodium hydroxide
reaction 2	warming with aluminium and aqueous sodium hydroxide
reaction 3	warming with dilute hydrochloric acid

Which reactions produces a gas that turns damp red litmus paper blue?

- A 1 only
- **B** 1 and 2
- **C** 2
- **D** 2 and 3
- 22 Chlorine is bubbled into aqueous iron(II) chloride. Subsequently, aqueous sodium hydroxide is added to the resultant solution and a reddish brown precipitate is observed.

Which statement is **not** correct?

- **A** Chlorine causes iron(II) chloride to undergo oxidation.
- **B** Iron(III) hydroxide is formed.
- **C** The aqueous sodium hydroxide is the reducing agent.
- **D** The oxidation state of chlorine has decreased.

23 Methane reacts very slowly with air at room temperature. When metal T is added to the methane-air mixture, methane ignites quickly.

Which statements about the addition of metal T are correct?

- 1 T provides an alternative pathway with a lower activation energy.
- 2 T increases the enthalpy change of the reaction.
- 3 T increases the rate of reaction.
- 4 T increases the yield of the reaction.
- A 1 and 2 only
- **B** 1 and 3 only
- **C** 1, 2 and 4 only
- **D** 3 and 4 only
- **24** Ammonia is manufactured by the Haber Process. The equation for the Haber process is given below.

 $N_2(g) + 3 H_2(g) \rightleftharpoons 2 NH_3(g) \qquad \Delta H = -92 \text{ kJ/mol}$

Which statement about the Haber Process is true?

- A Hydrogen used is obtained from the hydrogenation of alkenes.
- **B** Nitrogen used is obtained from the fractional distillation of crude oil.
- C The reaction is exothermic as energy is absorbed to break the strong N≡N bonds.
- **D** The yield of the reaction is always lower than 100% as the reaction is reversible.
- **25** Cynogen is a compound used as a rocket propellant. Its empirical formula is CN and 1.3 g of cynogen occupied 600 cm³ at room temperature and pressure.

What is the molecular formula of cynogen?

- A CN
- **B** C₂N₂
- **C** C₃N₃
- **D** C₄N₄

26 Nickel makes up 25.0% of the total mass of a coin. The coin has a mass of 8.0 g.

How many nickel atoms are there in the coin?

- A 2.03 X 10²²
- **B** 4.15 X 10²²
- **C** 8.12 X10²²
- **D** 1.20 X 10²⁴
- **27** 110 g of manganese reacts completely with 72 dm³ of fluorine gas to form a fluoride of manganese.

Which equation correctly represents the reaction?

- $\textbf{A} \qquad Mn + F_2 \rightarrow MnF_2$
- $\textbf{B} \qquad Mn + 2F_2 \rightarrow MnF_4$
- $\textbf{C} \qquad 2Mn + 3F_2 \rightarrow 2MnF_3$
- $\textbf{D} \qquad 4Mn+3F_2 \rightarrow 2Mn_2F_3$
- **28** Methanethiol, CH₃SH, burns as shown in the equation below.

 $CH_3SH + 3O_2 \rightarrow CO_2 + SO_2 + 2H_2O$

A sample of 20 cm³ of methanethiol was exploded with 30 cm³ of oxygen.

What would be the final volume of the resultant mixture of gases when cooled to room temperature and pressure?

- **A** 20 cm³
- **B** 30 cm³
- **C** 40 cm³
- **D** 50 cm³

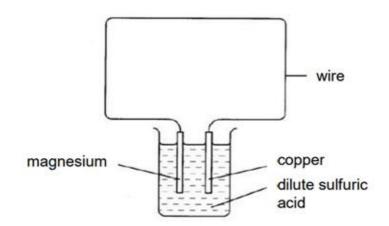
29 Elements X, Y and Z are in the same period of the Periodic Table. The properties of the oxides formed by these elements are shown below.

oxide X	dissolves in dilute hydrochloric acid only								
oxide Y	dissolves in aqueous sodium hydroxide only								
oxide Z	dissolves in both dilute hydrochloric acid and aqueous sodium hydroxide								

What is the order of the elements X, Y and Z in increasing atomic number?

- **A** X, Y, Z
- **B** X, Z, Y
- **C** Y, X, Z
- **D** Y, Z, X

30 The diagram shows a simple cell.



Which statements about the simple cell are correct?

- 1 Bubbles are formed around copper.
- 2 Electrons move from magnesium to copper across the wire.
- 3 Mass of magnesium remains the same.
- 4 Copper is the negative electrode.
- A 1 and 2 only
- **B** 2 and 3 only
- C 2 and 4 only
- D 3 and 4 only

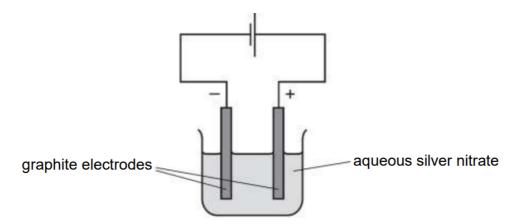
- 31 Which reaction is a step in the production of iron from haematite in the blast furnace?
 - A coke burning in air to produce carbon monoxide
 - **B** coke reacting with carbon monoxide to form carbon dioxide
 - **C** iron(III) oxide reacting with carbon monoxide to form iron
 - **D** iron reacting with limestone to produce slag
- **32** Four unknown metals, Q, R, S and T, are reacted with water, steam and dilute hydrochloric acid. The results are shown in the table.

	reaction with water	reaction with steam	reaction with dilute hydrochloric acid
Q	slow reaction	fast reaction	fast reaction
R	no reaction	no reaction	no reaction
S	no reaction	very slow reaction	slow reaction
Т	fast reaction	extremely fast reaction	extremely fast reaction

Which statements are correct?

- 1 R could be silver.
- 2 T could be Group I metal.
- 3 S is more reactive than Q and R.
- 4 Metals react faster with steam than they do with water.
- A 1 and 2 only
- **B** 1, 2 and 4 only
- C 2 and 3 only
- D 3 and 4 only

33 The diagram shows the electrolysis of aqueous silver nitrate.



Which statement is correct?

- **A** A brown gas is produced at the positive electrode.
- **B** A grey solid is coated on the negative electrode.
- **C** The anode dissolves and becomes smaller.
- **D** The electrons move from the negative terminal to positive terminal through the solution.
- **34** Four steel paper clips are treated before being placed in a beaker of water.

Which paper clip rusts most quickly?

- A attached to a piece of silver
- **B** coated with grease
- **C** dipped in paint and allowed to dry
- **D** electroplated with zinc
- **35** A Group I metal with the highest reactivity is reacted with a Group VII element with the highest colour intensity.

Which compound is formed?

- **A** francium fluoride
- **B** francium astadide
- **C** lithium fluoride
- **D** lithium astadide

36 In which parts of a motor car do the reactions, shown in the equations, take place?

	$N_2 + O_2 \rightarrow 2NO$	$2CO + 2NO \rightarrow 2CO_2 + N_2$
Α	engine	engine
В	engine	exhaust
С	exhaust	engine
D	exhaust	exhaust

- **37** In which reaction does the named product formed have a lower relative molecular mass than the reactant?
 - A conversion of ethanoic acid into ethyl ethanoate
 - **B** fermentation of glucose into ethanol
 - **C** formation of poly(ethene) from ethene
 - D oxidation of ethanol into ethanoic acid
- **38** The structural formula of a hydrocarbon is shown below.

$$CH_3 - CH_3$$

 $CH_3 - C = CH_2$

Which statements about the hydrocarbon are correct?

- 1 It can undergo polymerisation.
- 2 It exhibits isomerism.
- 3 It forms an alcohol by reacting with water.
- 4 It reacts with chlorine only if ultra-violet light is present.
- A 1 and 2 only
- **B** 1 and 3 only
- C 2 and 3 only
- **D** 2 and 4 only

39 A carboxylic acid has the molecular formula C₁₈H₂₈O₂.

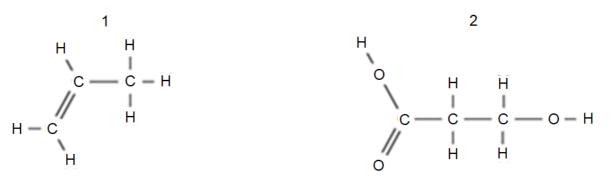
How many C = C bonds are there in one molecule of the acid?

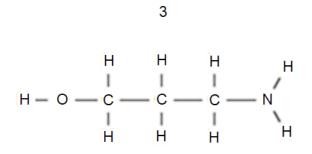
- Α
- **B** 2

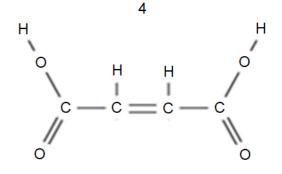
1

- **C** 3
- **D** 4
- 40

Which monomers would undergo polymerisation on their own?







- A 1, 2 and 3
- **B** 1, 2 and 4
- C 2 and 3
- **D** All of the above

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	VI			8	0	oxygen	16	16	S	sulfur 32	34	Se	selenium 79	52	Te	tellurium	128	84	Ро	polonium –	116	۲۷	livermorium —		69	Tm	thulium 169	101	Md	mendelevium —
	>			7	z	nitrogen	14	15	٩	phosphorus 31	33	As	arsenic 75	51	Sb	antimony	122	83	Ē	bismuth 209					68	ш	erbium 167	100	Еm	fermium -
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dn											28	ïZ	nickel 50	46	Ъd	palladium	106	78	£	platinum 195	110	Ds	darmstadtium 		63	Eu	europium 152	95	Am	americium -
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		1 H hydrogen	1								26	Fe	iron 56	44	Ru	nuthenium	101	76	Os	osmium 190	108	Hs	hassium –		61	Pm	promethium -	93	dN	neptunium -
											25	Mn	manganese	43	Чc	technetium	ı	75	Re	rhenium 186	107	Bh	bohrium –		60	ΡQ	neodymium 144	92		m uranium ne 238
				umber	lo		nass													tungsten 184					59	P	praseodymium 141	91	Ра	protactinium 231
			Key	proton (atomic) number	atomic symbol	name	/e atomic r													tantalum 181										thorium 232
				proton	ato		relativ				22	Ħ	titanium 48	40	Zr	zirconium	91	72	Hf	hafnium 178	104	Ŗ	Rutherfordium 		57	La	lanthanum 139	89	Ac	actinium -
			Į								21	Sc	scandium 45	39	≻	yttrium	89	57 – 71	anthanoids		89 - 103									
	=			4	Be	beryllium	6	12	Mg	magnesium 24	20	Ca	calcium 40	38	S	strontium	88	56	Ba	barium 137	-		radium –		lanthanoids			actinoids		
	_			ი	:=	lithium	7	11	Na	sodium 23	19	¥	potassium 30	37	Rb	rubidium	85	55	ട്	caesium 133	87	Ъг	francium _		<u>a</u>					

The volume of one mole of any gas is $24 \, \text{dm}^3$ at room temperature and pressure (r.t.p.).

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BEATTY SECONDARY SCHOOL PRELIMINARY EXAMINATION 2022 SECONDARY FOUR EXPRESS

CANDIDATE NAME		
CLASS	REGISTER NUMBER	

CHEMISTRY

Paper 1	Multiple Choice
Setter:	Mr Yeo Chee Keong

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

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A copy of the Periodic Table is printed on page 15.

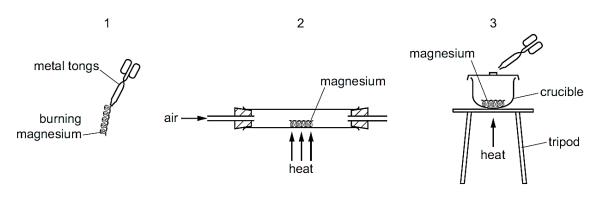
The use of an approved scientific calculator is expected, where appropriate.

6092/01

1 hour

31 August 2022

1 Shermen investigates the change in mass during the combustion of magnesium. The diagrams show three set-ups for this investigation.



Which set-up(s) is/are suitable for this investigation?

- A
 3 only
 B
 1 and 3 only

 C
 2 and 3 only
 D
 1, 2 and 3 only
- 2 The table shows the observations made when different reagents are added to an aqueous solution of Z.

reagents added	observations
aqueous sodium hydroxide	green-white precipitate; green precipitate only in excess sodium hydroxide
dilute nitric acid followed by aqueous silver nitrate	yellow precipitate
dilute nitric acid followed by aqueous barium nitrate	no visible reaction

What are the ions present in solution Z?

Α	A <i>l</i> ³⁺ , Fe ²⁺ , I [−]	В	Al ³⁺ , Fe ³⁺ , SO ₄ ²⁻
С	Pb²+, Fe²+, I⁻	D	Pb²+, Fe³+, C <i>l</i> ⁻

3 A mixture of colourless amino acids is separated using chromatography. The solvent used is propanol and the chromatogram is sprayed with a locating agent.

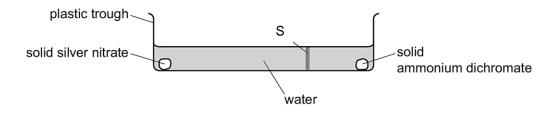
Which row describes the purpose of the propanol and the locating agent?

	purpose of propanol	purpose of locating agent
Α	to make the individual amino acids	to prevent the amino acids moving
	visible	any further
В	to move the amino acids up the	to make the individual amino acids
	chromatography paper	visible
С	to move the amino acids up the	to prevent the amino acids moving
	chromatography paper	any further
D	to prevent the amino acids moving	to make the individual amino acids
	too far up the paper	visible

- **4** How many underlined substance(s) can be obtained by fractional distillation of the mixture?
 - <u>hydrogen</u> from liquefied air
 - propene from bitumen
 - <u>ethanol</u> from water and ethanol mixture
 - <u>ethyl ethanoate</u> from ethanol and ethanoic acid



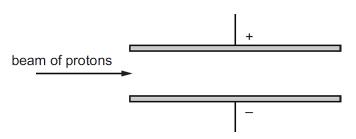
5 Silver dichromate is a red solid that can be made by reacting silver nitrate solution with ammonium dichromate solution. The apparatus was set up as shown.



After five minutes, a red solid appeared along the line marked 'S' on the diagram.

What conclusion can be made from this experiment?

- A Diffusion of silver nitrate occurs faster than the diffusion of ammonium dichromate.
- **B** Silver ions have a lower relative molecular mass than dichromate ions.
- **C** Solid silver nitrate is more soluble than solid ammonium dichromate.
- **D** The red solid formed would dissolve to form a coloured solution.
- 6 A beam of protons was passed through an electrostatic field between two charged plates. The electrostatic field deflected the beam of protons. The lower the relative mass of the particle, the larger the deflection.

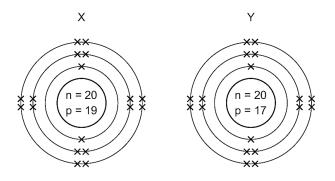


The experiment was repeated using a beam of electrons in place of the beam of protons.

Which row correctly shows the amount and direction of the beam of electrons?

	amount of deflection of beam of electrons	direction of deflection of beam of electrons
Α	deflected less than beam of protons	opposite direction to beam of protons
в	deflected less than beam of protons	same direction as beam of protons
С	deflected more than beam of protons	opposite direction to beam of protons
D	deflected more than beam of protons	same direction as beam of protons

- 7 Which ion contains the same number of both neutrons and electrons?
 - **A** ${}^{40}Ca^{2+}$ **B** ${}^{19}F^-$ **C** ${}^{24}Mg^{2+}$ **D** ${}^{32}S^{2-}$
- 8 The arrangements of the electrons in two ions formed from elements X and Y are shown.



Which equation represents the reaction between elements X and Y?

Α	$X_2 + 2Y \rightarrow 2X^+ + 2Y^-$	В	$X_2 \textbf{+} 2Y \rightarrow 2X^- \textbf{+} 2Y^+$
С	$2X + Y_2 \rightarrow 2X^+ + 2Y^-$	D	$2X + Y_2 \rightarrow 2X^- + 2Y^+$

9 Magnesium oxide may be used for the lining of an electric furnace for making crockery.

Which properties of magnesium oxide help to explain this use?

	ionic bonding	electrical conductivity	solubility in water
Α	no	yes	no
В	no	no	yes
С	yes	yes	yes
D	yes	no	no

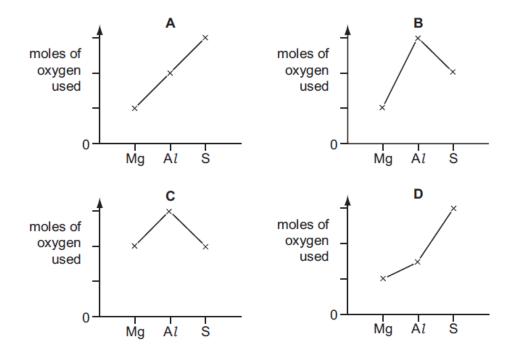
10 Both aluminium and graphite are good conductors of electricity and have high melting points.

Which row correctly shows the similarity and difference between aluminium and graphite?

	similarity	difference
Α	good conductors of electricity due to mobile electrons	aluminium has a high melting point due to strong metallic bonds while graphite has a high melting point due to strong intermolecular forces
В	good conductors of electricity due to mobile electrons	aluminium has a high melting point due to strong metallic bonds while graphite has a high melting point due to strong covalent bonds
С	high melting point due to strong forces of attraction	aluminium conducts electricity due to positive cations while graphite conducts electricity due to mobile electrons
D	high melting point due to strong forces of attraction	aluminium conducts electricity due to sea of delocalised electrons while graphite conducts electricity due to oppositely charged ions

11 One mole of magnesium, aluminium and sulfur are each completely burned in excess of oxygen gas.

Which graph shows the number of moles of oxygen used for each element?



12 A sample of solid ammonium chloride decomposes on heating.

solid ammonium chloride \rightarrow ammonia gas + hydrogen chloride gas

A total of 2.4 \times 10²¹ molecules of gas is formed.

What is the volume of ammonia gas produced?

- **A** 48 cm³ **B** 96 cm³ **C** 2.88×10^{25} cm³ **D** 5.76×10^{25} cm³
- **13** 62 g of impure copper(II) carbonate undergoes thermal decomposition to produce 10 dm³ of carbon dioxide gas.

What is the percentage purity of copper(II) carbonate? [M_r: CuCO₃, 124]

A 16.1% **B** 50.0% **C** 83.3% **D** 92.0%

14 In an electrolysis experiment, the same amount of charge deposited 12 g of titanium and 32 g of copper. The charge on the copper ion was 2+. [A_r: Ti, 48; Cu, 64]

What was the charge on the titanium ion?

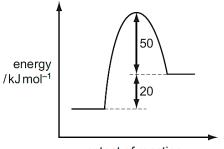
A 1+ B 2+ C 3+ D 4+

15 Concentrated aqueous sodium chloride is electrolysed using inert electrodes.

Which row correctly explains the change occurring during electrolysis?

	change occurring	explanation
Α	oxygen is liberated at the positive electrode	OH⁻ ions loses electrons more easily than C <i>l</i> ⁻ ions
В	pH of the electrolyte increases	H⁺ ions are discharged
с	products of electrolysis stay the same when molten sodium chloride electrolyte is used	Na ⁺ and C <i>l</i> ⁻ ions are present in both electrolytes
D	solid sodium is deposited at the negative electrode	Na⁺ ions are discharged

16 The reaction pathway for a reversible reaction is shown.



extent of reaction

Which statements about the reaction are correct?

- 1 The activation energy for the forward reaction is +70 kJ/mol.
- 2 The enthalpy change for the backward reaction is -50 kJ/mol.
- 3 The shape of the graph can be represented by the decomposition of silver salts in photographic films by light.
- 4 The shape of the graph can be represented by the dissolution of ammonium nitrate in water.
- A 1 and 2 onlyC 3 and 4 only
- B 2 and 3 onlyD 1 and 4 only
- **17** Qiyang investigates the effect of concentration on the rate of reaction between calcium carbonate and hydrochloric acid. He follows the method shown.
 - Place 1 g of calcium carbonate in a conical flask.
 - Add excess hydrochloric acid.
 - Let the reaction continue until no more gas is produced.
 - Repeat the experiment with different concentrations of hydrochloric acid.

Which essential step has been left out of the method if he is to work out the rate of the reaction?

- A placing a rubber bung in the conical flask
- B placing the experiment setup onto an electronic balance
- **C** plotting a graph to calculate the gradient
- **D** using a stopwatch to time the reaction

 $Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$

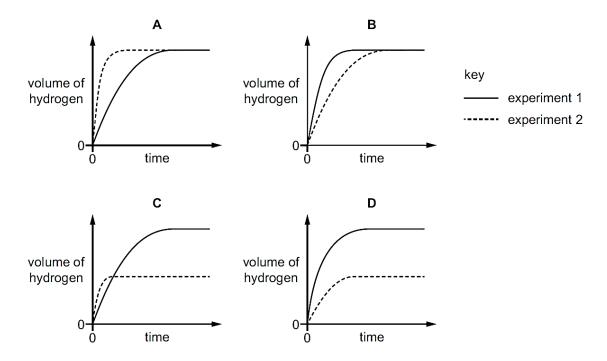
Two experiments were carried out.

experiment 1: 24.0 g of magnesium reacted with 100 cm³ of 1.0 mol/dm³ sulfuric acid.

experiment 2: 24.0 g of magnesium reacted with 50 cm³ of 2.0 mol/dm³ sulfuric acid.

In each experiment the volume of hydrogen was measured at various times. The results were plotted on a graph.

Which graph is correct?



19 Acidified MnO₄⁻ is often used in titrations to determine the concentrations of other solutions. One such reaction is represented by the ionic equation shown.

 $MnO_4^{-}(aq) + 8H^{+}(aq) + 5Fe^{2+}(aq) \rightarrow Mn^{2+}(aq) + 4H_2O(l) + 5Fe^{3+}(aq)$

Which statement is correct?

- A Eight moles of H⁺ ions are oxidised by gaining 4 moles of oxygen atoms.
- **B** Five moles of Fe^{2+} ions are oxidised by losing 5 moles of electrons.
- **C** Manganese is oxidised in the process as the oxidation state increases.
- D This is not a redox reaction as the number of hydrogen atoms remain unchanged.
- **20** The thermal decomposition of one mole of ammonium nitrate gives only two products: two moles of steam and one mole of an oxide of nitrogen, X.

What is the oxidation state of nitrogen in X?

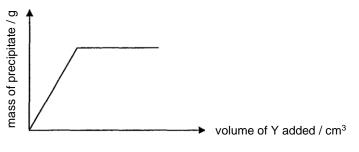
A +1 B +2 C +3 D +4

21 Acids are used in many chemical reactions.

Which row correctly shows the role of acid in the reaction mixture?

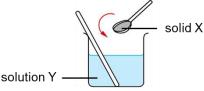
	reaction mixture	role of acid
Α	ethanoic acid, ethanol and concentrated sulfuric acid	catalyst
В	ethanol, potassium manganate(VII) and nitric acid	oxidising agent
С	lead(II) carbonate and phosphoric acid	precipitation
D	lead(II) nitrate and sulfuric acid	neutralisation

- 22 Which statement about oxides is correct?
 - **A** A solution of magnesium oxide has a pH less than 7.
 - **B** A solution of sulfur dioxide has a pH greater than 7.
 - **C** Magnesium oxide reacts with nitric acid to produce a salt.
 - D Sulfur dioxide reacts with hydrochloric acid to produce a salt.
- **23** An aqueous solution of X was placed in a test tube and an aqueous solution of Y gradually added from a burette. The mass of the precipitate was obtained as shown.



Which pair of reagents are possible identities of X and Y?

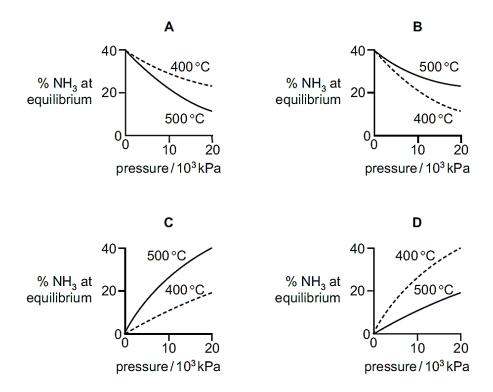
- **A** ammonia solution and zinc chloride
- **C** magnesium carbonate and water
- **B** calcium hydroxide and nitric acid
- **D** sodium carbonate and barium nitrate
- **24** A student wishes to prepare a pure and dry sample of copper(II) nitrate using the method shown in the diagram.



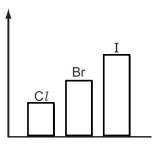
Which row correctly shows the identity of solid X and solution Y used?

	solid X	solution Y
Α	copper(II) chloride	excess nitric acid
В	copper(II) hydroxide	excess nitric acid
С	excess copper	nitric acid
D	excess copper(II) carbonate	nitric acid

25 Which diagram best represents the percentage of ammonia formed at different temperatures and pressures?



- 26 Which statement about the elements in the Periodic Table is correct?
 - **A** All the Group 0 elements cannot form compounds.
 - B Elements in Group V form ions with a charge of 5+.
 - **c** Elements in the same group react in a similar way because they all contain the same number of electrons.
 - **D** Germanium has a less metallic character than gallium.
- 27 Kendrick drew a bar chart representing the properties of some Group VII elements.

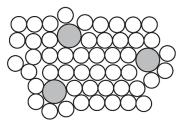


Which properties follow the trend observed in the bar chart?

- 1 colour intensity
- 2 melting point
- 3 oxidising ability
- 4 reactivity
- A 1 and 2 only
- C 3 and 4 only

B 2 and 3 onlyD 1 and 4 only

28 The diagram shows the structure of an alloy.



Which statement about alloys is correct?

- A All alloys contain iron atoms.
- **B** Alloys can only be formed by mixing copper or iron with other metals.
- C High carbon steel alloys are soft and easily shaped.
- **D** There are forces of attraction between the positive ions and 'sea of electrons'.
- **29** Abby carried out some experiments to place four metals, P, Q, R, and S in order of reactivity. The results are as shown.

	metal P	metal Q	metal R	metal S
solution of P nitrate	_	×	×	×
solution of Q nitrate	\checkmark	_	\checkmark	\checkmark
solution of R nitrate	\checkmark	×	-	\checkmark
solution of S nitrate	\checkmark	×	×	_

- **Key** ✓ shows a reaction happened
 - shows a reaction happened
 - shows the experiment was not performed

What is the correct order of reactivity of the four metals?

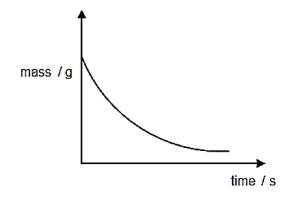
	most reactive			least reactive
Α	Р	Q	R	S
В	Р	S	R	Q
С	Q	R	S	Р
D	Q	Р	S	R

30 Metal X is more reactive than zinc but less reactive than sodium.

What would be the best method for obtaining metal X from its ore?

- A electrolysis of an aqueous solution of a salt of X
- B electrolysis of the molten oxide of X
- **C** heating the oxide of X in hydrogen
- **D** heating the oxide of X with powdered carbon

31 A known mass of unknown carbonate was placed in an open crucible and heated until there was no further change observed. The results are as shown.



Which carbonates will give the results as shown?

- 1 calcium carbonate
- 2 hydrated potassium carbonate
- 3 sodium carbonate
- 4 zinc carbonate
- A 1 and 3 only
- **C** 1 and 4 only

- **B** 2 and 3 only
- **D** 1, 2 and 4 only
- 32 A steel bicycle which had been left outdoors for several months was starting to rust.

What would **not** reduce the rate of corrosion?

- A Add acid to the rust and paint the bicycle.
- **B** Paint the bicycle and wipe the bicycle with an oily cloth.
- **C** Store the bicycle in a dry shed.
- **D** Wipe the bicycle with a clean, damp cloth and oil the bicycle.
- **33** Four sources of air pollution are listed.
 - 1 burning coal
 - 2 internal combustion in car engines
 - 3 incomplete combustion of carbon-containing fuels
 - 4 adding lead compounds to petrol

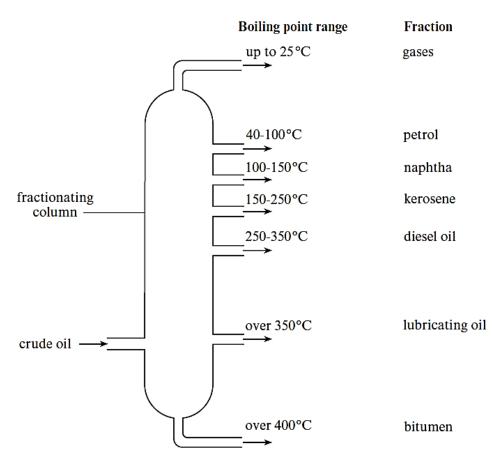
Which sources produce acid rain?

Α	1	and	2	only
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C 2 and 3 only

- **B** 1 and 3 only
- **D** 3 and 4 only

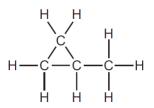
34 Crude oil is separated into fractions in the fractionating column as shown.



Which statements about the separation of crude oil are correct?

- 1 A mixture of octane and nonane can be found in the petrol fraction.
- 2 All the fractions belong to the same homologous series with an increasing boiling point down the column.
- 3 The molecular masses of the fractions increase down the column.
- A
 3 only
 B
 1 and 3 only

 C
 2 and 3 only
 D
 1, 2 and 3
- **35** The diagram shows the structural formula of an organic compound.



Which statement about this compound is correct?

- **A** It has a general formula of C_nH_{2n+2} .
- **B** It is a saturated hydrocarbon.
- **C** It is an isomer of butane.
- **D** It is formed from the hydrogenation of butene.

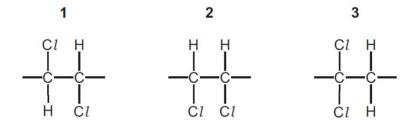
- **36** Which equation represents the complete combustion of an organic molecule with a relative molecular mass of 32?
 - $\textbf{A} \quad \textbf{CH}_3\textbf{NH}_3 + \textbf{3O}_2 \rightarrow \textbf{CO}_2 + \textbf{3H}_2\textbf{O} + \textbf{NO}$
 - $\textbf{B} \quad 2CH_4 + 4O_2 \rightarrow 2CO_2 + 4H_2O$

 - $\textbf{D} \quad 2HCO_2H + O_2 \rightarrow 2CO_2 + 2H_2O$
- 37 Which row correctly shows the products obtained by cracking of hydrocarbons?

	alkene	hydrogen	water
Α	\checkmark	×	×
в	\checkmark	\checkmark	×
С	\checkmark	\checkmark	\checkmark
D	×	\checkmark	\checkmark

38 A mixture of the three isomers of $C_2H_2Cl_2$ is polymerised.

Three repeating units of the possible polymers are shown.



Which repeating units could be seen within the polymer chains?

Α	1 and 2 only	В	1 and 3 only
С	2 and 3 only	D	1, 2 and 3

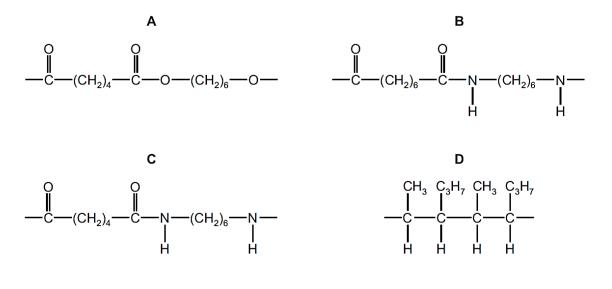
- **39** Several reagents are listed below.
 - aqueous bromine
 - ethanol
 - magnesium
 - potassium manganate(VII)
 - Universal Indicator

How many reagents can be used to physically distinguish separate beakers of propanol and propanoic acid?

A 2 B 3 C 4	D 5
----------------------------------	------------

- 40 P is a polymer that
 - has six carbon atoms in each of the monomers from which it was formed,
 - has a similar structure to nylon,
 - was formed from the loss of water molecules.

What is the partial structure of P?



		5	He	4	7 8 9	ц 0 2	nitrogen oxygen fluorine	14 16 19	15 16 17	P S CI	phosphorus sulfur chlorine 31 32 35.5	33 34 35	As Se Br	n arsenic 75	51 52 53	Sb Te I	antimony tellurium iodine 100 108 107	83 84 85	Bi Po At	bismuth polonium astatine		114 116 116 F/			68 69 70	Er Tm Yb	holmium erbium thulium ytterbium lutetium 165 167 169 173 175	100 101 102	Fm Md No	n fermium mendelevium nobelium Ia	
	=	-			ى ا	8	boron	5	13	Al	aluminiu 27	30	Zn	zinc gallium 65 70	48	РС	cadmium 112	80	۲	mercury	102	112 Cn	copernicium	-			terbium dysprosium 159 163	+			
												29	CL	copper 64	47	Ag	silver 108	62	Au	gold	191	111 Rg	n roentgenium	-	64	9	gadolinium 157	96	с С	curium	
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The Periodic Table of Elements

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

15

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Parent's Signature

PRELIMINARY EXAMINATION 2022 SECONDARY 4

CHEMISTRY

Paper 1 Multiple Choice

16 September 2022

1 hour

6092/01

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid. Write your name, class and register number clearly in the spaces provided at the top of this page.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

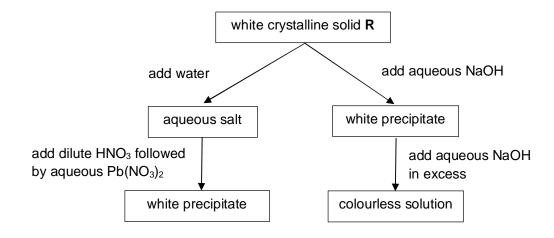
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet. A copy of the Periodic Table is printed on page 18.

The use of an approved scientific calculator is expected, where appropriate.

- 1 Which mixture can be separated into its components by adding water, stirring and filtering?
 - A ammonium carbonate and sodium chloride
 - B calcium nitrate and barium chloride
 - **C** iron(II) carbonate and potassium sulfate
 - **D** copper and sulfur
- 2 The diagram below shows the reaction of an unknown substance.



What is solid R?

- A zinc chloride
- **B** sodium carbonate
- **C** aluminium nitrate
- D calcium sulfate

3 The following reactions are carried out.

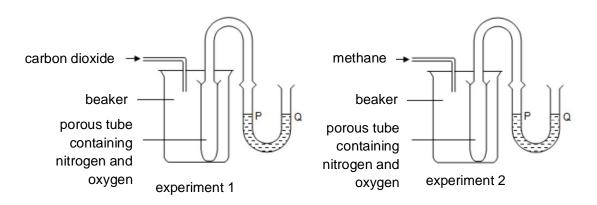
	L
reaction	result
propanoic acid is added to	gas E is given off
ammonium carbonate	
ammonium propanoate is	gas F is given off
warmed with aqueous	
sodium hydroxide	
propanoic acid is added to	compound G is formed in
aqueous ammonia	a colourless solution

What are E, F and G?

	<u>gas E</u>	<u>gas F</u>	compound G
Α	ammonia	carbon dioxide	ammonium carbonate
В	ammonia	carbon dioxide	ammonium propanoate
С	carbon dioxide	ammonia	ammonium carbonate
D	carbon dioxide	ammonia	ammonium propanoate

- 4 In which of the following substances are the particles closest to one another at 25 °C?
 - A dilute hydrochloric acid
 - B copper(II) oxide
 - **C** ethanol
 - **D** carbon monoxide

5 Two experimental set-ups to demonstrate the diffusion of gases are shown in the diagram below.



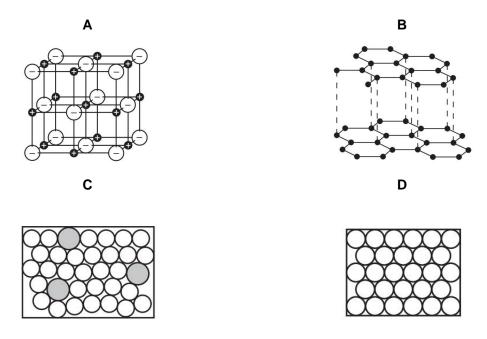
What changes, if any, to the water levels at P and Q would you expect to see in both experiments?

	experiment 1	experiment 2
Α	P and Q remain the same	Q is higher than P
в	P and Q remain the same	P is higher than Q
С	Q is higher than P	P is higher than Q
D	P is higher than Q	Q is higher than P

6 Which statements comparing the properties of electrons, neutrons and protons are correct?

	neutrons and protons are both heavier than electrons	only electrons and neutrons are charged
Α	yes	yes
В	yes	no
С	no	yes
D	no	no

7 Which diagram best shows the structure of a mixture?



8 Sodium nitrate is an ionic compound.

Which statement is not correct?

- A Cations are formed when sodium atoms lose electrons.
- **B** The oppositely charged ions are held strongly together.
- **C** Nitrate ion is a positively charged polyatomic ion.
- **D** Sodium nitrate solution can conduct electricity.
- **9** In the molecules CH₃OH, NH₃ and HF, which atoms use all of their outer shell electrons in bonding?
 - A C and H
 - B C and F
 - C N and H
 - D H and O

- 6
- **10** Element Q has a proton number 3. Element R has an electronic configuration 2,8,6.

What would be the formula of the compound formed between Q and R?

A QR **B** Q_2R **C** QR_2 **D** QR_4

11 15 cm³ of ethene reacts with 60 cm³ of oxygen at 150 °C in a reaction vessel according to the equation below.

 $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

What is the total volume of gases at the end of the reaction in the reaction vessel?

- **A** 30 cm³
- **B** 60 cm³
- **C** 75 cm³
- **D** 110 cm³
- **12** 20 cm³ of an aqueous 1.0 mol/dm³ solution of the hydroxide of metal X exactly neutralises 40 cm³ of 0.25 mol/dm³ dilute sulfuric acid.

What is the formula for the sulfate of X?

A XSO_4 **B** $X(SO_4)_2$ **C** X_2SO_4 **D** $X_2(SO_4)_3$

13 In a reaction between 23 g of ethanol and excess hydrogen bromide, the mass of bromoethane obtained is 27 g.

 $C_2H_5OH + HBr \rightarrow C_2H_5Br + H_2O$

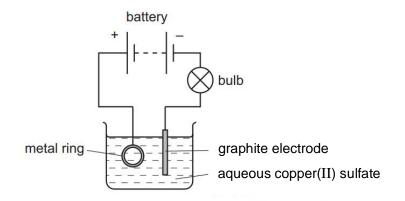
What is the percentage yield of bromoethane? [M_r : C₂H₅OH, 46; C₂H₅Br, 109]

A 25% **B** 50% **C** 60% **D** 85%

- 2 g of an impure zinc oxide reacts with excess nitric acid to produce 3.97 g of zinc nitrate.What is the percentage purity of zinc oxide used?
 - **A** 50% **B** 79% **C** 82% **D** 85%
- **15** In an electrolysis experiment, the same amount of charge deposited 68.9 g of silver and 6.64 g of chromium.

What is the charge on the chromium ion?

- **A** +2 **B** +3 **C** +5 **D** +6
- **16** The diagram below shows apparatus used in an attempt to electroplate a metal ring with copper.



The experiment did not work.

What change is needed in the experiment to make it work?

- A Replace the graphite electrode with a copper electrode.
- **B** Reverse the connections to the battery.
- **C** Increase the temperature of the electrolyte.
- **D** Add solid copper(II) sulfate to the electrolyte.

These electrolytes are listed below.

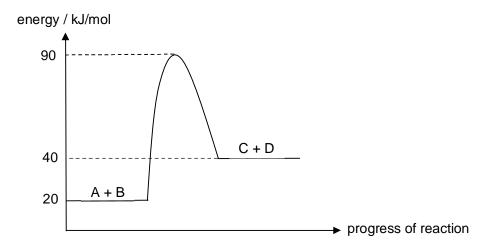
- cell 1: aqueous zinc nitrate
- cell 2: dilute hydrochloric acid
- cell 3: molten sodium bromide
- cell 4: concentrated copper(II) chloride

In which of these cells is a gas formed at both electrodes?

A 1 and 2 B 1 and 3 C 2 and 4 D 3 and 4

18 The energy profile diagram of a reversible reaction is shown below.

$$A + B \rightleftharpoons C + D$$



Which of the following statements is correct about the energy profile diagram?

- A Activation energy of the backward reaction is given by –50 kJ/mol.
- **B** Enthalpy change of the backward reaction is given by +20 kJ/mol.
- **C** Activation energy of the forward reaction is given by +70 kJ/mol.
- **D** Enthalpy change of the forward reaction is given by +50 kJ/mol.

- 19 Which one of the following is an endothermic process?
 - A Mixing of dilute sulfuric acid with aqueous sodium hydroxide.
 - **B** Addition of lithium to cold water.
 - **C** Heating of zinc carbonate to get zinc oxide.
 - **D** Rusting of an iron nail.
- 20 Which of the underlined substance acts as a reducing agent?
 - A $\underline{Fe_2O_3} + 3CO \rightarrow 2Fe + 3CO_2$
 - $\textbf{B} \qquad \underline{\text{Br}_2} + 2\text{NaI} \rightarrow 2\text{NaBr} + I_2$
 - **C** $\underline{H_2O_2}$ + NaOC $l \rightarrow O_2$ + NaCl + H₂O
 - **D** $\underline{Cu(NO_3)_2} + Zn \rightarrow Cu + Zn(NO_3)_2$
- 21 Which of the following statements about an acid is correct?
 - **A** pH is a measure of acid concentration in a solution.
 - **B** A weak acid can have the same pH as a strong acid.
 - **C** When an acid reacts with a reactive metal, hydrogen ions lose electrons.
 - **D** Universal indicator turns blue when placed in an acid.

22 The diagram shows a simplified Periodic Table.

]								
W									X
			 	 	 			Y	
			-				P		
	Z						5		

Which elements will form an oxide that will react with an acid?

- A W and Z only B W only C X and Y only D Y only
- **23** In an experiment, an excess aqueous copper(II) sulfate and aqueous sodium carbonate are mixed in a beaker.

What will be observed when the reaction is complete?

- A a colourless solution only
- **B** a green precipitate and a blue solution
- **C** a green precipitate and a colourless solution
- **D** a white precipitate and a colourless solution
- 24 Which is the best way to prepare calcium sulfate, starting from calcium carbonate?
 - A Add dilute sulfuric acid to calcium carbonate and then filter.
 - **B** Add excess aqueous sodium sulfate to calcium carbonate and then filter.
 - **C** Add excess nitric acid to calcium carbonate followed by dilute sulfuric acid and filter.
 - **D** Heat calcium carbonate and then react the calcium oxide with dilute sulfuric acid, then filter.

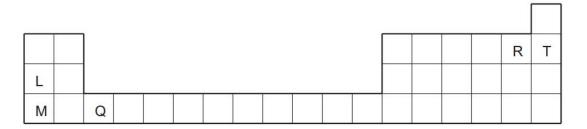
11

25 Ammonia is manufactured by the Haber process.

Which statement in not correct?

- A A catalyst of iron is used.
- **B** Hydrogen and nitrogen react in a 1:3 mole ratio to form two moles of ammonia.
- **C** Hydrogen for the process can be obtained by the cracking of oil.
- **D** The reaction will not give 100% yield in a closed container.
- **26** The diagram shows the positions of the elements L, M, Q, R and T in the Periodic Table.

These letters are not the chemical symbols of the elements.



Which statement about the properties of these elements is correct?

- A L reacts more vigorously with water than does M.
- **B** R has a more non-metallic character than T.
- **C** M and R react together exothermically.
- **D** L, M and Q are able to gain electrons to form anions.
- **27** Each of the following halogens, X_2 , Y_2 and Z_2 , was added to the respective halide solutions and the observations are shown in the table below.

halogen added	NaX	NaY	NaZ
X ₂		Y ₂ displaced	no visible reaction
Y ₂	no visible reaction		no visible reaction
Z ₂	X ₂ displaced	Y ₂ displaced	

Which of the following shows the elements X, Y and Z in increasing order of reactivity?

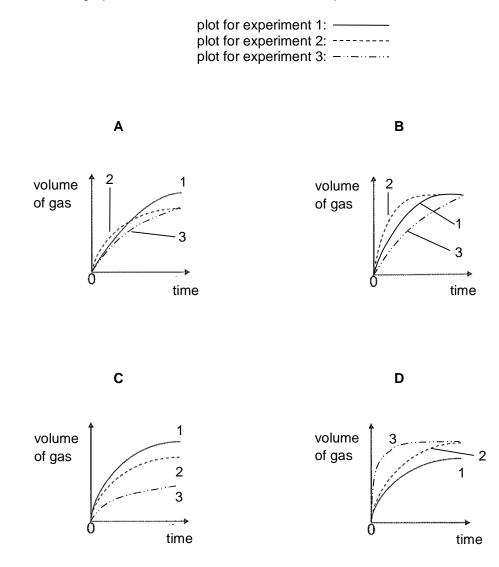
- **A** Y, X, Z
- **B** Y, Z, X
- **C** X, Y, Z
- **D** Z, X, Y

28 Three experiments are carried out to measure the volume of carbon dioxide produced when different concentrations of hydrochloric acid and ethanoic acid are added to excess calcium carbonate.

experiment	acid
1	50 cm ³ of 0.20 mol/dm ³ hydrochloric acid
2	20 cm ³ of 0.50 mol/dm ³ hydrochloric acid
3	50 cm ³ of 0.20 mol/dm ³ ethanoic acid

A graph of volume of carbon dioxide against time is plotted for all the experiments.

Which graph best shows the results for these experiments?



29 M is a metal. It can occur naturally as an element and sometimes in ore containing its oxides. M does not react with water and acid.

M can be used to make a chloride with formula MCl or MCl_2 .

A student made some statements about metal M.

- 1 It can be extracted by electrolysis.
- 2 It is likely to be displaced from its solution containing its ions by silver.
- 3 It can be extracted from its ore by hydrogen.
- 4 It is likely to be found as an ore containing the compound M₂O or MO.

Which statements are correct?

- **A** 1, 3 and 4 only
- **B** 2, 3 and 4 only
- **C** 1, 2 and 3 only
- D 3 and 4 only

30 A student made the following statements about some air pollutants.

1	Carbon monoxide is responsible for the production of acid rain.
2	Oxides of nitrogen are present in car exhausts.
3	Sulfur dioxide can be produced by the combustion of fossil fuels.
4	Methane causes global warming.

Which statements are correct?

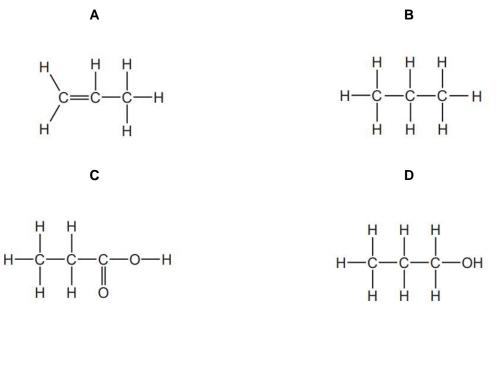
- A 1 and 2 only
- **B** 3 and 4 only
- **C** 2, 3 and 4 only
- **D** all of the above
- **31** When crude oil is fractionally distilled, which compounds leave from the bottom of the fractionating column?
 - **A** The compounds that are least flammable.
 - **B** The compounds that are the least viscous.
 - **C** The compounds with the lowest relative molecular mass.
 - **D** The compounds with the lowest boiling points.

32 Which fraction from the fractional distillation of crude oil is **not** correctly matched to its use?

	fraction	use
Α	bitumen	make road surfaces
В	paraffin	make polishes and waxes
С	kerosene	fuel for aircraft
D	naphtha	feedstock for plastics production

33 Alkanes, alkenes and alcohols are three types of organic compound.

Which structure does not belong to any of these three types of compound?



34 An organic compound X has the molecular formula $C_{20}H_{33}OH$.

How many carbon-carbon double bonds are present in a molecule of X?

35 A hydrocarbon $C_{12}H_{26}$ obtained from petroleum can undergo cracking to give three hydrocarbons.

hydrocarbon $C_{12}H_{26}$ obtained from petroleum $3C_2H_4 + C_3H_8$ + hydrocarbon **Q**

Which row best describes the molecules in hydrocarbon ${\bf Q}$ and the effect of ${\bf Q}$ on aqueous bromine?

	number of carbon atoms in Q molecule	effect of Q on aqueous bromine			
Α	3	decolourises			
в	3	no effect			
С	7	decolourises			
D	7	no effect			

36 Ethanol can be formed by

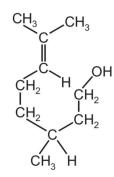
- 1 fermentation
- 2 reaction between steam and ethene

Which of these processes uses a catalyst?

	1	2
Α	yes	yes
в	yes	no
С	no	yes
D	no	no

37 Citronellol is found in rose oil.

The structure of citronellol is shown.

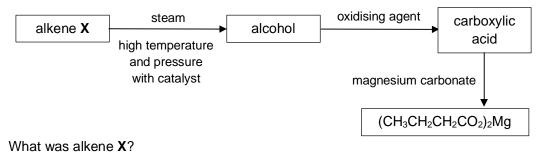


Which statement about citronellol is not correct?

- A Citronellol dissolves in water to give an alkaline solution.
- **B** Citronellol turns purple acidified potassium manganate(VII) colourless.
- **C** Citronellol reacts with hydrogen in the presence of a catalyst to give a saturated compound.
- **D** Citronellol forms a polymer with the same empirical formula as the monomer.
- **38** The reaction between a carboxylic acid, $C_xH_yCO_2H$ and an alcohol, $C_nH_{2n+1}OH$, produces an ester.

How many hydrogen atoms does one molecule of ester contain?

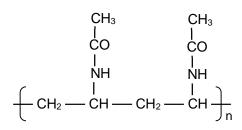
- **A** y+2n+3 **B** y+2n+2 **C** y+2n+1 **D** y+2n
- **39** A reaction scheme for an alkene **X** is given. The alkene underwent a series of reactions to obtain the salt, (CH₃CH₂CO₂)₂Mg.



- A CH₃CH=CH₂
- B CH₃CH₂CH=CH₂
- C CH₃CH=CHCH₃
- $\textbf{D} \qquad \textbf{CH}_3\textbf{CH}_2\textbf{CH}_2\textbf{CH}=\textbf{CH}_2$

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40 The diagram shows the formula of a polymer.



Which of the following could be used to make this polymer?

- $A \qquad CH_3 CO CH = CH_2$
- **B** CH_3COOH and $H_2N CH_2 CH_2 NH_2$
- $C \qquad CH_3 CO NH CH = CH_2$
- **D** CH_3COOCH_3 and $H_2N CH_2 CH_2 NH_2$

																						-	0								ı	_				
		0	2	Нe	helium	4	10	Ne	neon	20	18	Ar	argon	40	36	Кr	krypton	84	54	Xe	xenon	131	86	Rn	radon							74		Lu	175	103
		٨I					റ	ш	fluorine	19	17	Cl	chlorine	35.5	35	Вг	bromine	80	53	I	iodine	127	85	At	astatine							04	2;	γp	ytterblum 173	102
		N					8	0	oxygen	16	16	ა	sulfur	32	34	Se	selenium	79	52	Те	tellurium	128	84	Ро	polonium		116	Ż	livermorium			60	201	E 1	169	101
		^					7	z	nitrogen	14	15	٩	phosphorus	31	33	As	arsenic	75	51	Sb	antimony	122	83	Bi	bismuth	209						00	ßı	LL L	erbium 167	100
		N					9	ပ	carbon	12	14	ŝ	silicon	28	32	g	germanium	73	50	Sn	tin	119	82	Pb	lead	207	114	FΙ	flerovium			57	20 :	e i	165	66
		■					5	в	boron	11	13	Ρl	aluminium	27	31	G	gallium	70	49	I	indium	115	81	T_l	thallium	204						22	001	Dy	ay sprosium 16.3	86
2						L									30	Ŋ	zinc	65	48	Cd	cadmium	112	80	Рg	mercury	201	112	ů	copernicium	-		5E	81	L D	159	220
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I he Periodic Table of Elements	dn														28	Ż	nickel	59	46	Ъd	palladium	106	78	Ŧ	platinum	195	110	Ds	darmstadtium			63	3 1	Eu	europium 152	35
odic la	Gro																			Rh												50	70	Sm	150	34
ne rerio			1	т	hydrogen										26	Fe	iron	56	44	Ru	ruthenium	101	76	SO	osmium	190	108	붜	hassium			54	ō ,	Pm	Ë	93
															25	Mn	manganese	55	43	Tc	technetium	ı	75	Re	rhenium	186	107	Bh	bohrium			03	00	Nd	um neodymum 1 144	
							umber	0		lass					24	ъ	chromium			Mo										-			201	Pr	praseodymum 141	
					2	Key	proton (atomic) number	atomic symbol	name	relative atomic mass							vanadium			q							105		dubnium	•		50	000	e Ce		06
							proton	ato		relativ					22	i	titanium	48	40	Z	zirconium	91	72	坣	hafnium	178	104	Rf	rutherfordium	-		57		La	anmanum 139	68
						·										ഗ്	scandium	45	39	≻	yttrium	89	57 - 71	lanthanoids			89 - 103	actinoids				_				
		=					4	Be	beryllium	6	12	Mg	magnesium	24	20	Ca	calcium	40	38	Sr	strontium	88	56	Ba	barium	137	88	Ra	radium	•		obiocootoo	iai ili iai iulus			actinoids
		_					e	:	lithium			Na				¥	potassium	39	37	Rb	rubidium	85	55	Cs	caesium	133	87	ŗ	francium			-	-			
						-								_								_								-						

The Periodic Table of Elements

					_
1/5	103	L	law rencium		
1/3	102	No	nobelium	-	
169	101	PM	mendelevium	•	
10/	100	Еm	fermium		
165	66	Es	einsteinium	•	
163	98	ç	californium		
159	67	Ŗ	berkelium	•	
15/	96	С С	curium		
152	95	Am	americium		
150	94	Pu	plutonium		
•	63	ď	neptunium	•	
144	92		uranium	238	
141	91	Ра	protactinium	231	
140	06	Th	thorium	232	
139	68	Ac	actinium		
	actinoids				

The volume of one mole of any gas is 24 \mbox{dm}^3 at room temperature and pressure (r.t.p.)

18



DAMAI SECONDARY SCHOOL Preliminary Examination 2022

CANDIDATE NAME			
CLASS	INDEX NUMBER		
CHEMISTRY		6092/01	
Paper 1 Multiple Choice	23 Au	igust 2022	
Secondary 4 Express		1 hour	,

Setter: Ms See Pei Zhen

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid. Write your name, index number and class on all the work you hand in.

There are **forty** questions in this section. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

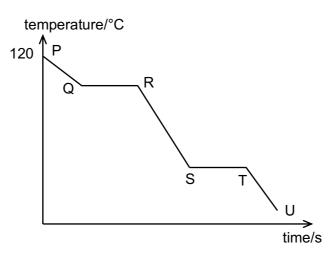
Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 15.

The use of an approved scientific calculator is expected, where appropriate.

40 marks

1 The graph shows the change in temperature with time when steam is cooled from 120 °C.



Which of the following shows the correct change taking place between different points of the graph?

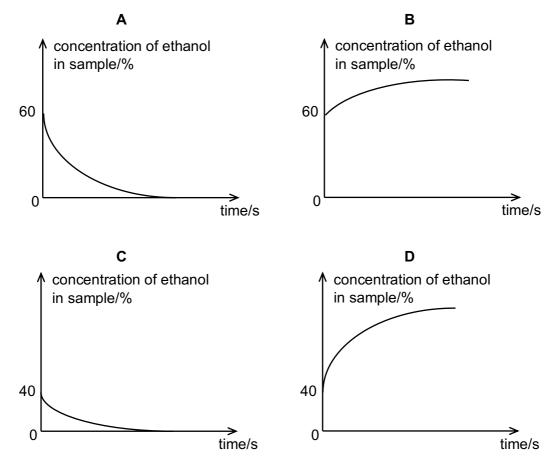
	points	change
Α	P to Q	kinetic energy of particle remains constant
в	Q to R	water boiling
С	R to S	the volume of liquid is decreasing
D	T to U	water freezing

- 2 A mixture is formed when two or more substances are physically combined together. Which statement about mixtures is true?
 - A Equal masses of two substances must be used.
 - **B** The mixture shows similar chemical properties to those of its constituents.
 - **C** The substances must be both metals.
 - **D** When the substances are combined, an ionic or a covalent compound forms.
- 3 What is necessary for two substances to be separated by paper chromatography?
 - **A** They are both soluble in water.
 - **B** They have the same solubility in the same solvent.
 - **C** They have different solubilities in the same solvent.
 - **D** Their solids have different densities in the same solvent.

4 Whisky is a beverage composed of mainly water and ethanol. Scotch Whisky is usually made up of 60 % of ethanol by volume.

A sample of Scotch Whisky is distilled using fractional distillation. Ethanol boils at 78 °C.

Which graph shows the change in concentration of ethanol in the sample as the distillation proceeds?



5 Q is an element in the Periodic Table.

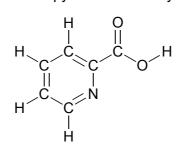
Which of the following represents an isotope of $^{81}_{35}$ Q?

- A ⁷⁹₃₃ Q
- **B** ⁷⁹₃₅ Q
- **C** $^{81}_{42}$ Q
- **D** ⁸¹₄₆ Q

6 Which ion has the lowest number of electron shells containing electrons?

Α	A <i>l</i> ³⁺	В	Be ²⁺	С	N ^{3–}	D	S ²⁻
A	Α ί	D	De	C	IN	U	3

7 The diagram shows a molecule of pyridine-2-carboxylic acid.



Determine the number of valence electrons involved in bonding and the number of valence electrons **not** involved in bonding in one molecule of pyridine-2-carboxylic acid.

	number of valence electrons involving in bonding	number of valence electrons not involved in bonding
Α	18	10
в	18	46
С	36	10
D	36	20

8 X, Y and Z are compounds of elements in Period 3. Their electrical conductivities are shown in the table below.

	Х	Y	Z
electrical conductivity of the compound when molten	good	good	does not conduct
electrical conductivity of the mixture obtained upon adding the compound to water	does not conduct	good	does not conduct

What are the possible identities of X, Y and Z?

	Х	Y	Z
Α	Al_2O_3	NaC <i>l</i>	diamond
в	Al_2O_3	Cu	diamond
С	Na ₂ SO ₄	Al_2O_3	NaC/
D	Na ₂ SO ₄	Cu	Br ₂

- Both hydrochloric acid and ethanoic acid have the same concentration of 1.00 mol/dm³.
 Which method(s) is/are suitable to test their strengths?
 - 1 using universal indicator solution
 - 2 measuring their electrical conductivity
 - 3 titration using 1.00 mol/dm³ of aqueous sodium hydroxide
 - **A** 2 only **B** 3 only **C** 1 and 2 **D** 1, 2 and 3
- 10 Which pair of solutions, when mixed together, forms a precipitate?
 - **A** sodium chloride and barium nitrate
 - **B** sodium nitrate and ammonium sulfate
 - C silver sulfate and nitric acid
 - **D** silver nitrate and hydrochloric acid
- **11** An aqueous solution containing a mixture of calcium ions, copper(II) ions and zinc ions was treated with an excess of aqueous ammonia. The reaction mixture was filtered.

What is the colour of the residue?

- A white
- B blue
- **C** green
- **D** no residue is obtained
- **12** 256 g of sulfur vapor has the same volume as 160 g of bromine gas at the same temperature and pressure.

What is the formula of a molecule of sulfur?

Α	S ₁₆	В	S ₈	С	S ₄	D	S_2

13 Which volume of 0.1 mol/dm³ sulfuric acid is required to react completely with 50 cm³ of 0.2 mol/dm³ lithium hydroxide solution?

A 0.5 cm^3 **B** 1 cm^3 **C** 50 cm^3 **D** 100 cm^3

- 14 Which statement about the ions of Group II elements is correct?
 - **A** They have two valence electrons.
 - **B** They contain an odd number of electrons.
 - **C** They contain more electrons than protons.
 - **D** They contain more protons than electrons.
- 15 Which pair of elements, when reacted together, gives the least violent reaction?
 - A lithium and iodine
 - **B** rubidium and fluorine
 - **C** lithium and fluorine
 - **D** rubidium and iodine

16 An element R is in Group VII of the Periodic Table.

Which of the following formulae is incorrect?

Α	R⁻	В	HR	С	R ₂	D	MgR
---	----	---	----	---	----------------	---	-----

17 Which of the following shows the correct source and effect of the named pollutant?

	pollutant	source	effect
Α	methane	combustion of fossil fuel	global warming
в	oxides of nitrogen	lightning activity	acid rain
С	ozone	depletion of ozone layer	acid rain
D	sulfur dioxide	volcanoes	global warming

18 Which of the following gives the definitions of reduction?

	oxygen	hydrogen	electrons
Α	loss	gain	gain
в	loss	loss	gain
С	gain	gain	loss
D	gain	loss	loss

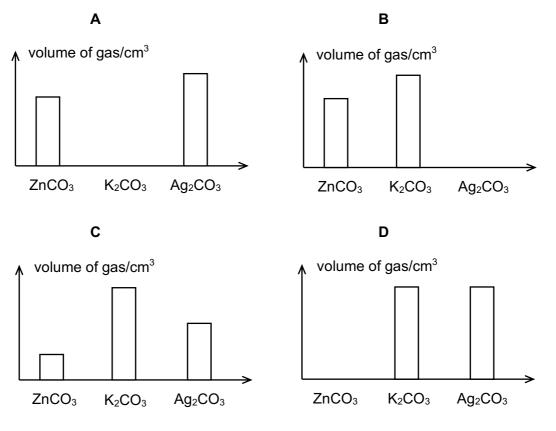
19 Sodium hypochlorite reacts with zinc metal to form zinc oxide and sodium chloride.

 $NaOCl + Zn \rightarrow ZnO + NaCl$

Which statement about this reaction is correct?

- A oxygen changes from oxidation state 0 to -2
- **B** chlorine changes from oxidation state +1 to -1
- **C** sodium changes from oxidation state +3 to +1
- D zinc remains in oxidation state 0
- 20 Iodine solution turns from brown to colourless when added to substance X. Based on this observation, what can be deduced about substance X?
 - **A** Substance X is an oxidising agent.
 - **B** Substance X is a reducing agent.
 - **C** Substance X is a bleaching agent.
 - **D** Substance X can only be aqueous sodium chloride.
- **21** The carbonates of zinc, potassium and silver were heated strongly.

Which graph best shows the relative volume of gas collected in the first minute of the reaction?



- 22 Which statement about alloys is always correct?
 - **A** Alloys contains only metallic atoms.
 - **B** Their structure contains a 'sea of electrons'.
 - **C** They have higher melting point than its pure metals.
 - **D** They have equal or better electrical conductivity than its pure metal.
- 23 Metals are found naturally in its elemental state or as metallic compounds.

Metals can be extracted from their compounds through either electrolysis or using carbon as a reducing agent.

Which row is correct?

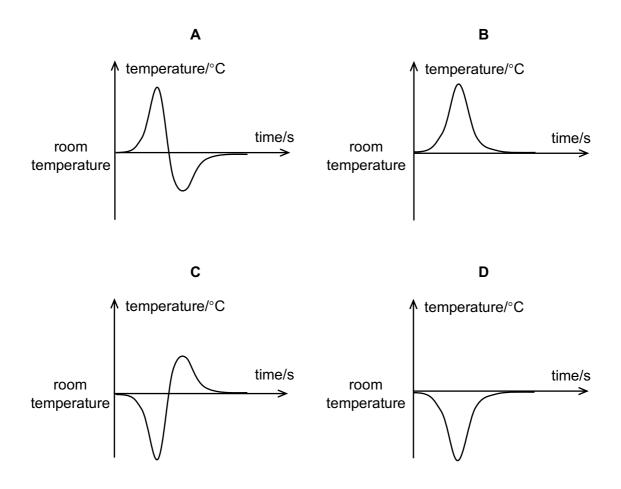
	exists as an element	obtained through electrolysis	obtained by reduction using carbon			
Α	Au	Na	Pb			
в	Mg	Na	Pb			
С	Au	Ag	Mg			
D	Mg	Ag	Са			

- 24 Which of the following are reason(s) why iron is recycled?
 - 1 Recycling scrap iron is cheaper than mining iron ores.
 - 2 Recycling scrap metal reduces environmental problems arising from disposal of scrap metal in landfills.
 - 3 Recycling iron reduces the amount of air pollutants released during extraction of iron.
 - A 1 only
 - **B** 1 and 2 only
 - **C** 2 and 3 only
 - **D** 1, 2 and 3
- 25 Which process is an exothermic process?
 - **A** photosynthesis
 - **B** sublimation of iodine
 - **C** dissolution of ammonium chloride in water
 - **D** formation of an oxygen molecule from two oxygen atoms

26 In a particular two-step chemical reaction, step 2 occurs immediately after step 1 is complete.

	sign of ∆ <i>H</i>	energy change/kJ
step 1	negative	200
step 2	positive	350

Which graph shows the temperature change that will occur for the two-step chemical reaction?



27 The enthalpy change of combustion, $\Delta H_{\text{combustion}}$, is the enthalpy change when one mole of substance is completely burned in oxygen gas.

Propane is used as a fuel for portable cookstoves and undergoes combustion according to the equation shown.

$$C_{3}H_{8} + 5O_{2} \rightarrow 3CO_{2} + 4H_{2}O \qquad \qquad \Delta H_{combustion} = -2220 \text{ kJ/mol}$$

Calculate the energy released when 22 g of propane is burned.

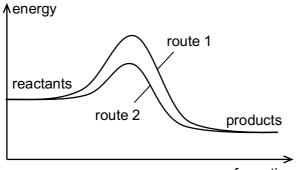
Α	222 kJ	В	1110 kJ	С	2220 kJ	D	5550 kJ
---	--------	---	---------	---	---------	---	---------

28 On 24 February 2021, an explosion at an industrial building in Tuas killed three workers and injured seven others. The source of explosion was later found to be potato starch, which could have been ignited in the presence of a naked flame.

Which of the following statement(s) is/are possible explanation(s) why the potato starch resulted in an explosion?

- 1 Potato starch is a good conductor of heat which spreads fire quickly.
- 2 Potato starch has a large surface area which increases rate of combustion.
- 3 The presence of large number of potato starch particles per unit volume of air increases the rate of combustion.
- A 2 only
- **B** 1 and 3 only
- C 2 and 3 only
- **D** 1, 2 and 3
- **29** The diagram shows the energy profile diagram for a reaction.

The original reaction proceeded by route 1. After the addition of substance F, the reaction proceeded by route 2.



progress of reaction

What change is likely to be observed when F is added to the original reaction mixture?

- **A** The reaction yields more products.
- **B** The reaction goes to completion faster.
- **C** The reaction becomes less exothermic.
- **D** The reaction becomes more exothermic.

30 A sealed container at 250 atm containing only ammonia gas was heated from room temperature to 450 °C.

Which gas(es) will be found in the container at 450 °C?

- A ammonia only
- **B** ammonia and nitrogen only
- **C** hydrogen and nitrogen only
- **D** ammonia, hydrogen and nitrogen
- **31** In separate electrolysis experiments, the same amount of charge deposited 8 g of copper from copper(II) nitrate and 3 g of titanium from titanium nitrate.

What is the charge on the titanium ion?

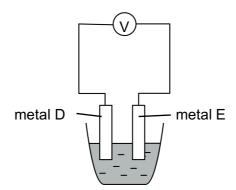
A 1+ B 2+ C 3+ D 4+

32 Which pair of statements describes the differences between the conduction of electricity in the electrolyte and the conduction of electricity in a platinum electrode during electrolysis?

	conduction of electricity in electrolyte	conduction of electricity in platinum electrode
1	current due to movement of ions	current due to movement of ions and electrons
2	charged particles move in opposite directions	charged particles move in a single direction
3	results in a chemical change	does not result in a chemical change

- A 1 only
- **B** 2 and 3 only
- **C** 1 and 3 only
- **D** 1, 2 and 3

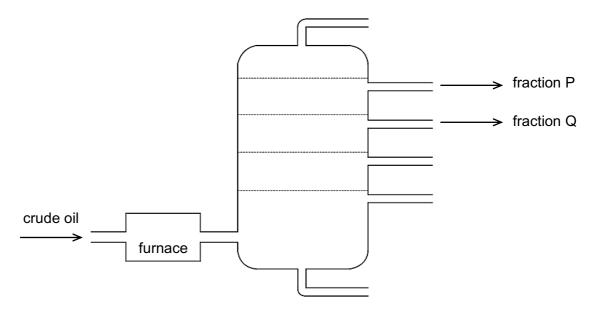
33 A simple cell was setup as shown in the diagram.



Which pair of metals will produce the highest voltage?

	metal D	metal E				
Α	magnesium	lead				
В	magnesium	aluminium				
С	silver	copper				
D	silver	magnesium				

34 The diagram shows the fractional distillation of crude oil.

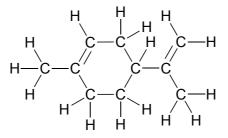


Which of the following properties of fraction P and Q is correct?

	properties of P and Q									
Α	P has longer hydrocarbon chains than Q	P burns less easily than Q								
в	P has a high boiling point than Q	P burns more easily than Q								
С	P has shorter hydrocarbon chains than Q	P burns less easily than Q								
D	P has a lower boiling point than Q	P burns more easily than Q								

35 Liquid limonene, $C_{10}H_{16}$, can be extracted from lemon peels.

The structure of limonene is given below.

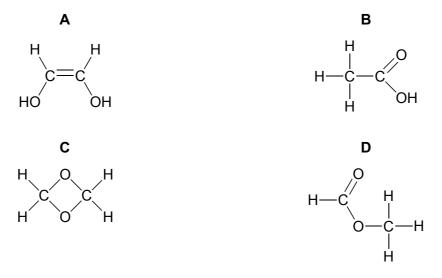


How many moles of bromine will react with 68 g of limonene?

- A 0.5 mol
- B 1 mol
- **C** 8 mol
- **D** 10 mol
- **36** The hydrocarbon $CH_3CH_2CHCH_2$ can undergo a number of chemical reactions. In which reaction will the carbon–carbon single bond(s) be broken?
 - **A** addition polymerisation
 - **B** addition of steam
 - **C** combustion
 - D hydrogenation
- 37 Which statement about fermentation is correct?
 - **A** Fermentation converts hydrocarbon to ethanol and liberates carbon dioxide.
 - **B** Fermentation converts hydrocarbon to ethanol and liberates carbon monoxide.
 - **C** Fermentation converts carbohydrate to ethanol and liberates carbon dioxide.
 - **D** Fermentation converts carbohydrate to ethanol and liberates carbon monoxide.

38 An aqueous solution of a compound with molecular formula $C_2H_4O_2$ reacts with magnesium metal to form a gas which extinguishes a lighted splint.

What is the structural formula of the compound?



- 39 Which of the following product is formed when methanol reacts with ethanoic acid?
 - A ethyl methanoate
 - **B** methyl ethanoate
 - **C** propanal
 - **D** propanoate acid

40 Which statement about macromolecules is correct?

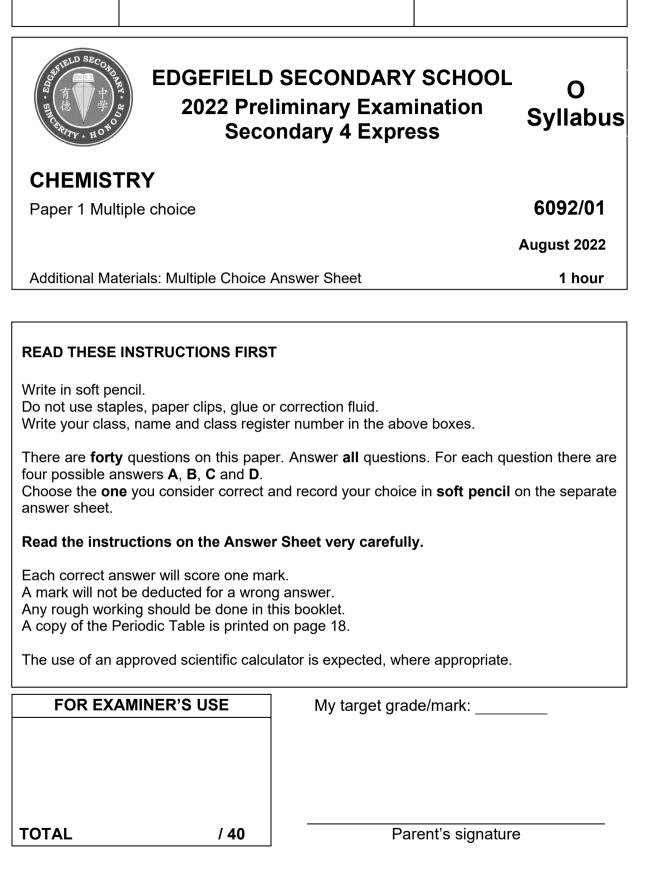
- A Nylon and *Terylene* are both polyesters.
- **B** Nylon and *Terylene* are made from the same monomers.
- **C** Nylon and proteins are formed via addition polymerisation.
- **D** The amide linkages in proteins are the same as those in nylon.

– End of Paper 1 –

								Gro	oup								
I											0						
			Ke	У			1 H hydrogen 1										2 He ^{helium} 4
3 Li ^{lithium} 7	4 Be ^{beryllium} 9		proton (atom atomic s nam relative ato	symbol								5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne ^{neon} 20
11 Na sodium 23	12 Mg magnesium 24											13 AI ^{aluminium} 27	14 Si silicon 28	15 P phosphorus 31	16 S ^{sulfur} 32	17 CI chlorine 35.5	18 Ar argon 40
19 K _{potassium} 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn ^{manganese} 55	26 Fe ^{iron} 56	27 Co cobalt 59	28 Ni ^{nickel} 59	29 Cu copper 64	30 Zn 55	31 Ga ^{gallium} 70	32 Ge _{germanium} 73	33 As ^{arsenic} 75	34 Se selenium 79	35 Br ^{bromine} 80	36 Kr ^{krypton} 84
37 Rb ^{rubidium} 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba ^{barium} 137	57–71 Ianthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W ^{tungsten} 184	75 Re rhenium 186	76 OS osmium 190	77 Ir iridium 192	78 Pt 195	79 Au ^{gold} 197	80 Hg 201	81 TI thallium 204	82 Pb lead 207	83 Bi ^{bismuth} 209	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89–103 actinoids	104 Rf Rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 DS darmstadtium	111 Rg roentgenium	112 Cn copernicium		114 F/ flevorium		116 Lv livermorium		
la	anthanoic	ls	57 La lanthanum 139 89	58 Ce cerium 140 90	59 Pr praseodymium 141 91	60 Nd neodymium 144 92	61 Pm promethium - 93	62 Sm samarium 150 94	63 Eu ^{europium} 152 95	64 Gd _{gadolinium} 157 96	65 Tb terbium 159 97	66 Dy dysprosium 163 98	67 Ho holmium 165 99	68 Er erbium 167 100	69 Tm thulium 169 101	70 Yb ytterbium 173 102	71 Lu ^{Iutetium} 175 103
actinoids		i	Ac actinium	Th thorium 232	Pa protactinium 231	U uranium 238	Np neptunium	Pu plutonium	Am americium	Cm curium	Bk berkelium	Cf californium	ES einsteinium	Fm fermium	Md mendelevium	No nobelium	Lr lawrencium -

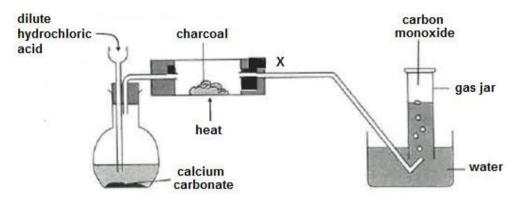
The Periodic Table of Elements

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



This document consists of 18 printed pages.

1 The following diagram shows an experimental setup used by a student to prepare carbon monoxide from charcoal. What should the student do to obtain a purer yield of carbon monoxide?

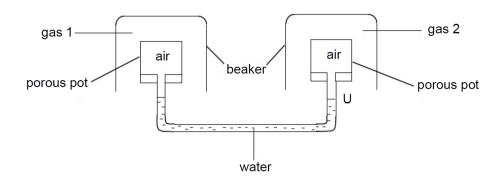


- A Use dilute sulfuric acid instead of dilute hydrochloric acid so that hydrogen chloride gas will not be formed.
- **B** Bubble the stream of gas from X into a flask containing drying agent before collection.
- **C** Pass the stream of gas from X through a filtering system to remove soot produced from charcoal.
- **D** Pass the stream of gas from X into a flask containing aqueous sodium hydroxide before collection.
- 2 How many of the molecules shown contain only one single covalent bond?

 $C\mathit{l}_2 \hspace{0.1in} H_2 \hspace{0.1in} N_2 \hspace{0.1in} O_2 \hspace{0.1in} CO_2$

- **A** 1
- **B** 2
- **C** 3
- **D** 4

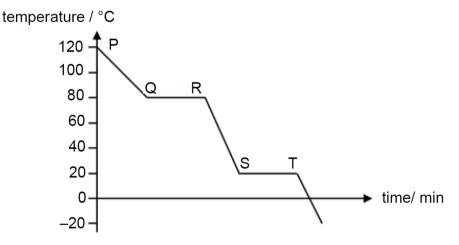
3 The apparatus is set up, using different gases in the two inverted beakers.



Which pair of gases would cause an upward movement of the water level at U?

	gas 1	gas 2
Α	helium	carbon monoxide
В	helium	hydrogen
С	nitrogen	carbon monoxide
D	nitrogen	hydrogen

4 The graph shows the change in temperature with time when a substance at 120 °C is cooled to –20 °C.



Which statement correctly describes the change taking place between the points?

- **A** The volume of vapour is decreasing from R to S.
- **B** The particles release energy as they become closer together from Q to R.
- **C** The particles absorb energy as they become more orderly from S to T.
- **D** The energy of the particles remain constant from 20 °C to -20 °C.

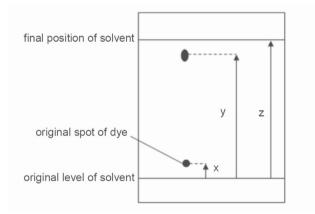
5 The melting and boiling points of some gases in air are shown below.

gas	melting point/ °C	boiling point/ °C
oxygen	- 219	– 183
argon	- 189	– 186
nitrogen	- 210	– 196

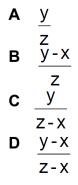
What temperature should the sample of air be decreased to in order to obtain only liquid oxygen?

A – 180 °C

- **B** 182 °C
- **C** 185 °C
- D 219 °C
- **6** Which of the following physical processes could be used to separate a mixture of hexane and water?
 - **A** filtration
 - B fractional distillation
 - **C** sublimation
 - **D** use of separating funnel
- **7** A student carried out a chromatography experiment. The diagram below shows the chromatogram obtained.



Which one of the following gives the R_f value of the dye?



- 8 Which substance is likely to be a pure compound?
 - A a colourless liquid which gives two fractions when distilled
 - **B** a white powder that dissolves in water
 - **C** a yellow liquid that boils at 115 °C
 - **D** green crystals that start to melt at 72 °C and completely melt at 75 °C
- **9** The descriptions of three substances are given as follows:

substance	description
Х	It is made up of identical molecules which burns in excess air to form carbon dioxide and water.
Y	It is a gas which burns in excess air to form water only.
Z	Its solution can be separated into three dyes by paper chromatography.

Which of the following correctly classifies substances X, Y and Z?

	Х	Y	Z				
Α	element	element	compound				
В	compound	compound	mixture				
С	compound	element	mixture				
D	element	mixture	element				

10 An element, Z, has *p* protons and *n* neutrons in the nucleus of its atoms. Element Z reacts with oxygen to form a basic oxide.

Which list gives the correct information about the ion of an isotope of Z?

	number of protons	number of neutrons	number of electrons
Α	р	<i>n</i> + 1	<i>p</i> + 1
В	p	<i>n</i> + 1	<i>p</i> – 1
С	p + 1	n	<i>p</i> + 1
D	p + 1	n	<i>p</i> – 1

- **11** A hydrated salt, MSO₄.nH₂O is formed when 0.2 mol of MSO₄ reacts with 36.0 g of water. What is the value of n?
 - **A** 2
 - **B** 4
 - **C** 5
 - **D** 10

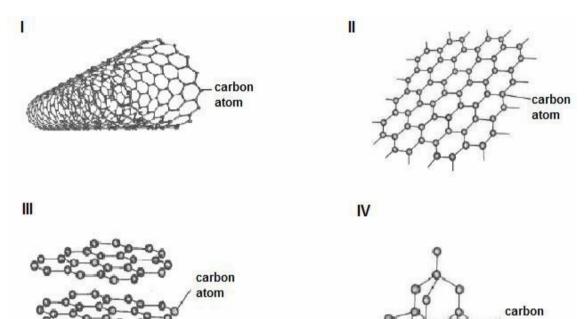
12 When a few drops of aqueous ammonia are added to copper(II) sulfate solution, the reaction that takes place can be represented by the following ionic equation:

 $Cu^{2+}(aq) + 2OH^{-}(aq) \rightarrow Cu(OH)_{2}(s)$

In excess aqueous ammonia, a soluble copper(II) complex ion is formed. What would be observed when 20 cm³ of 0.5 mol/dm³ aqueous copper(II) sulfate was mixed with 30 cm³ of 1.0 mol/dm³ aqueous ammonia?

- **A** pale blue solution
- **B** dark blue solution
- **C** blue precipitate in colourless solution
- **D** colourless solution
- **13** At the start of a reaction, a 2.00 dm³ solution contains 0.500 mol of ethanol. After 100 seconds, the concentration of the ethanol has decreased to 0.140 mol/dm³. What is the decrease in the concentration of ethanol?
 - A 0.036 mol/dm³
 - **B** 0.140 mol/dm³
 - **C** 0.110 mol/dm³
 - **D** 0.250 mol/dm³
- 14 The shell of a quail egg makes up 2% of the mass of an average quail egg. An average quail egg has a mass of 15 g. Assuming the quail egg shell is made up of pure calcium carbonate, what is the volume of 1.0 mol/dm³ hydrochloric acid that 10 quail eggs can neutralise?
 - A 0.0250 dm³
 - **B** 0.0300 dm³
 - **C** 0.0500 dm³
 - **D** 0.0600 dm³
- **15** Element **Y** exists as 3 stable isotopes and has a relative atomic mass of 65.0. Which of the following compositions of isotopes is correct?
 - A 32.1% ⁶⁴Y, 56.4% ⁶⁶Y and 11.5% ⁶⁷Y
 - **B** 54.6% ⁶⁴**Y**, 6.6% ⁶⁶**Y** and 38.8% ⁶⁷**Y**
 - **C** 56.3% ⁶⁴**Y**, 31.1% ⁶⁶**Y** and 12.6% ⁶⁷**Y**
 - **D** 50.3% ⁶⁴**Y**, 25.5% ⁶⁶**Y** and 24.2% ⁶⁷**Y**
- **16** Chloroform, also known as trichloromethane, is a colourless, sweet-smelling liquid which was once used as an anaesthetic. How many valence electrons are not involved in bonding?
 - **A** 0
 - **B** 2
 - **C** 18
 - **D** 21

- **17** Which statement about one mole of a metal is always true?
 - **A** It contains the same number of particles as 1/12 mole of 12 C.
 - **B** It has the same mass as one mole of hydrogen atoms.
 - **C** It contains the same number of particles as one mole of hydrogen atoms
 - **D** It contains the same mass as one mole of 12 C.
- **18** Carbon can form different structures as shown in the diagram below. Which of these structure(s) is/are able to conduct electricity?





- A I and IV only
- B II and III only
- **C** I, II and III only
- D III and IV only

atom

19 Two separate tests were carried out on an unknown salt solution, **Z**. The results of the tests are shown in the table below.

	test	result
1	add aqueous ammonia	green precipitate formed which is insoluble in excess
2	add dilute nitric acid then aqueous silver nitrate	yellow precipitate formed

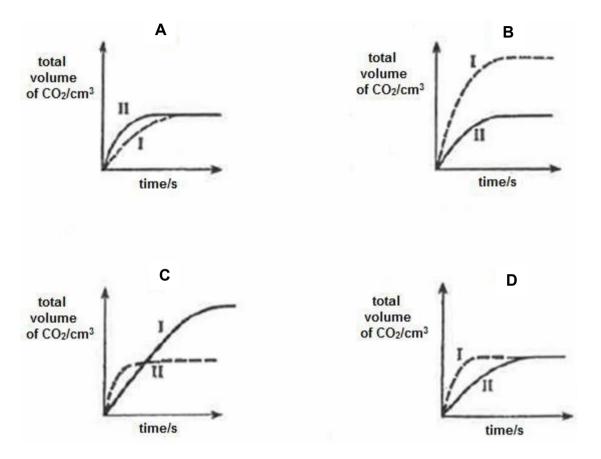
What is the identity of salt **Z**?

- A Copper(II) chloride
- **B** Iron(II) chloride
- **C** Iron(II) iodide
- **D** Iron(III) iodide
- 20 Ammonia is produced by the Haber process.

Which statement is **not** correct?

- **A** An iron catalyst is used.
- **B** Each hydrogen molecule reacts with three nitrogen molecules to form two molecules of ammonia.
- **C** Hydrogen for the Haber process can be obtained by the cracking of crude oil.
- **D** The reaction is reversible.

21 In two separate experiments, the reaction of calcium carbonate with an excess of dilute hydrochloric acid was investigated. The calcium carbonate used in Experiment I was more finely divided than that used in Experiment II. Assuming all other conditions were identical in both experiments, which of the following graphs best illustrates the results?



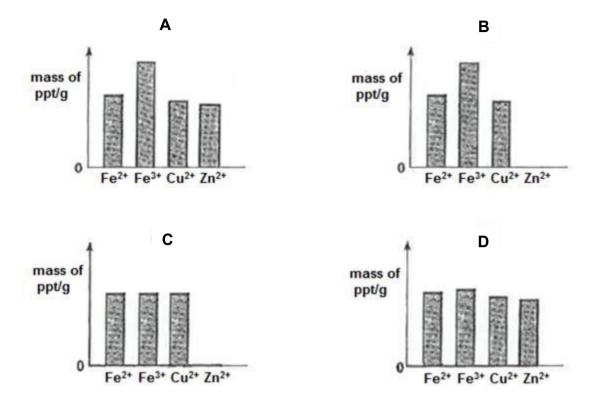
22 Metal Z and its compounds undergo the following reactions.

Reaction I: $Z + 2HCl \rightarrow ZCl_2 + H_2$ Reaction II: $ZCO_3 \rightarrow ZO + CO_2$ Reaction III: $ZO + CO \rightarrow Z + CO_2$

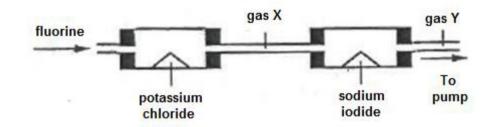
What could metal Z be?

- A Magnesium
- B Copper
- **C** Iron
- D Calcium

23 Four separate solutions are prepared such that each solution contains 1 g of one of the ions Fe²⁺, Fe³⁺, Cu²⁺, Zn²⁺. Excess aqueous sodium hydroxide is added to each solution and the mass of any resulting precipitate is recorded. Which of the following diagrams, A, B, C, D illustrates the results?

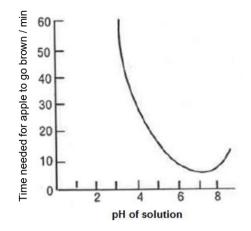


24 The reaction shown below was carried out. Which of the following gives the correct colour of gas X, sodium iodide and gas Y?



	gas X	sodium iodide	gas Y
Α	Pale yellow	Brown	Violet
В	Greenish yellow	White	Violet
С	Pale yellow	Yellow	Brown
D	Greenish yellow	Brown	Brown

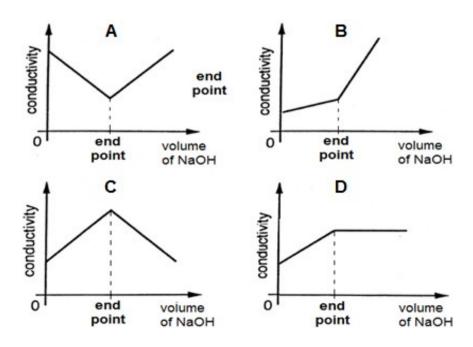
25 Pieces of apples usually go brown when they are left in air for a few minutes. To stop browning, cut apples are placed in special solutions. The graph below indicates how browning is affected by the pH of a solution.



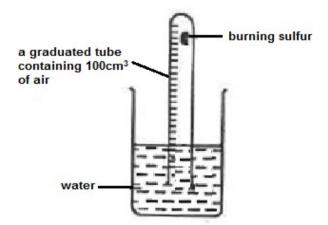
Which one of these solutions stops browning?

- **A** sodium carbonate (pH 9)
- **B** sodium chloride (pH 7)
- **C** ethanoic acid (pH 4)
- **D** sodium hydrogen sulfate (pH 2.5)
- **26** Aqueous sodium hydroxide is a strong alkali while dilute ethanoic acid is a weak acid. The reaction between the alkali and the acid causes a change in the electrical conductivity of the mixture.

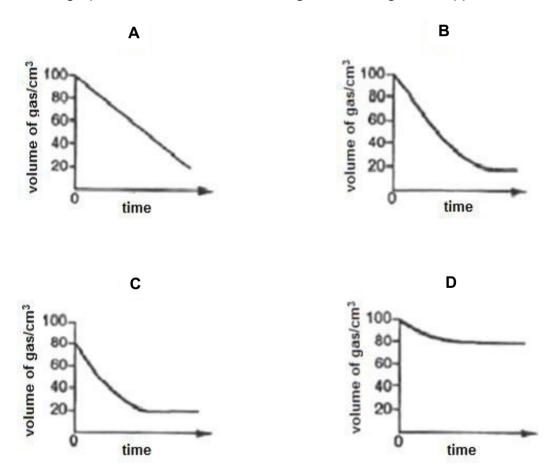
Which of the following graph correctly shows the change in electrical conductivity when aqueous sodium hydroxide is added slowly to the dilute ethanoic acid until it is in excess?



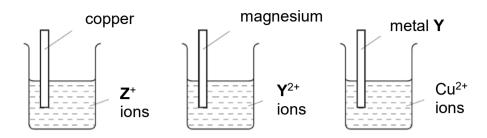
27 Sulfur burns in air to form a water-soluble solid oxide. A small lump of sulfur was burnt in the tube shown in the diagram below. The initial volume of air in the tube is 100 cm³.



Which graph shows how the volume of gas remaining in the apparatus changes?



28 A student conducted three experiments to compare the reactivities of four different metals; copper, magnesium, metal **Y** and metal **Z**.



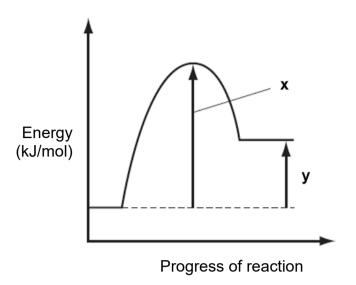
A deposit was observed on the metal strip for each experiment. How many metals that were investigated will be able to react with aqueous hydrochloric acid?

- **A** 1
- **B** 2
- **C** 3
- **D** 4
- **29** Which electrolytic set-up results in no change in the concentration of the solution during electrolysis?
 - **A** aqueous sodium chloride solution between carbon electrodes
 - **B** copper(II) sulfate solution between copper electrodes
 - **C** copper(II) sulfate solution between platinum electrodes
 - **D** dilute sodium chloride solution between platinum electrodes
- **30** In an electrolysis, the same amount of charge deposited 54.0 g of silver and 14.9 g of tin.

If the charge on silver ion is 1+, what was the most likely charge of the tin ion?

- **A** 1+
- **B** 2+
- **C** 3+
- **D** 4+
- **31** Which statement describes what happens when hydrogen and oxygen are used in a fuel cell?
 - A Electricity is generated due to flow of electrons from cathode to anode.
 - **B** Hydrogen is burned to form steam.
 - **C** Hydrogen is oxidised by losing electrons at the anode.
 - **D** Oxygen is oxidised by gaining electrons from hydrogen.

32 The energy profile diagram for a chemical reaction is shown below.



Which statement about the energy profile diagram is correct?

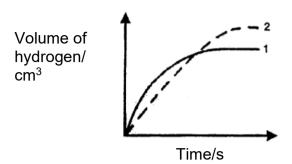
- A The overall enthalpy change is equal to $\mathbf{x} + \mathbf{y}$.
- **B** The reaction is exothermic.
- **C** The value of **x** would decrease in the presence of catalyst.
- **D** The value of **y** would increase in the presence of catalyst.
- **33** The scheme shows four stages, 1 to 4, in the conversion of solid candle wax, $C_{30}H_{62}$, into carbon dioxide and water

1	$C_{30}H_{62}(s) \rightarrow C_{30}H_{62}(l)$
2	$C_{30}H_{62}(I) \rightarrow C_{30}H_{62}(g)$
3	$C_{30}H_{62}(g) + 45.5O_2(g) \rightarrow 30CO_2(g) + 31H_2O(g)$
4	$30CO_2(g) + 31H_2O(g) \rightarrow 30CO_2(g) + 31H_2O(I)$

Which stages are exothermic?

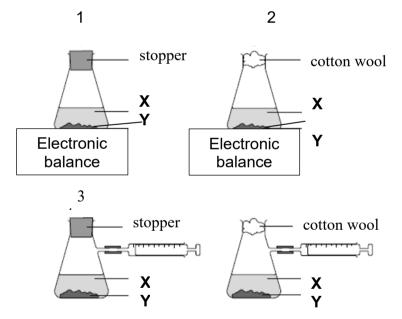
- **A** 1 and 2
- **B** 1 and 4
- **C** 2 and 3
- **D** 3 and 4

34 In the graph below, curve **1** was obtained by the reaction between 50.0 cm³ of 1.00 mol/dm³ sulfuric acid and excess zinc granules.



Which changes would produce curve **2**?

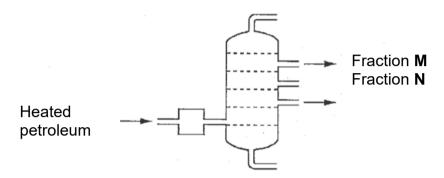
- A increase the temperature by 10°C
- **B** add the same mass of zinc powder instead of zinc granules
- **C** use 100.0 cm³ of 1.00 mol/dm³ sulfuric acid instead of 50.0 cm³ of 1.00 mol/dm³ sulfuric acid
- **D** use 100.0 cm³ of 0.75 mol/dm³ sulfuric acid instead of 50.0 cm³ of 1.00 mol/dm³ sulfuric acid
- **35** A liquid **X** reacts with solid **Y** to form a gas.



Which two diagrams show suitable methods for investigating the speed of the reaction?

- **A** 1 and 3
- **B** 1 and 4
- **C** 2 and 3
- **D** 2 and 4

- 36 Which pair of pollutants can cause the most damage to limestone buildings?
 - A carbon monoxide and oxygen
 - **B** chloroflurocarbons and ozone
 - **C** methane and sulfur dioxide
 - **D** nitrogen dioxide and sulfur dioxide
- **37** The diagram shows the fractional distillation of petroleum.



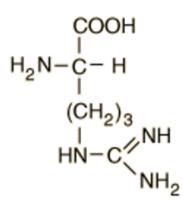
Which row about fraction **M** and **N** are correct?

	M burns more easily than N	M has a higher boiling point than N	M is more viscous than N					
Α	True	False	False					
В	True	True	False					
С	False	True	True					
D	False	False	True					

- 38 In the polymerisation of ethene to form poly(ethene), which does not change?
 - **A** boiling point
 - **B** density
 - **C** empirical formula
 - D molecular mass
- **39** The reaction between a carboxylic acid, C_xH_yCO₂H and an alcohol, C_nH_{2n+1}OH, produces an ester.

How many hydrogen atoms does one molecule of the ester contain?

- **A** y+ 2n
- **B** y+2n+1
- **C** y+2n+2
- **D** y+2n+3



The following statements were made about the amino acid.

- 1 It undergoes addition polymerisation.
- 2 It forms a polymer with the same linkage as nylon.
- 3 It reacts with magnesium to form hydrogen gas.
- 4 It decolorises acidified potassium manganate(VII) solution readily.

Which statements are correct?

- A 1 and 2
- **B** 1 and 3
- **C** 2 and 3
- **D** 2 and 4

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	N	_		8	С	oxvden	16	16	თ	sulfur 32	34	Se	selenium 79	22	Te	tellurium 108	84	5 6	polonium	1	116	LV livermorium	-	_	69	Tm	thulium 169	101	Md	mendelevium
	>			2	Z	nitroden	14	15	ᡅ	phosphorus 31	33	As	arsenic 7.5	21	sb	antimony	3 8	S in	bismuth	209					68	ш	erbium 167	100	БП	fermium
	≥			9	C	carbon	12	14	N.	silicon 28	32	Ge	germanium 73	20	Sn	tin 110	83	d d	lead	207	114	F/ flerovium	I		67	Я	holmium 165	66	Бs	einsteinium
	=	-		5	ſ	boron	11	13	Ρl	aluminium 27	31	Ga	gallium 70	49	IJ	indium 115	2 6	ΪL	thallium	204					66	2	dysprosium 163	98	້ບ	californium
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											29	Cu	copper 64	47	Ag	silver 108	70	Au	gold	19/	111	Kg roentrenium	р П		64	в	gadolinium 157	96	Cm	curium
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Group		hydrogen	~								26	Fe	iron 56	44	Ru	ruthenium	76	ŝ	osmium	190	108	HS hassium	I	~	61	Рп	promethium _	93	dN	neptunium
				-							25	Mn	manganese 55	43	Ъс	technetium	75	Re	rhenium	186	107	Bh bohrium	I		60	PN	neodymium 144	92	⊃	uranium
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	_												potassium 39										_			2				

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



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Preliminary Examination 2022



Fuhua Secondary Fuhua Secondar

CHEMISTRY

Paper 1 Multiple Choice

31 August 2022 0800 – 0900 1 hour

Additional Material: Optical Mark Recognition (OMR)

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid. Write your name, class, index number on the OMR and this question booklet.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OMR.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done on this paper.

A copy of the Periodic Table is printed on page 14.

The use of an approved scientific calculator is expected, where appropriate.

PARENT'S SIGNATURE	FOR EXAMINER'S USE
	40

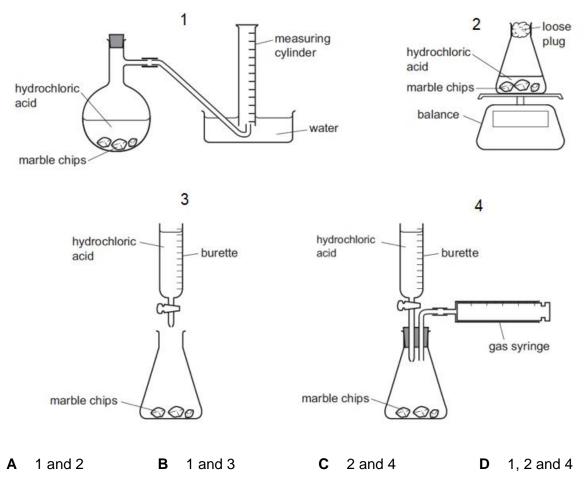
Setter: Mdm Hia Soo Ching

Vetters: Mr Elton Tan, Ms Choo Hui En, Ms Nur Hanis, Ms Veron Lee

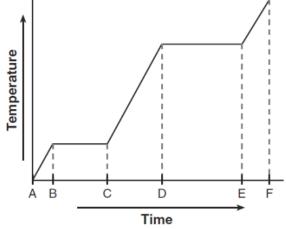
6092/01

1 A student follows the rate of the reaction between marble chips, CaCO₃, and dilute hydrochloric acid.

Which of the following set-ups can be used to measure the rate of reaction, together with a stopwatch?



2 A sample of a pure solid substance was heated until it turns completely gaseous. The graph below shows the heating curve obtained from the experiment.



Which of the following statements is not correct?

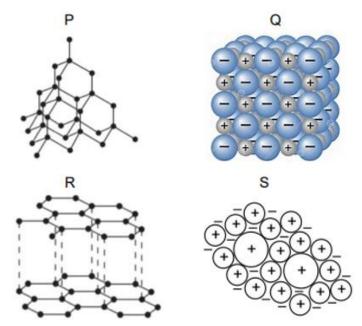
- **A** At time interval AB, the average kinetic energy of the particles remains the same.
- **B** At time interval BC, the solid and liquid states are in equilibrium.
- **C** At time interval CD, heat is absorbed by the particles.
- **D** At time interval EF, the particles are moving rapidly in any direction.

3 The table below shows information about elements flerovium, Fl, and livermorium, Lv.

	Fl	Lv
proton number	114	116
nucleon number	289	292

Which of the following statements about the elements is correct?

- **A** A Lv^{2+} ion has the same number of electrons as a F*l* atom.
- **B** A F l^{2+} ion has the same number of protons as an atom of Lv.
- **C** An atom of F*l* has two more electrons as an atom of Lv.
- **D** An atom of Lv has one fewer neutron than an atom of Fl.
- **4** Bromine crystals are obtained by freezing bromine at -223°C. What will the bromine crystals contain?
 - A bromine atoms only
 - **B** bromine molecules only
 - **C** bromine ions and molecules
 - **D** bromine atoms and molecules
- 5 The diagrams below show the structures of substances P, Q, R and S.



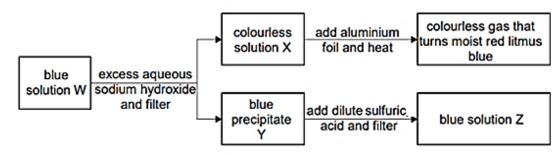
Which of these structures conduct electricity because of mobile electrons?

 A
 P and R
 B
 R and S
 C
 Q and S
 D
 Q, R and S

6 Which of the following contains 1 mole of ions when in aqueous state?

- A 0.250 mol of CaO
- **B** 0.250 mol of (NH₄)₃PO₄
- **C** 0.500 mol of H₂SO₄
- **D** 0.500 mol of CH₃COOH

- Citric acid is widely used as a flavouring and preservative in food.Which statement best describes the mixture formed when citric acid dissolves in ethanol?
 - A It turns blue litmus red.
 - **B** It contains covalent molecules only.
 - **C** It contains both covalent molecules and ions.
 - **D** It produces effervescence when added to carbonates.
- 8 The flowchart below shows the reaction that solution W undergoes.



What are the identities of W, X, Y and Z?

	W	Х	Y	Z
Α	Cu(NO ₃) ₂	NaNO₃	Cu(OH) ₂	CuSO ₄
В	CuSO ₄	Na_2SO_4	Cu(OH) ₂	CuSO ₄
С	Fe(NO ₃) ₂	NaNO₃	Fe(OH) ₂	FeSO ₄
D	$(NH_4)_2SO_4$	NH₄OH	Cu(OH) ₂	CuSO ₄

9 The flowcharts show the reagents added into separate test tubes containing aqueous magnesium nitrate and aluminium nitrate.

excess hydrochloric aqueous sodium aqueous sodium Ρ $Mg(NO_3)_2$ R Q acid hydroxide carbonate aqueous ammonia aqueous sodium excess sulfuric $Al(NO_3)_3$ S U carbonate acid

P, Q and R are magnesium compounds.

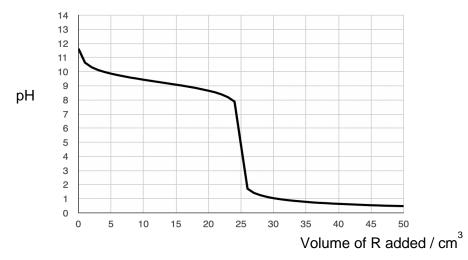
S, T and U are aluminium compounds.

How many of the compounds formed, P - U, will give a white precipitate in aqueous solutions?

A 2 B 3 C 4 D 5

4

10 Aqueous solution R is gradually added to aqueous solution S. The changes in pH are shown on the graph.



What are the identities of R and S?

	R	S
Α	aqueous ammonia	ethanoic acid
В	ethanoic acid	sodium hydroxide
С	hydrochloric acid	aqueous ammonia
D	aqueous ammonia	hydrochloric acid

11 The consecutive reactions that may occur in a thunderstorm are as follows:

 $\begin{array}{l} N_2 + O_2 \rightarrow 2NO \\ 2NO + O_2 \rightarrow 2NO_2 \\ 4NO_2 + 2H_2O + \ O_2 \rightarrow 4HNO_3 \end{array}$

How many moles of nitric acid are formed from 0.50 mol of nitrogen?

A 0.50 mol **B** 1.00 mol **C** 2.00 mol **D** 6.00 mol

12 A washing powder contains sodium hydrogencarbonate, NaHCO₃, as the active ingredient.

In a titration, a solution containing 1.00 g of washing powder was found to react completely with 2.86 cm³ of 0.250 mol/dm³ of dilute hydrochloric acid.

Assuming that sodium hydrogencarbonate is the only ingredient that reacts with the acid, what is the percentage by mass of sodium hydrogencarbonate in the washing powder?

A 3.0 % **B** 6.0 % **C** 12.0 % **D** 24.0 %

13 Brass, made of copper and zinc, is more suitable to make musical instruments as compared to pure copper.

Which statement best explains why brass is harder than pure copper?

- **A** The zinc atoms have more valence electrons than copper atoms.
- **B** The zinc atoms form strong metallic bonds with copper atoms in brass.
- C The zinc atoms prevent the delocalised electrons from moving freely in the lattice
- **D** The zinc atoms prevent layers of copper atoms from sliding over each other easily.
- 14 The table below refers to four metals and some of their compounds.

metal	action of heat on	effect of hydrogen on	action of sulfuric acid
metai	metal carbonate	heated oxide	on metal
Р	decomposed	reduced	no reaction
Q	no reaction	no reaction	effervescence observed
R	decomposed	no reaction	effervescence observed
S	decomposed	reduced	effervescence observed

What is the order of reactivity in descending order?

- **A** Q, S, R, P
- **B** Q, R, S, P
- **C** R, S, P, Q
- **D** R, Q, P, S

15 Which of the following is **not** a redox reaction?

- $\textbf{A} \quad 2Ag + Br_2 \rightarrow 2AgBr$
- $\textbf{B} \quad 2\textbf{CO} + \textbf{O}_2 \rightarrow 2\textbf{CO}_2$
- $\textbf{C} \quad Na_2CO_3 + CuCl_2 \rightarrow 2NaCl + CuCO_3$
- $\label{eq:constraint} \textbf{D} \quad Fe + \ 2HC\mathit{l} \rightarrow FeC\mathit{l}_2 + H_2$
- **16** The table below shows the colour changes when a few drops of aqueous potassium iodide and acidified aqueous potassium manganate (VII) were added separately into four different solutions.

solution	potassium iodide	potassium manganate (VII)
1	colourless to brown	purple to colourless
2	colourless to brown	no change
3	no change	purple to colourless
4	no change	no change

Which of the following solutions is/are oxidising agent(s)?

Α	1 only	В	1 and 2	С	1 and 3	D	4 only
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17 The pollutants released into the air from car exhausts and some power stations include oxides of the type XO and YO₂. What are X and Y?

	Х	Y
Α	carbon	nitrogen
В	carbon	nitrogen and sulfur
С	carbon and nitrogen	carbon and nitrogen
D	carbon and nitrogen	carbon, nitrogen and sulfur

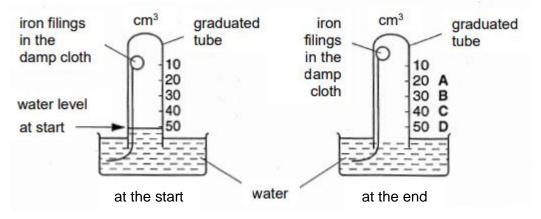
18 A car burning lead-free fuel has a catalytic converter fitted to its exhaust. On analysis, its exhaust gases are shown to contain small quantities of nitrogen oxides.

What modification(s) would result in lower exhaust concentrations of nitrogen oxides?

- 1 An increase in the surface area of the catalyst in the converter.
- 2 An increase in the percentage of oxygen going into the car.
- 3 A much higher temperature of combustion in the engine.



19 Iron filings are wrapped in a piece of damp cloth and left to rust in the apparatus as shown.



Which letter indicates the water level when rusting has been completed?

20 P, Q and R are elements found in Group VII of the Periodic Table. Three experiments were carried out to determine the reactivity of P, Q and R.

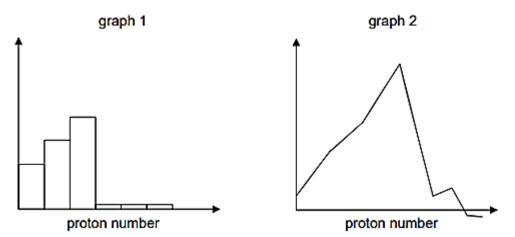
The three reactions are represented by the three equations shown below.

- 1 $R^{-}(aq) + Q_2(aq) \rightarrow$ no reaction
- 2 $P^{-}(aq) + R_2(aq) \rightarrow no reaction$
- 3 $2Q^{-}(aq) + P_2(aq) \rightarrow Q_2(aq) + 2P^{-}(aq)$

Which statement about P, Q and R is correct?

- **A** Q_2 is more reactive than P_2 .
- **B** R_2 has a lighter colour than Q_2 .
- **C** R_2 is a stronger oxidising agent than P_2 .
- **D** P₂ is a solid at room temperature and pressure.

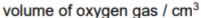
21 The graphs below show the trend in physical properties of the elements across Period 3.

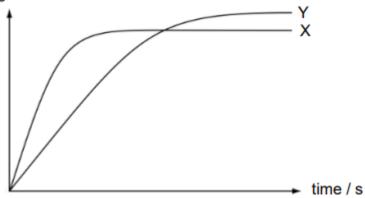


Which physical property is represented by the y-axis of the graphs?

	graph 1	graph 2
Α	electrical conductivity	melting point
В	charge on ion	atomic radius
С	number of valence electrons	melting point
D	metallic character	charge on ion

22 The diagram below shows curve X which was obtained by the decomposition of 100 cm³ of 1.00 mol/dm³ hydrogen peroxide using manganese (IV) oxide as catalyst.





Which of the following changes made to the original experiment would produce curve Y?

- A Adding 10.0 cm³ of water.
- **B** Adding 10.0 cm³ of 0.500 mol/dm³ of hydrogen peroxide.
- **C** Lowering the temperature of the solution by 10.0 °C.
- **D** Reducing the mass of manganese (IV) oxide added.

- **23** Which of the following acids and the quantity stated will produce the fastest initial rate of reaction when 4.00 g of magnesium ribbon is added to it at room temperature and pressure?
 - A 15.0 cm³ of 2.00 mol/dm³ nitric acid
 - **B** 20.0 cm³ of 1.00 mol/dm³ hydrochloric acid
 - **C** 20.0 cm³ of 1.50 mol/dm³ sulfuric acid
 - **D** 30.0 cm³ of 2.00 mol/dm³ ethanoic acid
- 24 Hydrogen and chlorine react together to form hydrogen chloride.

 $H_2(g) + Cl_2(g) \rightarrow 2HCl(g) \quad \Delta H = -184 \text{ kJ/mol}$

- 1 Increasing the pressure has no effect on the total volume of hydrogen chloride obtained.
- 2 48 dm³ of hydrogen gas is mixed with 24 dm³ of chlorine gas to produce 48 dm³ of hydrogen chloride gas.
- 3 An increase in pressure will lead to higher frequency of collisions between H₂ and Cl₂ molecules.
- 4 A decrease in temperature of the mixture will lead to an increase in rate of reaction.

Which of the statements are correct?

- **A** 1 and 3 **B** 2 and 3 **C** 1, 2 and 3 **D** 2, 3 and 4
- **25** Chlorodifluoromethane could be obtained from the following reaction:

$$C_2F_4 + 2HCl \rightarrow 2CHF_2Cl \quad \Delta H = -32 \text{ kJ/mol}$$

The bond energies of some of the bonds are given in the following table.

bond	bond energy
bond	kJ/mol
C–F	495
C–H	413
C–C	347
C=C	610
C–Cl	339

What is the bond energy of the H-Cl bond?

Α	389 kJ/mol	В	431 kJ/mol	С	778 kJ/mol	D	862 kJ/mol
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26 Bismuth(III) oxychloride dissolves in concentrated hydrochloric acid to give a colourless solution of bismuth(III) chloride.

BiOCl (s) + 2HCl (aq) \rightarrow BiCl₃ (aq) + H₂O (l); Δ H = -132 kJ/mol

The activation energy for the forward reaction is 45 kJ/mol. Addition of water re-forms bismuth(III) oxychloride as a white precipitate.

What is the activation energy for the reverse reaction?

A – 45 kJ/mol **B** – 87 kJ/mol **C** 87 kJ/mol **D** 177 kJ/mol

- 27 Three electrolytic cells are set up using inert electrodes. The electrolytes used are listed below.
 - cell 1: concentrated aqueous potassium chloride
 - cell 2: dilute sulfuric acid
 - cell 3: dilute copper (II) chloride

In which of these cell(s) is/are gases formed at both electrodes?

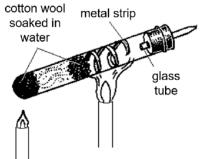
A 2 only **B** 3 only **C** 1 and 2 **D** 2 and 3

28 Three simple cells are set up using zinc metal and three other unknown metals, U, V and W, as electrodes.

cell	metals used	voltage / V	positive electrode
1	Zn, U	-0.45	Zn
2	Zn, V	+2.71	V
3	Zn, W	+1.11	W

What of the following lists the metals in order of decreasing reactivity?

- **A** U, Zn, V, W
- **B** U, Zn, W, V
- **C** V, W, Zn, U
- **D** V, Zn, W, U
- **29** In the experiment shown below, a strip of metal was heated in a glass tube. When a spark was created at the outlet of the glass tube, no flame was observed.



Which of the following could be the metal strip?

A calcium B lead C magnesium D zinc

- 30 Which of the following statements about the Haber Process is correct?
 - **A** The final yield is increased by operating at high temperature.
 - **B** The final yield is increased by operating at low pressure.
 - **C** The rate of reaction is increased by operating at low temperature.
 - **D** The rate of reaction is increased by operating at high pressure.
- 31 Which statement about a petroleum fraction is correct?
 - A It boils at a fixed temperature.
 - **B** Its molecules are all hydrocarbons.
 - **C** None of its molecules is found in other fractions,
 - **D** All its molecules contain the same number of carbon atoms.
- 32 Two compounds are thought to be isomers.

Possible similarities and differences are listed below. Which combination would confirm isomerism?

	similarity	difference
Α	molecular mass	molecular structure
В	molecular structure	molecular mass
С	chemical properties	physical properties
D	physical properties	chemical properties

33 5 g of vegetable oil (M_r = 800) reacted completely with 900 cm³ of hydrogen gas (measured at room temperature and pressure) to form margarine which is a saturated fat. How many carbon-carbon double covalent bonds are there in one molecule of the oil?

A 3 B 4 C 5 D 6	Α	3	В	4	С	5	D	6
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- **34** Which of the following molecules is **not** a substitution product formed when butane reacts with chlorine in the presence of sunlight?
 - **A** $C_4H_5Cl_4$
 - **B** C_4HCl_9
 - $C \quad C_4H_2Cl_8$
 - **D** $C_4H_3Cl_7$
- **35** An alcohol, X, was fully oxidised to form a carboxylic acid. Neutralisation of the acid with aluminium oxide gives a salt with the formula (CH₃CO₂)₃A*l*.

What was alcohol X?

- A CH₃OH
- **B** CH₃CH₂OH
- C CH₃CH₂CH₂OH
- $\textbf{D} \quad CH_3CH_2CH_2CH_2CH_2OH$

		1	est		observati	on	
	a	dd bro	mine water		bromine water remains orange		
	add aqu	ieous s	odium carbon	ate	effervescence of	observe	ed
		1	н-с- н	н н С 	-с ⁰ о-н		
		2	н-с- н	H -CC H	0 0-с=с-н н н	Ú.	
		3	н-с- н	-c ^{_0}	$ \begin{array}{ccc} H & H \\ - C & -C & -H \\ H & H \\ H & H \end{array} $		
		4	н-с	0 H 0-C	H H -C-C-H H H		
What c	ould compou	nd P b	e?				
A 1	only	В	3 only	С	1 and 3	D	1 and

36 The table shows the results of tests carried out on compound P which has the molecular formula $C_4H_8O_2$.

37 The structures of two isomers of butane are given below.

CH₃CH₂CH=CH₂ and CH₃CH=CHCH₃

4

How many statements about the two isomers are correct?

- Combustion of 10 g of each isomer will give the same volume of gases. •
- Both will react with steam to give the same molecule. •
- Both will react with hydrogen to give the same molecule. •
- 1 mol of each isomer will react with 1 mol of bromine to give the same mass of • products.

A 1 B 2 C 3 D	4	4
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- 38 Petroleum can be separated into fractions by fractional distillation. Which statement about this process is **not** correct?
 - **A** The lubricating oil fraction is a source of polishes and waxes.
 - **B** The fraction obtained at the top of the fractionating column has the highest boiling point.
 - **C** In a fractionating column, the bitumen fraction is obtained below the kerosene fraction.
 - **D** The molecules reaching the top of the column have the smallest relative molecular mass.
- **39** The structure below shows part of a polymer.

		H-Z N-H N-H	H-N N N
		Н	

- 1 It is a nylon.
- 2 It is formed in an addition polymerisation reaction.
- 3 It is formed from two different types of monomers.
- 4 Each monomer has at least two different functional groups.

Which statements are correct?

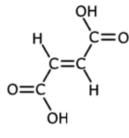
Α	1 and 4	В	2 and 3	С	1, 3 and 4	D	2, 3 and 4
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40 The following diagrams show four monomers.

HO-WN-NH,

HO-- OH

How many of these monomers would react with the molecule below to form a polymer?



A 1

B 2

3

С

D 4

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	١١٨			6	ш	fluorine	3	2 i	Cl chlorine 35.5	35	Ъ	bromine	00	3 -	iodine	127	85	At	astatine –						70	٩Y	ytterbium 173	102	No	nobelium –
	N			ω	0	oxygen	0	<u>9</u> 0	sulfur 32	34	Se	selenium	2	a T	tellurium	128	84	Ро	polonium I	116	2 >	livermorium	Ĩ		69	Tm	thulium 169	101	pM	mendelevium –
	>			7	z	nitrogen	4 L	ດ ຄ	Phosphorus 31	33	As	arsenic	2	5 5	antimonv	122	83	ä	bismuth 209	2					68	ш	erbium 167	100	Ещ	fermium –
	≥			9	U	carbon	2	4 . 7	silicon 28	32	Ge	germanium	2		ţi,	119	82	Pb	lead 207	114	F/	flerovium	I		67	РH	holmium 165	66	Еs	einsteinium –
	=			5	ш	boron	= 4	13	A <i>l</i> aluminium 27	31	Ga	gallium		5 L	indium	115	81	Tl	thallium 204								dysprosium 163			
		8								30	Zn	zinc	00	0 t C	cadmium	112	80	Нg	mercury 201	112	5 5	copernicium	I		65	Tb	terbium 159	97	Ж	berkelium –
																			gold 197			-			64	Gd	gadolinium 157	96	Cm	curium
dno	• 11.									28	ïŻ	nickel	96	5 D	palladium	106	78	Ŧ	platinum 195	110	Ds	darmstadtium	L		63	Eu	europium 152	95	Am	americium -
Group										27	ပိ	cobalt	38	54 7 7	rhodium	103	77	I	iridium 192	109	Mt	meitnerium	Ĩ	2			samarium 150			
		1 H hvdrogen	, _							26	Fe			‡ 2	ruthenium	101	76	os	osmium 190	108	Rs S	hassium	I		61	Pm	i promethium	93	dN	neptunium –
										25	Mn	manganese	00	γ γ	tec	-	75	Re	rhenium 186			q		8	60		praseodymium neodymium 141 144			uranium 238
				umber	loc		mass			24	ບັ	chromium		Mo Mo	molvbdenum	96	74	V	tungsten 184	106	Sa	seaborgium	1		59	Pr	praseodymium 141	91	Ра	protactinium 231
			Key	proton (atomic) number	atomic symbol	name	relative atomic mass			23	>	vanadium	10	- 4N		93	73	Ta	tantalum 181	1	Db	F	1		58	Ce	cerium 140	90	Th	thorium 232
				proton	atc		relativ			22	F	titanium	0 0 0	7 t0	zirconium	91	72	Ŧ	hafnium 178	104	ž ž	Rutherfordium	1		57	La	lanthanum 139	89	Ac	actinium –
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	-			-			-									_						_								

The volume of one mole of any gas is $24 \, \text{dm}^3$ at room temperature and pressure (r.t.p.).

14



Geylang Methodist School (Secondary) Preliminary Examination 2022

CHEMISTRY	Sec 4 Express
Paper 1 Multiple Choice	6092/01
Additional Materials: Multiple Choice Answer Sheet	1 hour

26 August 2022

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The use of an approved scientific calculator is expected, where appropriate.

This document consists of **19** printed pages and **1** blank page.

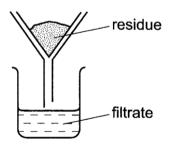
[Turn over

- A gas is evolved during a reaction.Which two pieces of apparatus would enable the rate of this reaction to be measured?
 - **A** balance and pipette
 - **B** gas syringe and thermometer
 - **C** stopwatch and gas syringe
 - **D** stopwatch and pipette
- 2 The table shows the colours and the solubilities in water of four solids.

solid	colour	solubility in water
W	blue	insoluble
Х	blue	soluble
Y	white	insoluble
Z	white	soluble

A mixture containing two of the solids is added to excess water, stirred and filtered.

A blue filtrate and a white residue are obtained.



Which two solids are present in the mixture?

Α	W and X	В	W and Y
С	X and Y	D	X and Z

3 A mixture of three liquids is separated by fractional distillation.

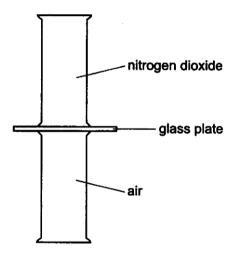
Which statements are correct?

- 1 The mixture boils at constant temperature throughout the separation.
- 2 The temperature at which the mixture boils increases during the separation.
- 3 The liquid with the highest boiling point is collected first.
- 4 The liquid with the lowest boiling point is collected first.

Α	1 and 3	В	1 and 4
С	2 and 3	D	2 and 4

4 Nitrogen dioxide is a dark brown gas and is denser than air.

A gas jar containing nitrogen dioxide is sealed with a glass plate and is then inverted on top of a gas jar containing air.

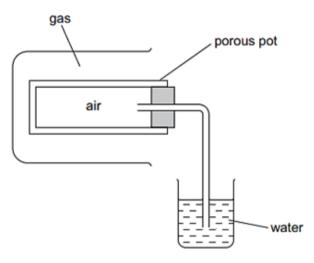


The glass plate is removed.

Which one of the following correctly describes the colours inside the gas jars after a long period of time?

	upper gas jar	lower gas jar			
Α	brown	brown			
В	dark brown	light brown			
С	colourless	dark brown			
D	light brown	dark brown			

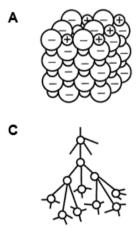
5 The apparatus shown in the diagram was used to compare the rate of diffusion between a gas and air.



A beaker containing the gas was placed over the porous pot.

Which gas would cause bubbles to be observed in the beaker of water?

- A carbon dioxide
- B hydrogen
- **C** oxygen
- D sulfur dioxide
- 6 Which of the following diagrams shows the structure of bronze?







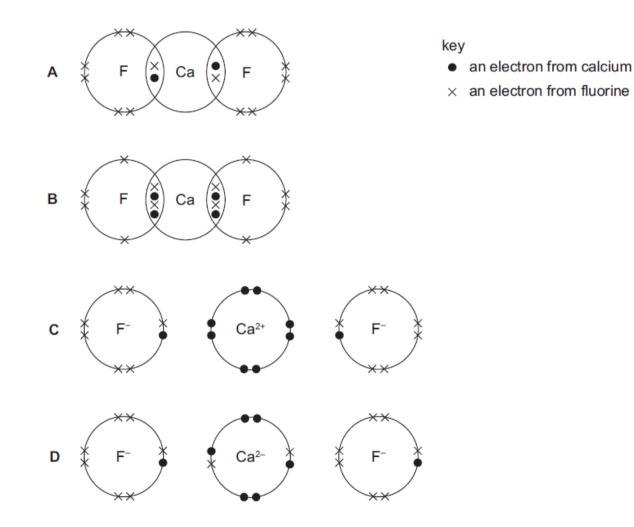
7 Tritium is an isotope of hydrogen and has the symbol T.Which formula is **incorrect** for a tritium compound?

Α	CaOT	В	NT ₃
С	TNO3	D	T ₂ O

8 The symbols for two ions are shown.

Which statement is correct?

- A The fluoride ion contains more electrons than the sodium ion.
- **B** The sodium ion contains more neutrons than the fluoride ion.
- **C** The two ions contain the same number of electrons as each other.
- **D** The two ions contain the same number of protons as each other.
- 9 Which diagram shows the outer electron arrangement in calcium fluoride?



- **10** Which statement shows that graphite and diamond are different forms of the element carbon?
 - **A** Both graphite and diamond have giant molecular structures.
 - **B** Complete combustion of equal masses of graphite and diamond produces equal masses of carbon dioxide and no other products.
 - **C** Graphite and diamond have different melting points.
 - **D** Graphite conducts electricity, whereas diamond does not.
- 11 An investigation of the properties of the chlorides of Period III elements shows that the boiling points of sodium chloride and silicon tetrachloride are 1465°C and 57°C respectively. This difference in boiling points is a result of
 - A covalent bonds being weaker than ionic bonds.
 - **B** sodium chloride having strong metallic bonds.
 - **C** silicon tetrachloride having weak intermolecular forces of attraction.
 - **D** silicon forming weaker bonds with chlorine than does sodium.
- An organic compound contains 24 g of carbon, 4 g of hydrogen and 32 g of oxygen.What is the empirical formula of the compound?
 - A CHO
 - B CH₂O
 - C CH4O
 - **D** C₂H₄O₂
- **13** In an electrolysis experiment, the same amount of charge that deposited 32g of copper deposited 26g of chromium.

What is the formula of the chromium ion?

- A Cr⁺
- B Cr²⁺
- **C** Cr³⁺
- D Cr⁴⁺

- 14 Which statement about the properties of the elements in Group 0 of the Periodic Table, helium to xenon, is correct?
 - A Argon reacts with iron to form a compound.
 - **B** Helium is less dense than air.
 - **C** The elements change from gas to solid down the group.
 - **D** The elements exist as covalent molecules.
- **15** The table below shows the electronic structure of five elements V, W, X, Y and Z.

element	electronic structure
V	2, 8, 1
W	2, 8, 7
Х	2, 8
Y	2, 1
Z	2, 6

Which one of the following statements is **not** true?

- **A** V and Y belong to the same Group in the Periodic Table.
- **B** V and W belong to the same Period in the Periodic Table.
- **C** W, X and Z are non-metallic elements.
- **D** X and Z belong to the same Group in the Periodic Table.
- **16** The following observations were made when nickel and iron were placed separately into solutions of metals P, Q and R.

	salt solution of P	salt solution of Q	salt solution of R
nickel	displaced	not displaced	not displaced
iron	displaced	displaced	not displaced

What is the correct order in decreasing reactivity of the five metals?

- A P, Ni, Fe, Q, R
- **B** R, Fe, Ni, Q, P
- **C** R, Fe, Q, Ni, P
- D R, Q, Fe, Ni, P

17 The position of metal M in the reactivity series is shown.

K, **M**, Al, Zn, Fe, Cu, Ag

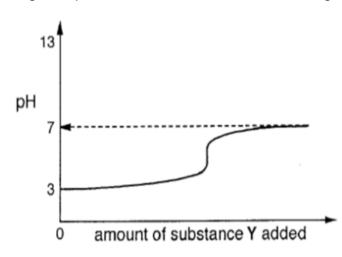
Which method will be used to extract **M** from its ore?

- A electrolysis of its molten chloride
- B electrolysis of its aqueous sulfate
- **C** reduction of its oxide by heating with coke
- **D** reduction of its oxide by heating with hydrogen
- **18** An unknown solid Y has the following properties.
 - Y is stable to heat.
 - When dilute acid is added to Y, effervescence of a colourless gas is observed.
 - Y dissolves in water to form a colourless solution.
 - When aqueous sodium hydroxide is added until in excess to the solution, no visible reaction is observed.

What could be the identity of solid Y?

- A calcium oxide
- **B** sodium carbonate
- **C** zinc metal
- D zinc carbonate

19 Substance Y was added bit by bit, with stirring, to aqueous solution Z. The changes in pH of the mixture are shown in the graph.



What could Y and Z be?

	Y	Z
Α	aluminium oxide	hydrochloric acid
В	calcium oxide	nitric acid
С	sodium oxide	ethanoic acid
D	zinc oxide	propanoic acid

20 Which of the following oxides will **not** react with sulfuric acid?

- A barium oxide
- B nitrogen dioxide
- **C** sodium oxide
- **D** zinc oxide

- 21 Which of the following reactants can be safely used to prepare a potassium chloride?
 - A aqueous potassium hydroxide and dilute hydrochloric acid
 - **B** aqueous potassium sulfate and aqueous sodium chloride
 - C potassium and aqueous sodium chloride
 - D potassium and dilute hydrochloric acid
- 22 Which test is best used to distinguish between calcium chloride and calcium carbonate?
 - A adding aqueous sodium hydroxide
 - B adding dilute hydrochloric acid
 - C using damp litmus paper
 - **D** using silver nitrate solution
- **23** A salt has the chemical formula $(NH_4)_2Fe(SO_4)_2.12H_2O$.

Excess aqueous sodium hydroxide was added slowly, with shaking to a hot solution of the salt in a boiling tube until there is no further reaction. The boiling tube was then left to stand for some time.

Which observation would not be made?

- A A green precipitate was produced.
- **B** A pungent gas which turned damp red litmus blue was produced.
- **C** On standing, the precipitate turned brown.
- **D** The precipitate dissolved in excess sodium hydroxide.
- 24 The Haber process is a reversible reaction as some of the ammonia formed is unstable as it decomposes readily back into its reactants.

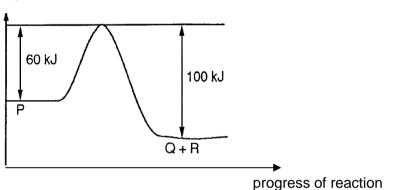
Which of the following method is used to prevent this from happening?

- A Adding water to dissolve ammonia.
- **B** Cooling the mixture to liquefy ammonia.
- **C** Filter the mixture to remove ammonia.
- **D** Fractional distil the mixture to separate ammonia gas.

- 25 Which of the following statements best explains why farmers should not lime the soil and add ammonium nitrate fertiliser at the same time?
 - A The ammonium nitrate makes the soil too alkaline for plant growth.
 - **B** The ammonium nitrate will be less soluble in soil that has been limed.
 - **C** The lime makes the soil too alkaline for plant growth.
 - **D** The lime will react with ammonium nitrate and results in loss of nitrogen.
- 26 The figure below represents the energy profile diagram for the following reaction:

$$P \rightarrow Q + R$$

energy



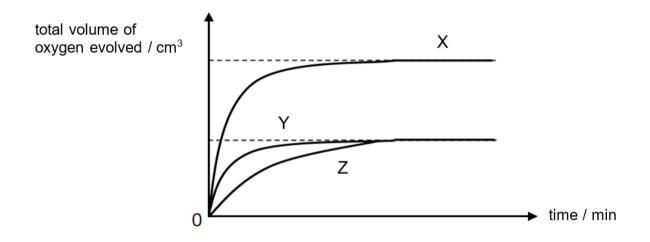
What is the enthalpy change for this reaction?

- **A** 100 kJ
- **B** 40 kJ
- **C** + 40 kJ
- **D** +160 kJ

27 Which process does not involve the use of a catalyst?

- A cracking of hydrocarbons
- **B** the extraction of iron from haematite in a blast furnace
- **C** the production of ammonia from nitrogen and hydrogen
- **D** the redox reactions that remove combustion pollutants from car exhausts

- 28 Upon decomposition, hydrogen peroxide produces oxygen gas as one of the products. Three solutions were used in an experiment to study the rate of decomposition of hydrogen peroxide.
 - I 50 cm³ of 2.0 mol/dm³ hydrogen peroxide
 - II 100 cm³ of 1.0 mol/dm³ hydrogen peroxide
 - III 100 cm³ of 2.0 mol/dm³ hydrogen peroxide



Which curves correspond to the respective solutions?

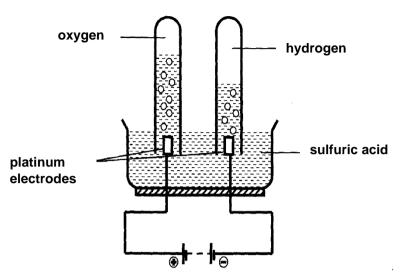
	I	II	III
Α	Х	Y	Z
В	Х	Z	Y
С	Y	Z	х
D	Z	Х	Y

29 Many reactions involve oxidation and reduction.

Which statement is correct?

- A Acidified manganate(VII) ions change colour from colourless to purple when reduced.
- **B** All reactions that involve oxidation also involve reduction.
- **C** During a reaction, oxidising agents lose electrons.
- **D** Reduction is the loss of hydrogen from a compound.

30 The diagram represents an experiment in which electric current is passed through dilute sulfuric acid.



Which of the following best explains why the volume of hydrogen is twice the volume of oxygen formed?

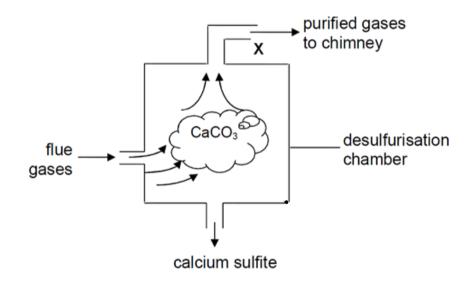
- **A** Some of the oxygen gas dissolved in the solution.
- **B** The ratio of hydrogen to oxygen in a water molecule is 2:1.
- **C** The presence of SO_4^{2-} ions makes it difficult for the oxygen to be formed.
- **D** The sulfuric acid solution is too dilute.
- **31** In which electrolysis experiment would there be **no** change in the concentration of the electrolyte?

	electrolyte	electrodes
Α	aqueous copper (II) sulfate	carbon
В	aqueous copper (II) sulfate	copper
С	concentrated aqueous potassium chloride	carbon
D	dilute sulfuric acid	platinum

32 The carbon cycle regulates the amount of carbon dioxide in the atmosphere.Combustion, photosynthesis and respiration are involved in this cycle.How do these processes affect the amount of carbon dioxide in the atmosphere?

	combustion	photosynthesis	respiration
Α	increases	increases	increases
В	increases	decreases	increases
С	decreases	increases	decreases
D	decreases	decreases	decreases

33 The following diagram shows a simplified process of desulfurisation.



Which of the following observation at the outlet X best describes the nature of the gases to chimney?

- A Gases turned acidified potassium manganate (VII) colourless.
- **B** Gases turned acidified potassium manganate (VII) purple.
- **C** Gases turned acidified potassium iodide brown.
- **D** Gases formed white precipitate with lime water.

34 The table shows the boiling points of four fractions, **P**,**Q**, **R** and **S**, obtained when crude oil is distilled.

fraction	Р	Q	R	S
boiling range /ºC	35 – 75	80 –145	150 – 250	greater than 250

How is fraction **P** different from fraction **S**?

- A Fraction **P** is more viscous than fraction **S**.
- **B** Fraction **P** contains molecules of larger molecular masses than fraction **S**.
- **C** Fraction **P** is more flammable than fraction **S**.
- **D** Fraction **P** is in less demand than fraction **S**.
- **35** Methane has a boiling point of -161°C.

Which molecular formula and boiling point could be correct for another member in the same homologous series?

	molecular formula	boiling point/°C	
Α	C ₂ H ₄	-90	
в	C_2H_6	-185	
С	C ₃ H ₆	-72	
D	C ₃ H ₈	-42	

36 The reaction between a hydrocarbon C_yH_6 and chlorine can be represented as follows.

 $C_yH_6(g) + 2C_{l_2}(g) \rightarrow C_yH_4C_{l_2}(g) + 2HC_{l_2}(g)$

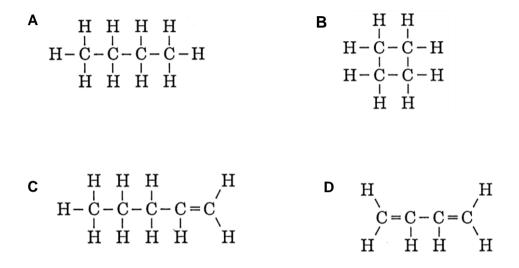
Which of the following statement is correct?

- A It is an addition reaction.
- **B** Ultraviolet light is required for the reaction to take place.
- **C** The molecular formula of the hydrocarbon is C_3H_6 .
- **D** High temperature and a catalyst are required in the reaction.

37 The structure of but-1-ene is shown below.

$$\begin{array}{cccc} H & H & H \\ H - C - C - C - C = C \\ H & H & H \end{array}$$

Which one of the following structures is an isomer of but-1-ene?

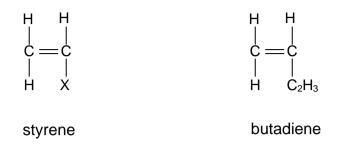


38 The table shows the properties of four compounds.

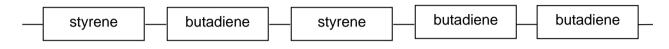
Which compound could be ethanoic acid?

compound	degree of ionisation in water	addition of an aqueous solution of the compound to magnesium
A	high	hydrogen produced
В	high	no reaction
С	low	hydrogen produced
D	low	no reaction

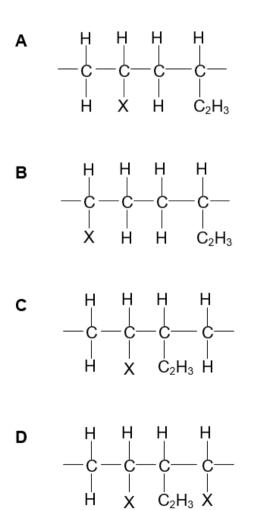
39 Styrene-butadiene is a synthetic rubber. It is made by polymerising a mixture of the monomers styrene and butadiene.



One possible structure for the polymer is shown below.



Which of the following is not a possible repeating unit in this polymer?

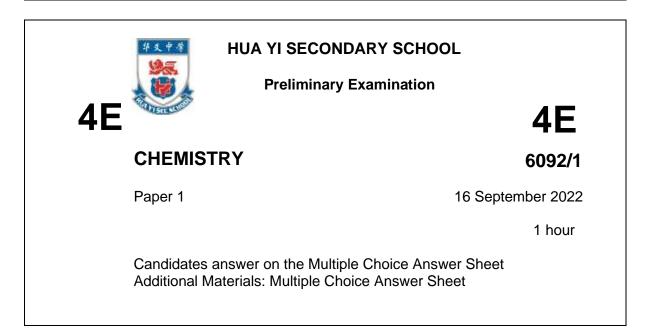


- 40 Which of the following can be represented by the empirical formula CH₂?
 - I poly(ethene)
 - II poly(propene)
 - III butane
 - A I and II only
 - B II and III only
 - **C** I and III only
 - D I, II and III

END OF PAPER

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Name:	Index Number:	Class:



READ THESE INSTRUCTIONS FIRST

Write your Name, Index Number and Class on all the work you have done. Write in soft pencil. Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 20.

For Examiner's Use

Paper 1

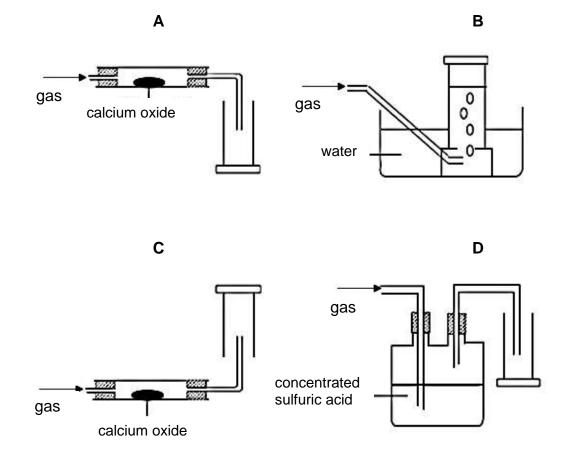
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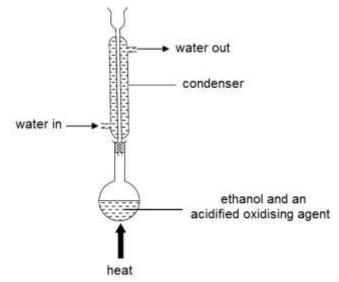
[Turn Over

Setter: Ms Tok Peilin

A gas turns moist red litmus blue, is soluble in water and is less dense than air.Which diagram shows a correct way of drying and collecting the gas?



2 The apparatus shown is commonly used to oxidise ethanol to ethanoic acid.



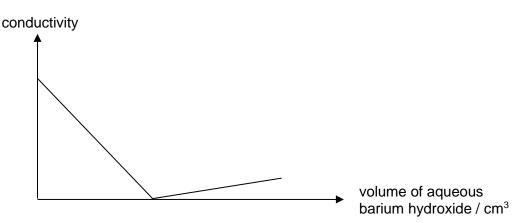
Which is the purpose of the condenser?

- A prevents air from oxidising ethanoic acid formed
- **B** prevents ethanoic acid from reforming back to ethanol
- **C** prevents ethanol from being converted to ethene
- **D** prevents the escape of any unreacted ethanol
- **3** Ethyl acetate is an organic compound that is insoluble in water.

Given a mixture of ethyl acetate and aqueous copper(II) sulfate at room temperature, which two steps should be carried out to obtain samples of ethyl acetate and copper(II) sulfate crystals?

	step 1	step 2
Α	fractional distillation	crystallisation
В	simple distillation	evaporation
С	using a separating funnel	crystallisation
D	using a separating funnel	evaporation

4 The diagram shows the change in electrical conductivity when aqueous barium hydroxide is added to a fixed volume of substance X.



Which of the following is **not** a possible identity for substance X?

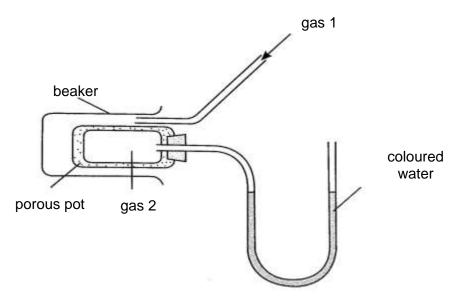
- A aqueous zinc sulfate
- **B** aqueous iron(III) nitrate
- **C** aqueous sodium fluoride
- D aqueous copper(II) chloride

5 Oxygen consists of two isotopes, oxygen-16 and oxygen-18.

Which statement correctly describes the two isotopes of oxygen?

- A Both oxygen-16 and oxygen-18 have the same relative atomic mass.
- **B** Both oxygen-16 and oxygen-18 form ions with a charge of -2.
- **C** Oxygen-16 has different chemical properties from oxygen-18.
- **D** Oxygen-16 and oxygen-18 have different electronic configurations.

6 The apparatus shown is used to investigate the diffusion of gases.



It was observed that the water level of the coloured water did not change even after gas 2 was delivered into the beaker for some time.

	gas 1	gas 2
Α	C ₂ H ₄	N ₂
В	C ₂ H ₆	O ₂
С	CO ₂	NH ₃
D	SO ₂	HCl

Which of the following could be the identities of gases 1 and 2?

- 7 How does rubidium bond with fluorine?
 - A Each atom of rubidium receives an electron from a fluorine atom.
 - **B** Each atom of rubidium shares a pair of electrons with a fluorine atom.
 - **C** Each atom of rubidium shares an electron with a fluorine atom.
 - **D** Each atom of rubidium gives an electron to a fluorine atom.
- 8 The structural formula of ethylene molecule is shown.



What is the total number of shared electrons in each ethylene molecule?

Α	3	В	5	С	6	D	10

- 9 Which statement explains why graphite and copper can conduct electricity in solid state?
 - **A** Both graphite and copper contain mobile electrons.
 - **B** Both graphite and copper contain mobile ions.
 - **C** Graphite contains mobile electrons while copper contains mobile ions.
 - **D** Graphite and copper contain both mobile electrons and mobile ions.
- **10** On complete combustion, a sample of hydrocarbon gives 11.0 g of carbon dioxide and 9.0 g of water.

What is the molecular formula of the hydrocarbon?

- **A** CH₄
- **B** C₂H₄
- **C** C₃H₆
- **D** C₃H₈
- **11** The main ore of zinc is zinc blende, ZnS. When this ore is heated in air, the reaction is represented by the following equation.

$$2ZnS + 3O_2 \rightarrow 2ZnO + SO_2$$

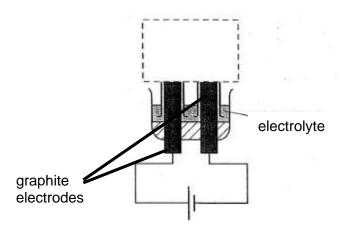
What volume of oxygen at room temperature and pressure would be required to react completely with 194 g of ZnS?

- **A** 3 dm³ **B** $\frac{3 \times 24}{2}$ dm³ **C** 3 × 24 dm³ **D** 3 × 32 dm³
- 12 When 20 g of impure calcium carbonate is heated, 6.6 g of carbon dioxide is obtained.

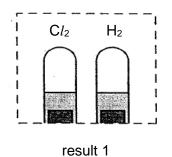
What is the percentage purity of the sample of calcium carbonate? (assume that none of the impurity produce carbon dioxide on heating)

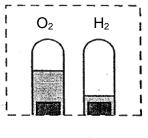
A 15.0% **B** 25.0% **C** 55.0% **D** 75.0%

13 The diagram shows an incomplete diagram of an electrolysis experiment.



A student carries out the experiment above and obtains two different results 1 and 2 as shown.



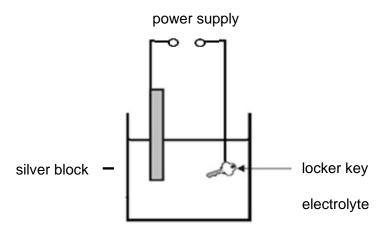


result 2

Which of the following correctly identifies the electrolyte used in the experiment to obtain results 1 and 2?

	electrolyte used to obtain result 1	electrolyte used to obtain result 2
Α	dilute hydrochloric acid	dilute sodium chloride
В	concentrated hydrochloric acid	dilute nitric acid
С	concentrated sodium chloride	concentrated hydrochloric acid
D	dilute sodium chloride	dilute nitric acid

14 A student decided to silver-plate a locker key.



Which of the following combination gives the most suitable set-up for the electroplating?

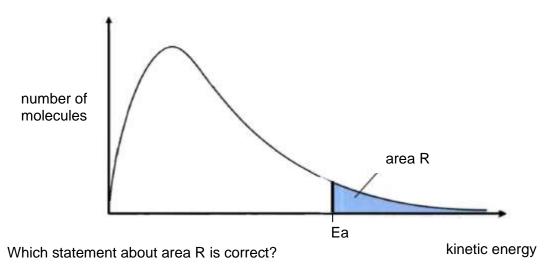
	anode	cathode	electrolyte
Α	locker key	silver block	sulfuric acid
В	locker key	silver block	aqueous silver nitrate
С	silver block	locker key	sulfuric acid
D	silver block	locker key	aqueous silver nitrate

15 A reversible reaction is exothermic in the forward direction and the heat given out is 196 kJ/mol. The activation energy for the forward direction is 75 kJ/mol.

What is the activation energy of the reverse direction?

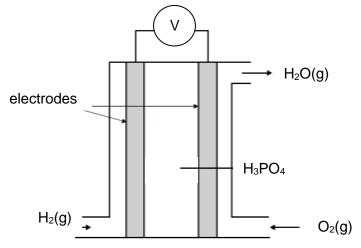
- A 75 kJ/mol
- B 121 kJ/mol
- C 196 kJ/mol
- D 271 kJ/mol

16 The diagram shows the distribution of kinetic energy of a sample of gaseous molecules at a fixed temperature. Ea is the activation energy for the decomposition of this gas.



- A Addition of a catalyst moves the position of the Ea to the right.
- **B** All the molecules in area R possess energy no higher than the Ea.
- **C** Molecules in area R have enough energy for the reaction.
- **D** The collisions between molecules in area R are not successful.
- **17** Phosphoric acid fuel cell, PAFC, is a fuel cell that can provide power for vehicles.

A simplified sketch of PAFC is shown.

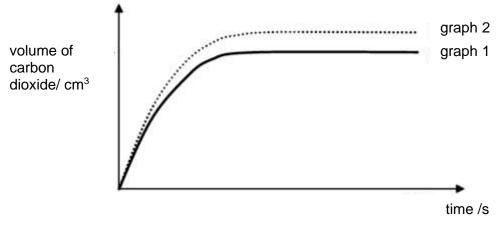


Which statement about the above PAFC is incorrect?

- A Phosphoric acid acts as a fuel.
- **B** The only waste product is non-polluting.
- **C** The fuel cell uses hydrogen gas and oxygen gas to produce electricity.
- **D** The fuel cell requires reactants to be continuously supplied to produce electricity.

18 In an experiment, an excess of 2 mol/dm³ dilute hydrochloric acid was reacted with 50 cm³ of 1 mol/dm³ aqueous potassium carbonate.

The results of the experiment are shown in graph 1.



Which of the following changes to graph 1 would produce graph 2?

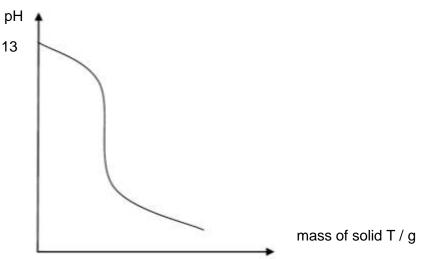
- A adding a catalyst to the reaction mixture
- **B** adding a small amount of solid potassium carbonate to the reaction mixture
- **C** adding water to the reaction mixture
- **D** increasing the concentration of hydrochloric acid
- A textbook writes "Nitric acid, HNO₃, is a strong oxidising agent".Which of the following cannot be a product of nitric acid in its reaction with a reducing agent?
 - **A** N₂
 - **B** N₂O₅
 - C NO
 - D NO₂

- **20** An excess of iron(II) chloride is added to acidified potassium manganate(VII). Which statements are correct?
 - 1 Iron(II) ions are reduced to iron(III) ions.
 - 2 Manganate(VII) ions are oxidised to manganese(II) ions.
 - 3 Potassium manganate(VII) is an oxidising agent.
 - 4 The purple solution disappears.
 - A 1 and 2
 - **B** 1 and 4
 - **C** 2 and 3
 - **D** 3 and 4
- 21 An unknown acid dissociate completely in water to produce 0.5 mol of H⁺ ion.

Which of the following acids will produce the same amount of $\mathsf{H}^{\scriptscriptstyle +}$ ion when dissociated in water?

- A 200 cm³ of 2.0 mol/dm³ of ethanoic acid
- **B** 200 cm³ of 2.0 mol/dm³ of hydrochloric acid
- **C** 500 cm³ of 1.0 mol/dm³ of nitric acid
- **D** 500 cm³ of 1.0 mol/dm³ of sulfuric acid

22 Solid T is gradually added to aqueous solution U. The changes in pH are shown on the graph.



What are substances T and U?

	substance T	substance U
Α	insoluble metal oxide	nitric acid
В	soluble metal oxide	hydrochloric acid
С	soluble non-metal oxide	aqueous ammonia
D	soluble non-metal oxide	sodium hydroxide

23 Which of the following pairs of reactants is most suitable for preparing the given salt?

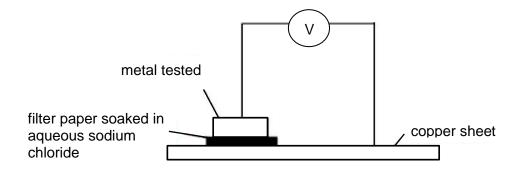
	reactants	salt
Α	copper and sulfuric acid	copper(II) sulfate
В	lead(II) carbonate and sulfuric acid	lead(II) sulfate
С	sodium nitrate and hydrochloric acid	sodium chloride
D	zinc oxide and nitric acid	zinc nitrate

- 24 Which reaction will not produce ammonia gas?
 - A heating ammonium chloride
 - **B** heating a mixture of ammonium chloride and limewater
 - **C** heating a mixture of sodium nitrate and dilute sulfuric acid
 - **D** heating nitrogen gas and hydrogen gas

25 Across a period of the Periodic Table, there is a trend from metallic to non-metallic elements.

Which statement provides the explanation for the trend?

- A This is due to an increase in mass number.
- **B** This is due to an increase in number of electron shells.
- **C** This is due to an increase in number of neutrons.
- **D** This is due to an increase in number of valence electrons.
- 26 The reactivity of Group II metals follows a similar trend as that of Group I metals. The diagram shows four Group II metals A, B, C and D being tested in an electric cell.



The voltage produced is recorded and shown in the table.

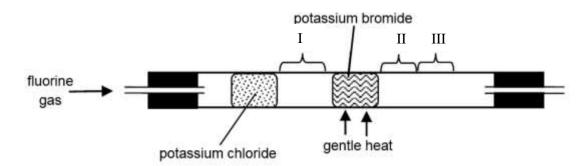
metal	voltage / V
А	0.2
В	0.6
С	0.4
D	0.8

The four metals tested are calcium, magnesium, strontium and barium.

What is the possible identity of metal C?

- A barium
- B calcium
- **C** magnesium
- D strontium

27 Using the apparatus shown, fluorine gas was passed through the tube. After a short time, coloured substances were seen at points I, II and II.



Which row correctly shows the observations at I, II and III?

	Ι	II	III
Α	green gas	orange-brown vapour	reddish-brown liquid
В	green gas	yellow gas	orange-brown vapour
С	pale-yellow gas	green gas	reddish-brown liquid
D	pale-yellow gas	orange-brown vapour	reddish-brown liquid

28 Zirconium, Zr, is a transition metal. It burns with a white light to form a mixture of zirconium(II) oxide and zirconium(IV) oxide.

These oxides react with both acids and bases. Zirconium is resistant to corrosion. Zirconium oxide can speed up the rate of some chemical reactions hence is widely used in the chemical industry.

Which statements show that zirconium is a transition metal?

- 1 The oxides of zirconium are amphoteric.
- 2 Zirconium has oxidation states of +2 and +4 in its oxides.
- 3 Zirconium is resistant to corrosion.
- 4 Zirconium oxide can speed up chemical reactions.
- A 1 and 2 only
- B 2 and 4 only
- **C** 1, 3 and 4 only
- **D** 2, 3 and 4 only

- **29** The reactions of four metals, P, Q, R and S, are as described.
 - Metals Q and S can be extracted by reacting their metal oxides with carbon but metals P and R can only be extracted by electrolysis of its molten compounds.
 - Metal Q can also be extracted by heating its metal oxide with metal S.
 - The metal carbonate of P decomposes more readily than the metal carbonate of R.

What is the correct order in decreasing reactivity for the four metals?

- **A** P, R, Q, S
- **B** P, R, S, Q
- **C** R, P, Q, S
- **D** R, P, S, Q
- **30** Three metal oxides each have the formula G₂O₃.

Which statements about these oxides are correct?

- 1 If the relative molecular mass, *M*r, for the oxide is 152, metal G is chromium.
- 2 If the relative molecular mass, *M*r, for the oxide is 160, metal G does not corrode in dry air.
- 3 If the relative molecular mass, *M*r, for the oxide is 102, the oxide of metal G is amphoteric.
- A 1 and 2 only
- **B** 1 and 3 only
- C 2 and 3 only
- **D** 1, 2 and 3

31 The properties of three common types of steel are listed in the table.

steel H	brittle
steel J	malleable
steel K	resistant to corrosion

Which row matches the type of steel to its properties?

	steel H	steel J	steel K
Α	high carbon steel	low carbon steel	stainless steel
В	low carbon steel	high carbon steel	stainless steel
С	stainless steel	high carbon steel	low carbon steel
D	stainless steel	low carbon steel	high carbon steel

32 Blocks of magnesium were bolted onto steel hull of a ship.

This is done to increase the working life of the steel hull by preventing or slowing down the formation of rust.

Which statement provides the explanation?

- A Magnesium reacts with steel hull to form an alloy.
- **B** Magnesium has corrosion resistant properties.
- **C** Magnesium is oxidised in preference to iron found in the steel hull.
- **D** Magnesium minimises contact of oxygen and water with the steel hull.
- **33** Acid rain contains sulfuric acid and causes lakes to become acidic. Acidic lakes may be treated with powdered limestone (impure calcium carbonate) to neutralise the acidity. Calcium sulfate is formed. If large lumps of limestone are used, instead of powdered limestone, the reaction starts but soon stops, leaving most of the limestone unreacted.

Which statements explains why the reaction starts but soon stops?

- **A** A layer of insoluble calcium sulfate forms on the surface of the lumps.
- **B** Limestone only contains small amounts of calcium carbonate.
- **C** Powdered limestone is more reactive than lumps of limestone.
- **D** The acid reacts with the calcium sulfate instead of the calcium carbonate.

34 Cars are installed with either diesel or petrol engines. The combustion of fuels such as diesel and petrol produces air pollutants.

The table shows the mass of air pollutants found in exhaust fumes when 1 kg of each fuel is combusted under identical conditions.

air pollutant produced	mass of air pollutant after diesel is combusted / g	mass of air pollutant after petrol is combusted / g
carbon monoxide	15	300
unburnt hydrocarbons	20	25
oxides of nitrogen	95	40

Which of the following can be inferred from the above data?

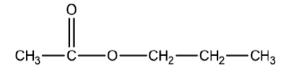
- **A** A diesel engine has a higher temperature than a petrol engine.
- **B** Burning of petrol contributes more towards formation of acid rain.
- **C** Combustion of petrol is more exothermic than that of diesel.
- **D** Petrol requires less oxygen for complete combustion.
- **35** Which one of the following substances can be used to remove sulfur dioxide from flue gases?
 - A calcium carbonate
 - B carbon dioxide
 - **C** dichlorofluoromethane
 - **D** dilute hydrochloric acid
- **36** Which property shows an increase in the alkane series from butane \rightarrow propane \rightarrow ethane \rightarrow methane?
 - **A** boiling point
 - **B** flammability
 - **C** melting point
 - D viscosity
- 37 Which property does not change in the polymerisation of ethene to form poly(ethene)?
 - A boiling point
 - B density
 - **C** empirical formula
 - D mass

- **38** X is an organic compound containing four carbon atoms. It gives negative results with the following tests.
 - reacting X with aqueous bromine
 - reacting X with acidified potassium manganate (VII) solution
 - reacting X with sodium carbonate solution

Which of the following could be the structural formula of X?

- $A \qquad CH_3CH_2CO_2CH_3$
- **B** CH₃CH₂CH=CH₂
- $C \qquad CH_3CH_2CH_2CO_2H$
- D CH₃CH₂CH₂OH
- **39** Esters are sweet smelling substances found in fruits and flowers.

The diagram shows an ester found in pears.

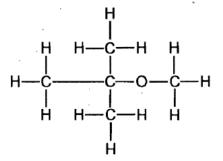


Which of the following pair of compounds react together to form the ester shown?

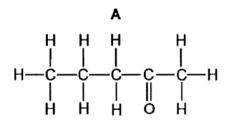
- A butanoic acid and methanol
- **B** ethanoic acid and propanol
- **C** methanoic acid and butanol
- **D** propanoic acid and ethanol

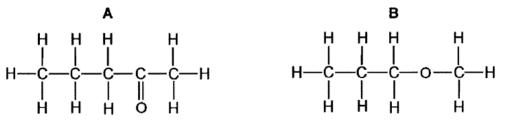
40 A compound known in industry as 'MTBE' is used as an additive in 'lead-free' petrol.

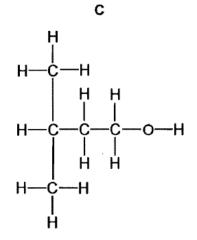
The structural formula of MTBE is shown.

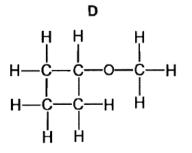


Which compound is an isomer of MTBE?









End of Paper

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The Periodic Table of Elements

	、要中学		DOCL
Candidate Name			
Class		Index Number	
PRELIMINARY	EXAMINATION 202 EXPRESS	2	40

CHEMISTRY Paper 1

6092/01

24 Aug 2022

Duration: 1 h

Date:

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write in soft pencil. Do not use staples, paper clips, glue or correction tape/fluid. Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the answer sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done on this question paper. A copy of the Periodic Table is printed on page 2. The use of an approved scientific calculator is expected, where appropriate.

Set by: Mr Daniel Lau Vetted by: Ms Woo Wei Shan

This document consists of <u>15</u> printed pages (including cover page).

The Periodic Table of the Elements

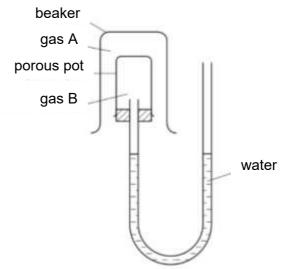
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sodium 23	magnesium 24											aluminium 27	silicon 28	phosphorus 31	sulfur 32	chlorine 35.5	argon 40
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Со	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
potassium	calcium	scandium	titanium	vanadium	chromium	manganese	iron	cobalt	nickel	copper	zinc	gallium	germanium	arsenic	selenium	bromine	krypton
39	40	45	48	51	52	55	56	59	59	64	65	70	73	75	79	80	84
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Мо	Тс	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Те	I	Xe
rubidium 85	strontium 88	yitrium 89	zirconium 91	niobium 93	molybdenum 96	technetium	ruthenium 101	rhodium 103	palladium 106	silver 108	cadmium 112	indium 115	tin 119	antimony 122	tellurium 128	iodine 127	xenon 131
55	56	09 57 – 71	72	73	74	- 75	76	77	78	79	80	81	82	83	84	85	86
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lanthanoids

5	7	58	59	60	61	62	63	64	65	66	67	68	69	70	71
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8	9	90	91	92	93	94	95	96	97	98	99	100	101	102	103
A	C	Th	Ра	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
actir	nium	thorium	protactinium	uranium	neptunium	plutonium	americium	curium	berkelium	californium	einsteinium	fermium	mendelevium	nobelium	lawrencium
-	-	232	231	238	-	-	-	-	-	-	-	-	-	-	-

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.)

1 The diagram shows a beaker full of gas A inverted over a porous pot containing gas B.



The water level does not move. Which of the following could be gas A and gas B?

	gas A	gas B
Α	carbon monoxide	neon
в	carbon dioxide	nitrogen
С	methane	ammonia
D	ethane	nitrogen monoxide

- **2** When ethanol is manufactured, ethanol can be separated from the mixture of water, sugar and yeast by fractional distillation because
 - **A** the boiling point of ethanol is lower than water.
 - **B** ethanol is a volatile liquid.
 - **C** ethanol does not react with water on heating.
 - **D** ethanol is immiscible in water.
- **3** Some brown powder is placed in a test-tube. Water is added to the test-tube and shaken. The contents are then filtered. A black solid is left on the filter paper. After evaporating the filtrate, orange crystals are left.

What does this analysis tell you about the coloured substances?

- **A** The black solid is an element.
- **B** The brown powder is a compound.
- **C** The brown powder is a mixture.
- **D** The orange crystals is a mixture.

- 4 Which property determines the amount of energy required to melt ice?
 - **A** The forces of attraction between the molecules.
 - **B** The reactivity of the molecules.
 - **C** The shape of the molecules.
 - **D** The strength of the covalent bonds in the molecules.
- **5** Tritium (symbol T) is an isotope of hydrogen.

Which formula is incorrect for a compound of tritium?

- A BaOT
- **B** CT₄
- **C** NT₃
- **D** T₂O
- 6 Compound C contains two elements, metal D and non-metal E.

Compound C consists of a lattice of positive ions and negative ions.

Each positive ion is surrounded by eight negative ions and each negative ion is surrounded by four positive ions.

Which ions are present in, and what is the formula of, compound C?

	ions present	formula
Α	D* E ²⁻	D ₂ E
в	D ²⁺ E ⁻	DE ₂
С	E ⁺ D ²⁻	E ₂ D
D	E ²⁺ D ⁻	ED ₂

7 The equation shows the reaction between oxide of an element G and dilute hydrochloric acid.

$$GO + 2 HC / \rightarrow GC /_2 + H_2 O$$

Which particles are responsible for conducting electricity in G, GO and GCl₂?

	G	GO	GCI ₂
Α	electrons	positive & negative ions	positive & negative ions
в	electrons	positive ions	positive & negative ions
С	positive ions	electrons	electrons
D	positive & negative ions	negative ions	positive ions

8 Bones contain a complex mixture of calcium salts, protein and other materials. When a bone is strongly heated in a current of air, the only residue is calcium oxide. From a sample of 100 g of bone, 42.0 g of calcium oxide were obtained.

What is the percentage by mass of calcium in the bone?

A 12.0 % **B** 30.0 % **C** 42.0 % **D** 71.4 %

9 Aspirin tablets have important medical uses such as reducing fever and relieving pain.

Aspirin, $C_9H_8O_4$, is made from salicylic acid, $C_7H_6O_3$, according to the equation

 $C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + CH_3COOH$

Assuming a 70% yield, what is the mass of salicylic acid required to make an aspirin tablet of 325 mg?

[Mr of $C_7H_6O_3 = 138$, Mr of $C_9H_8O_4 = 180$]

A 174 mg **B** 249 mg **C** 356 mg **D** 424 mg

10 200 cm³ of ammonia burns in 120 cm³ of oxygen according to the following equation:

 $4 \text{ NH}_3 (g) + 3 \text{ O}_2 (g) \rightarrow 2 \text{ N}_2 (g) + 6 \text{ H}_2 O (I)$

What volume of nitrogen will be obtained?

- **A** 80 cm³ **B** 100 cm³ **C** 240 cm³ **D** 320 cm³
- **11** Which method(s) is/are suitable to distinguish between 1.0 mol/dm³ of aqueous hydrochloric acid and 1.0 mol/dm³ of aqueous ethanoic acid?
 - 1 using a pH meter
 - 2 determining the volume of 1.0 mol/dm³ of sodium hydroxide solution used to neutralise 25.0 cm³ of the acids separately
 - 3 measuring the total volume of hydrogen gas formed when excess magnesium is added to the acids separately

A 1 only **B** 1 and 2 **C** 1 and 3 **D** 2 and 3

12 Which equation suggests that a metal oxide, JO, behaves as an amphoteric oxide?

A JO (s) + 2 H⁺ (aq)
$$\rightarrow$$
 J²⁺ (aq) + H₂O (*I*)

- **B** JO (s) + 2 OH⁻ (aq) \rightarrow JO₂²⁻ (aq) + H₂O (*I*)
- **C** JO (s) + H₂O (*I*) \rightarrow J²⁺ (aq) + 2 OH⁻ (aq)
- **D** JO (s) + NH₄⁺ (aq) \rightarrow J²⁺ (aq) + H₂O (*l*) + NH₃ (g)

13 The following scheme shows the steps to prepare pure silver chloride from silver carbonate.

reagent K reagent L

silver carbonate → silver sulfate → silver chloride

Identify reagents K and L.

	reagent K	reagent L	
Α	aqueous sodium sulfate	barium chloride	
в	aqueous sodium sulfate	dilute hydrochloric acid	
С	dilute sulfuric acid	barium chloride	
D	dilute sulfuric acid	dilute hydrochloric acid	

- **14** Ammonia is produced via the Haber Process. Three statements on the Haber Process are shown below.
 - 1 The Haber Process is usually carried out at 450 °C and 200 atm pressure.
 - 2 Unreacted nitrogen and hydrogen are recycled back to the reaction chamber.
 - 3 The chemical reaction becomes irreversible when finely divided iron catalyst is used.

Which of these statements is/are correct?

- **A** 1 only **B** 1 and 2 **C** 2 and 3 **D** 1, 2 and 3
- **15** The equations below show the reactions of hydrogen peroxide.

1 2 Fe²⁺ + H₂O₂ + 2 H⁺
$$\rightarrow$$
 2 Fe³⁺ + 2 H₂O

2 2 MnO₄⁻ + 5 H₂O₂ + 6 H⁺
$$\rightarrow$$
 5 O₂ + 2 Mn²⁺ + 8 H₂O

Which row correctly describes the reactions that hydrogen peroxide undergoes?

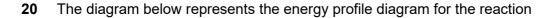
	1	2	
A oxidation		oxidation	
в	oxidation reduction		
С	reduction oxidation		
D	reduction	reduction	

16 Nitrogen dioxide reacts with water according to the following equation.

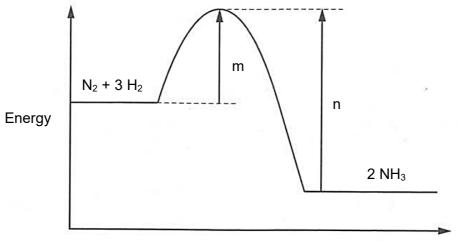
 $2 \text{ NO}_2 + H_2O \rightarrow HNO_2 + HNO_3$

Which of the following statements correctly describes this reaction?

- **A** NO₂ is reduced to form HNO₃.
- **B** The oxidation state of N in HNO₂ is +3.
- **C** The reaction is a decomposition reaction.
- **D** Water acts as a catalyst in this reaction.
- 17 Which property shows a decreasing trend for the elements listed?
 - A colour intensity of F, C*I*, Br
 - B density of Na, Mg, A/
 - **C** reactivity of F, C/, Br
 - D reactivity of Na, K, Rb
- 18 Caesium is a Group I metal.Which reaction involving this element would **not** produce hydrogen?
 - A adding caesium to ethanoic acid
 - B adding caesium to water
 - **C** electrolysing aqueous caesium chloride
 - **D** electrolysing molten caesium chloride
- **19** Which method is the **least** effective method in reducing the amount of pollutant gases that cause acid rain?
 - **A** Burning fuel with low sulfur content.
 - **B** Pass waste gases through catalytic converters in motor vehicles.
 - **C** Reduce usage of air–conditioners.
 - **D** Use limestone to absorb pollutant gases from factories.



```
N_2 + 3 H_2 \rightleftharpoons 2 NH_3
```



Progress of reaction

Which of the following correctly represents the enthalpy change and activation energy for the forward and reverse reactions?

	forward reaction		reverse reaction	
	enthalpy change activation energy		enthalpy change	activation energy
Α	m - n	m	n - m	n
В	n - m	m	m - n	m
С	m - n	n	n - m	n
D	n - m	n	m - n	m

21 Gaseous phosphorus pentachloride can be decomposed into gaseous phosphorous trichloride and chlorine by heating.

$$\mathsf{PC}I_5 \to \mathsf{PC}I_3 + \mathsf{C}I_2$$

Given that the P–C/ bond energy is 330 kJ/mol and the C/–C/ bond energy is 240 kJ/mol, what is the enthalpy change of the reaction in kJ/mol?

A - 420 **B** - 90 **C** + 90 **D** + 420

- 9
- 22 The table below shows some bond energies.

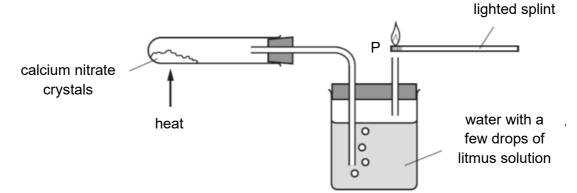
bond	kJ/mol
C - C	346
С-Н	413
Si - Si	176
Si - H	318

Which of the following statements could be considered to be consistent with these values?

- **A** 346 kJ is the energy evolved when 1 mole of graphite sublimes.
- **B** Si Si bonds are the least readily broken of those listed.
- C Si Si chains are more stable than C C chains.
- **D** Methane, CH₄, is chemically more stable than silane, SiH₄.
- **23** A student investigates calcium nitrate crystals by heating them in the apparatus shown.

$$2 \operatorname{Ca}(\operatorname{NO}_3)_2 \rightarrow 2 \operatorname{CaO} + 4 \operatorname{NO}_2(g) + \operatorname{O}_2(g)$$

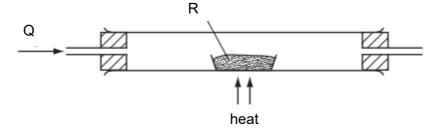
A colourless gas leaves the apparatus at P. A flame is held to this gas.



What observations would the student make?

	litmus solution	formula	
Α	changes to blue	flame burns more brightly	
в	changes to blue	flame goes out	
С	C changes to red flame burns more		
D	changes to red	flame goes out	

- 10
- 24 In the apparatus shown, gas Q is passed over solid R.



No reaction occurs if Q and R are

	Q	R	
Α	hydrogen	calcium oxide	
в	hydrogen	copper(II) oxide	
С	oxygen	carbon	
D	oxygen	copper	

- 25 The following equation and statements describe three metals, X, Y and Z.
 - $1 \quad Y + 2 \text{ XNO}_3 \rightarrow Y(NO_3)_2 + 2 \text{ X}$
 - 2 ZNO_3 decomposes readily at room temperature to form Z.
 - 3 XNO₃ and Y(NO₃)₂ decompose only at temperatures above 250 °C.

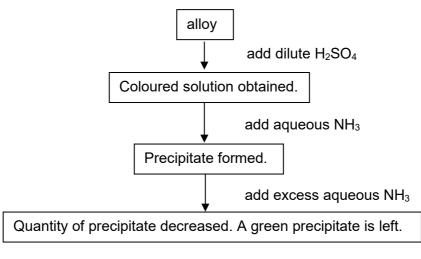
What is the reactivity of the three metals, starting from the most reactive?

- **A** X, Y, Z
- **B** Y, X, Z
- **C** Z, X, Y
- **D** Z, Y, X
- **26** Ships made from steel often have pieces of magnesium attached to them to protect the steel from corrosion.

Which equation shows a reaction that occurs when magnesium is used to protect steel from corrosion?

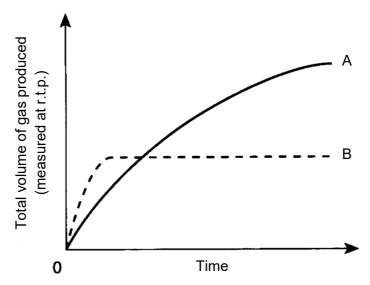
- $\textbf{A} \quad \text{Fe (s)} \rightarrow \text{Fe}^{2\text{+}} \text{ (aq)} + 2 e$
- $\textbf{B} \quad \text{Fe (s)} \rightarrow \text{Fe}^{3\text{+}} \text{ (aq) + 3e}$
- $\label{eq:main_state} \begin{array}{ll} \textbf{C} & \mbox{Mg}\left(s\right) \rightarrow \mbox{Mg}^{2+}\left(aq\right) + 2e \end{array}$
- \mathbf{D} Mg²⁺ (aq) + 2e \rightarrow Mg (s)

27 A sample of an alloy containing two metals was subjected to the following tests.



What are the two metals present in the alloy?

- A copper and lead
- B copper and zinc
- C iron and lead
- **D** iron and zinc
- **28** In the graph shown below, curve A represents the results of the reaction between 2 g of zinc granules and an excess acid at 25 °C. Which of the following changes will produce curve B?



- A using 2 g of zinc powder at 15 °C
- **B** using 2 g of zinc granules at 30 °C
- **C** using 1 g of zinc granules at 15 °C
- **D** using 1 g of zinc granules at 30 °C

29 A student wishes to investigate the effect of acid concentration on the speed of the reaction between a given mass of calcium carbonate and an excess of hydrochloric acid.

Which measurement would **not** allow him to achieve the aim of his investigation?

- **A** change in the mass of the reaction mixture with time
- **B** final temperature of the reaction mixture
- **C** time taken for a given volume of gas to be collected
- **D** volume of gas produced in a given time
- **30** Methane reacts very slowly with air at room temperature. But if a transition metal C is added to the methane-air mixture, the methane ignites quickly. The addition of C:
 - 1 causes the activation energy to be lower.
 - 2 increases the ΔH .
 - 3 increases the rate of reaction.
 - 4 reduces the energy of the reactants.

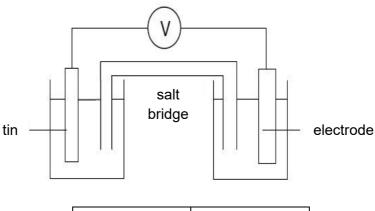
Which of the following statements are true when C is added to methane-air mixture?

- **A** 1 and 2 **B** 1 and 3 **C** 3 and 4 **D** 1, 3 and 4
- **31** In an experiment, 2 moles of aluminium ions, A/^{β+}, were discharged in the electrolysis of molten aluminium oxide.

How much metal ions would be discharged by an equal amount of electricity in the following experiments?

- **A** 2 mol of Cu²⁺, in the electrolysis of aqueous copper(II) nitrate
- **B** 3 mol of Ag⁺, in the electrolysis of aqueous silver nitrate
- **C** 3 mol of Pb²⁺, in the electrolysis of molten lead(II) bromide
- **D** 6 mol of Zn^{2+} , in the electrolysis of aqueous zinc sulfate
- **32** In which electrolysis experiment would there be **no** change in pH of the solution when inert electrodes are used?
 - **A** aqueous copper (II) nitrate
 - B aqueous silver sulfate
 - **C** concentrated copper (II) chloride solution
 - **D** concentrated potassium bromide solution

33 Four metals, D, E, G and tin were connected in pairs and the voltages were recorded.



electrode	voltage (V)	
E	- 1.10	
D	+ 0.90	
G	+ 2.50	

Which option correctly describes the reactivity of the metal from the most reactive to the least reactive?

- A D, tin, E, G
- **B** G, D, tin, E
- **C** G, E, tin, D
- **D** G, E, D, tin
- **34** Recent medical studies have suggested that oils made up of polyunsaturated fatty acids are healthier than those with monosaturated ones.

In the analysis of oleic acid (relative molecular mass, M_r = 280), it is found that 56.0 g of the acid requires 0.8 g of hydrogen gas for complete hydrogenation.

Given that one mole of C=C group reacts with one mole of hydrogen gas as shown in the general equation below:

What is the number of C=C bonds in a molecule of oleic acid?

A 1 **B** 2 **C** 3 **D** 4

- **35** Which property shows an increase in the alkane series as the number of carbon atoms decreases from butane to methane?
 - A boiling point
 - **B** melting point
 - **C** viscosity
 - **D** flamability
- 36 The diagram below shows an organic molecule, J.

$$\begin{array}{cccccccc} 0 & H & H & O \\ & & & | & | & | & | \\ H & - O - C - C - C - C - C - O - H \\ & & | & | \\ H & H \end{array}$$

Which statement is not true about molecule J?

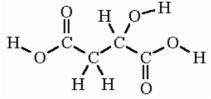
- **A** It can be used as one of monomers to make a polyester.
- **B** It has a higher boiling point than methanoic acid.
- **C** Upon combustion, 1 mole of J produces 4 moles of carbon dioxide gas.
- **D** 2 moles of J produces 1 mole of H_2 gas when reacted with excess iron.
- **37** When a straight-chained pentane is reacted with chlorine gas in the presence of UV light, a substitution reaction occurs according to the following equation:

$$C_5H_{12} + C_{l_2} \rightarrow C_5H_{11}C_l + HC_l$$

How many different isomers of $C_5H_{11}CI$ can be formed from the substitution reaction?

A 3 **B** 5 **C** 7 **D** 12

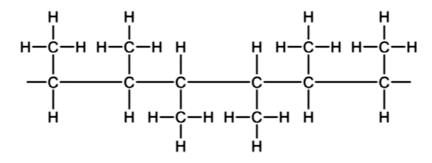
38 Apples contain malic acid. The diagram below shows the structural formula of malic acid.



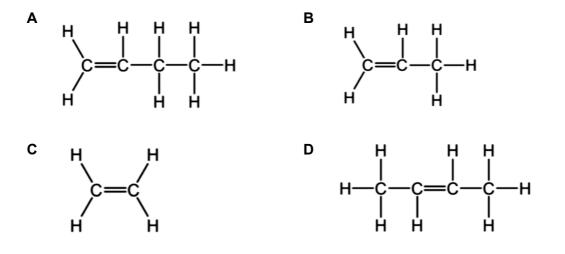
Which of the following salt(s) could be formed upon reacting malic acid with sodium hydroxide?

- $1 \quad C_4H_5O_5Na$
- $2 \quad C_4H_4O_5Na_2$
- $3\quad C_4H_3O_5Na_3$
- **A** 2 only **B** 3 only **C** 1 and 2 **D** 1, 2 and 3

39 The diagram below shows the structure of a polymer.



Which of the following monomer was used to form the polymer?



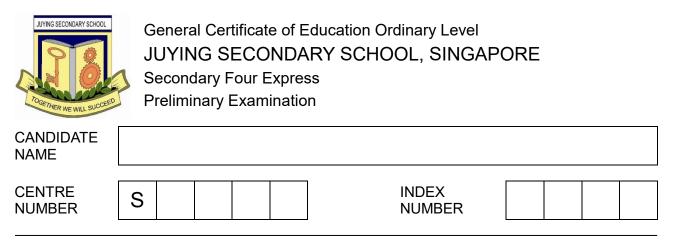
40 The diagrams show four monomers.



How many of these monomers would react with the molecule below to form a polymer?



- End of Paper -



CHEMISTRY

Paper 1 Multiple Choice

6092/01 30 August 2022 1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

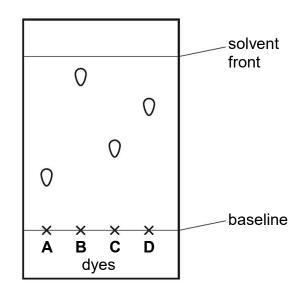
Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet. A copy of the Periodic Table is printed on page 18. The use of an approved scientific calculator is expected, where appropriate. **1** A student performed an experiment on enthalpy change.

The student put exactly 25.0 cm³ of dilute hydrochloric acid into a conical flask, and added 2.5 g of solid sodium carbonate.

Which set of apparatus does the student need to use?

- A electronic balance, measuring cylinder, thermometer
- **B** electronic balance, pipette, stopwatch
- **C** electronic balance, pipette, thermometer
- **D** burette, pipette, thermometer
- 2 Chromatography is a technique used to separate coloured dyes.

Which dye has an Rf value of 0.7?



3 Four gas jars each contain one of the gases ammonia, chlorine, hydrogen chloride and oxygen. A strip of damp blue litmus paper and a strip of damp red litmus paper are placed in each jar.

Which gas will change the colour of both strips of litmus paper?

- A ammonia
- B chlorine
- **C** hydrogen chloride
- D oxygen

4 An aqueous solution of zinc nitrate is tested by adding reagents.

Which observation is correct?

	reagent added	observations	
Α	acidified aqueous barium nitrate	forms a white precipitate	
в	aqueous ammonia	forms a white precipitate, soluble in excess of the reagent	
С	aqueous sodium hydroxide	forms a white precipitate, insoluble in excess of the reagent	
D	powdered copper	forms a grey precipitate	

- 5 Which statement is **not** correct?
 - A Energy is released when a liquid changes into a solid.
 - **B** Particles move faster in the gaseous state than in the liquid state.
 - **C** The carbon atoms in gaseous methane are further apart than those in solid diamond.
 - **D** There is a large decrease in the volume of a solid metal when pressure is applied to it.
- 6 A particle contains 34 protons, 45 neutrons and 36 electrons.

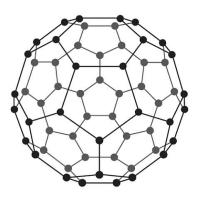
Which symbol is correct for this particle?

- **A** ${}^{45}_{21}$ Sc **B** ${}^{45}_{21}$ Sc²⁻ **C** ${}^{79}_{34}$ Se²⁻ **D** ${}^{79}_{34}$ Se²⁺
- **7** Two naturally occurring isotopes of oxygen are ¹⁶O and ¹⁷O.

Which statement is correct?

- A Both isotopes react with iron to form rust.
- **B** Neither isotope reacts with iron to form rust.
- **C** Only ¹⁶O reacts with iron to form rust.
- **D** Only ¹⁷O reacts with iron to form rust.

8 Buckminsterfullerene has the chemical formula C_{60} .



How is the structure of buckminsterfullerene best described?

- **A** a covalent compound
- **B** an ionic compound
- **C** a polymer
- D a molecule
- 9 Which statement describes the structure of an ionic compound?
 - A It is a giant lattice of oppositely charged ions.
 - **B** It is a giant lattice of positive ions in a 'sea' of electrons.
 - **C** It is a giant molecule of oppositely charged ions.
 - **D** It is a simple molecule of oppositely charged ions.
- **10** A compound P is the only substance formed when two volumes of ammonia gas react with one volume of carbon dioxide gas at room temperature and pressure.

What is the formula of compound P?

- **A** NH₂CO₂NH₄ **B** (NH₂)₂CO **C** NH₄CO₂NH₄ **D** (NH₄)₂CO₃
- **11** A compound contains 70% by mass of iron and 30% by mass of oxygen.

What is its empirical formula?

A FeO **B** Fe₂O₃ **C** Fe₃O₂ **D** Fe₃O₄

What is the correct equation for the reaction at the positive electrode?

- $\mathbf{A} \qquad \mathsf{A}l \to \mathsf{A}l^{3+} + 3e^{-}$
- **B** $Al^{3+} + 3e^- \rightarrow Al$
- **C** $O_2 + 4e^- \rightarrow 2O^{2-}$
- $\textbf{D} \qquad 20^{2-} \rightarrow O_2 \textbf{+} 4e^-$
- **13** Iron can be electroplated with silver to make its appearance attractive.

Which row about electroplating iron with silver is correct?

	anode	cathode	electrolyte
Α	iron	silver	iron nitrate
В	iron	silver	silver nitrate
С	silver	iron	iron nitrate
D	silver	iron	silver nitrate

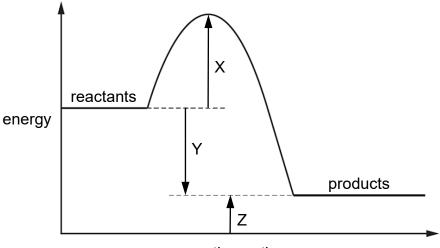
- **14** The formation of liquid water from hydrogen and oxygen may occur in three stages.
 - $1 \qquad 2H_2(g) + O_2(g) \rightarrow 4H(g) + 2O(g)$
 - $2 \qquad 4H(g) + 2O(g) \rightarrow 2H_2O(g)$
 - $3 \qquad 2H_2O(g) \rightarrow 2H_2O(I)$

Which stages are exothermic?

A 1, 2 and 3 B 1 and 2 only C 2 and 3 only D 2 only

15 The diagram shows the energy profile of a chemical reaction.

Two energy changes are labelled X and Y.



reaction pathway

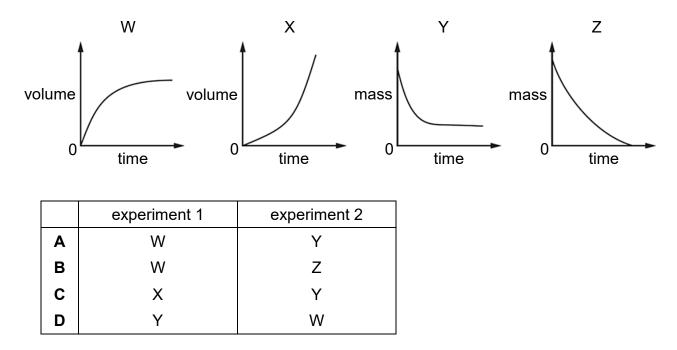
Which statement about the reaction is correct?

- **A** The activation energy of the reaction is X + Y + Z.
- **B** The activation energy of the reaction is Z.
- **C** The enthalpy change of the reaction is X + Z Y.
- **D** The enthalpy change of the reaction is Y.

16 In two experiments, 1 and 2, an excess of powdered calcium carbonate was reacted in a flask with dilute hydrochloric acid.

In experiment 1, the carbon dioxide evolved was collected in a gas syringe over time. In experiment 2, the mass of the flask and its contents was measured over time. The results of both experiments were plotted on graphs.

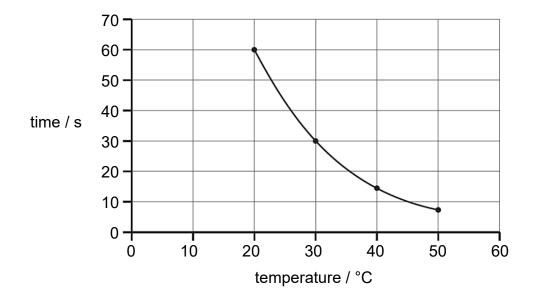
Which graphs correctly show the results of these two experiments?



17 A reaction is carried out at four different temperatures.

The time taken for the reaction to complete at each temperature is measured.

The results are shown.



Which statement about the reaction is correct?

- **A** The time taken increases as the temperature increases.
- **B** The time taken decreases by 10 s for every 10 °C rise in temperature.
- **C** The rate is inversely proportional to the temperature.
- **D** The rate is inversely proportional to the time taken.
- **18** Iron(II) chloride solution reacts with chlorine gas.

 $2FeCl_2(aq) + Cl_2(g) \rightarrow 2FeCl_3(aq)$

Which statements about this reaction are correct?

- 1 Fe²⁺ ions are reduced to Fe³⁺ ions.
- 2 Chlorine acts as a reducing agent.
- 3 Fe^{2+} ions each lose an electron.
- 4 Cl_2 molecules are reduced to Cl_2 ions.
- **A** 1 and 3 **B** 2 and 3 **C** 2 and 4 **D** 3 and 4

- **19** Which statement about oxides is correct?
 - **A** A solution of magnesium oxide has a pH less than 7.
 - **B** A solution of sulfur dioxide has a pH greater than 7.
 - **C** Magnesium oxide reacts with nitric acid to make a salt.
 - **D** Sulfur dioxide reacts with hydrochloric acid to make a salt.

20 In which reaction are two of the products salts?

- A aqueous lead(II) nitrate and aqueous copper(II) sulfate
- **B** aqueous sodium hydroxide and solid ammonium sulfate
- **C** dilute hydrochloric acid and aqueous sodium carbonate
- **D** dilute hydrochloric acid and magnesium

21 Which methods are suitable for preparing both zinc sulfate and copper(II) sulfate?

- 1 reacting the metal oxide with warm dilute sulfuric acid
- 2 reacting the metal with dilute sulfuric acid
- 3 reacting the metal carbonate with dilute sulfuric acid
- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only
- **22** Ammonia is manufactured by reacting hydrogen with nitrogen in the Haber process.

Which row correctly describes the Haber process?

	source of hydrogen	source of nitrogen	temperature of reaction / °C	pressure of reaction / atm
Α	air	natural gas	450	2
В	air	natural gas	250	200
С	natural gas	air	250	2
D	natural gas	air	450	200

23 P and Q are two elements from the same period in the Periodic Table.

The table gives some properties of P and Q.

property	Р	Q
appearance	shiny grey	dull yellow
electrical conductivity when solid	good	poor
malleability	malleable	brittle

Which statement about P and Q is correct?

- A P forms an acidic oxide.
- **B** P is found to the left of Q in the Periodic Table.
- **C** Q forms positive ions when it reacts with another element.
- **D** Q is more metallic than P.
- 24 Tennessine, Ts, is a newly discovered element.

The atomic number of tennessine is 117 and it is placed directly below astatine in the Periodic Table.

Which statement about the properties of tennessine is likely to be correct?

- A Tennessine has a higher reactivity than astatine.
- **B** Tennessine has a lower boiling point than astatine.
- **C** Tennessine has a lighter colour than astatine.
- **D** Tennessine has a higher density than astatine.
- **25** In the chemical formulae of some ionic compounds, the metal is represent by M.

Which pair of compounds shows that the metal is a transition element?

- A M₂O₃ and M₂(SO₄)₃
- B M₂O and MCO₃
- C MS and MSO₄
- D MO and M(NO₃)₂

- 26 Which statement about the uses of metals is not correct?
 - A Copper is used for making brass.
 - **B** Iron is used for making steel.
 - **C** Aluminum is used as a catalyst in the cracking of hydrocarbons.
 - **D** Nickel is used as a catalyst in the hydrogenation of alkenes.
- 27 Three metals, X, Y and Z, were reacted with water.

The oxides of the same three metals were also heated strongly with carbon.

The results are shown.

metal	reaction of the metal with water	reaction of the metal oxide with carbon
х	vigorous reaction with cold water	no reaction
Y	no reaction	metal and carbon dioxide produced
Z	very slow reaction with cold water but violent reaction with steam	no reaction

What is a correct conclusion about X, Y and Z?

- **A** X is sodium and Y is magnesium.
- **B** X is the least reactive and Y is the most reactive.
- **C** Z is less reactive than Y.
- **D** Z is magnesium and Y is copper.
- **28** Aqueous copper(II) sulfate solution is placed in an iron container and left to stand for several days.

Which statement describes what happens?

- A Copper(II) sulfate reacts with atmospheric oxygen to form black copper(II) oxide.
- **B** Some fine iron particles are formed in the solution.
- **C** The part of the container in contact with the solution is coated with copper.
- **D** The solution turns from green to blue.

29 Iron is extracted from its ore in a blast furnace.

Haematite, coke, limestone and hot air are added to the furnace.

Which explanation is not correct?

- A Coke burns and produces a high temperature.
- **B** Haematite is the ore containing the iron as iron(III) oxide.
- **C** Hot air provides the oxygen for the burning.
- **D** Limestone reduces the iron(III) oxide to iron.
- **30** Which metal is attached to underground pipes made of iron, to provide sacrificial protection from corrosion?

Α	Ag	В	Cu	С	Mg	D	Pb
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31 The table shows the composition of exhaust gases from the internal combustion engine of a petrol vehicle.

gas	percentage of the gas in the exhaust fumes / %
gas X	71
carbon dioxide	14
water vapour	13
gas Y	1
hydrocarbons	0.3
nitrogen oxides	0.2
sulfur dioxide	< 0.003

What are gases X and Y most likely to be?

	Х	Y	
Α	argon	oxygen	
в	carbon monoxide	methane	
С	oxygen	argon	
D	nitrogen	carbon monoxide	

- **32** Four sources of air pollution are listed.
 - 1 burning fossil fuels containing sulfur
 - 2 nitrogen reacting with oxygen in car engines
 - 3 incomplete combustion of carbon fuels
 - 4 adding lead compounds to petrol

Which sources produce acid rain?

Α	1 and 2	В	1 and 3	С	2 and 3	D	3 and 4
---	---------	---	---------	---	---------	---	---------

33 Which statements about the carbon cycle are correct?

- 1 Carbon dioxide is added to the atmosphere by respiration.
- 2 Carbon dioxide is added to the atmosphere by combustion of coal.
- 3 Carbon dioxide is removed from the atmosphere by photosynthesis.
- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only
- **34** Petroleum is separated into fractions by fractional distillation.

Separation occurs in a fractionating column.

Some properties of three of these fractions are shown.

fraction	boiling point range / °C	number of carbon atoms in the molecules
1		5 – 10
2	320 – 350	16 – 24
3	120 – 210	

Which statement is correct?

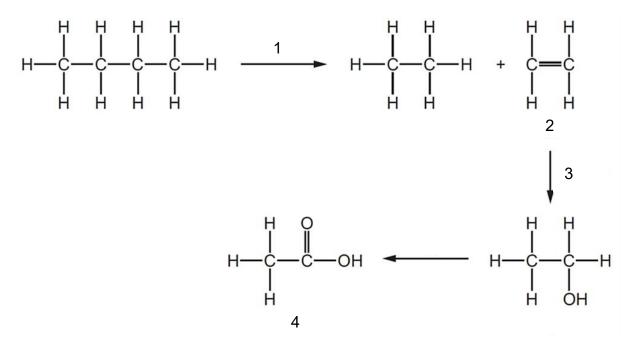
- A Fraction 1 has a higher boiling point range than fraction 2.
- **B** Fraction 2 is removed from a position that is higher up the fractionating column than fraction 1.
- **C** Molecules in fraction 3 have shorter chains than those in fraction 2.
- **D** None of the fractions are liquid at room temperature.

35 Bromine reacts with methane.

Which statements are correct?

- 1 The reaction takes place in the dark.
- 2 The reaction of bromine with methane forms bromomethane.
- 3 Bromomethane reacts with bromine to produce dibromomethane.
- 4 The reaction of bromine with methane is an addition reaction.
- **A** 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 and 4
- 36 Which compound is not produced by an addition reaction of ethene?

37 What are the names of the reactions and compounds labelled in the reaction scheme?

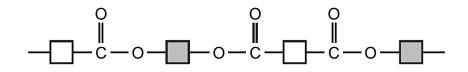


	1	2	3	4
Α	cracking	ethane	steam	methanoic acid
В	cracking	ethene	steam	ethanoic acid
С	substitution	ethane	oxygen	methanoic acid
D	substitution	ethene	oxygen	ethanoic acid

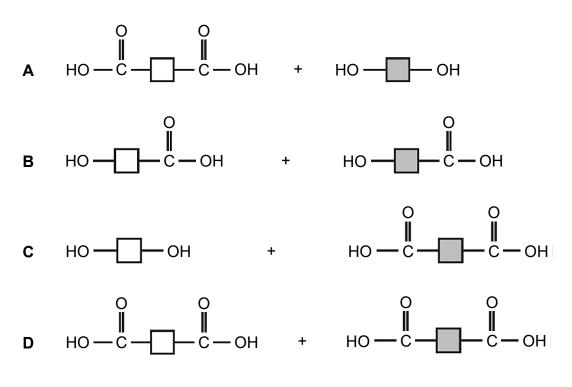
- 38 Which statement about carboxylic acids is correct?
 - A Ethanoic acid can be made by the fermentation of glucose.
 - **B** Propanoic acid can react with ethanoic acid to form an ester.
 - **C** Solutions of 1.0 mol/dm³ ethanoic acid and 1.0 mol/dm³ hydrochloric acid will react with magnesium at equal rates.
 - **D** The formula of butanoic acid is $CH_3CH_2CO_2H$.
- **39** In the addition polymer poly(propene), what is the simplest ratio of carbon atoms to hydrogen atoms?

	carbon atoms	hydrogen atoms
Α	1	2
В	2	1
С	2	4
D	3	6

40 The diagram shows the partial structure of a polymer.



From which pair of compounds is it made?



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Key							ы hydrogen 1										helium 4
proton (atomic) number	proton (atomic) number							_				5	9	7	8	6	10
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The Periodic Table of Elements

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

18



CHIJ KATONG CONVENT PRELIMINARY EXAMINATIONS 2022 Secondary Four Express

CHEMISTRY

6092/01 Duration: 1 hour

Classes: 405 and 406

Additional Material: Optical Answer Sheet.

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid/ tape. Write your name, class and index number in the spaces provided at the top of this page and

on the Optical Answer Sheet.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in the question booklet. A copy of the Periodic Table is printed on page 11.

At the end of the examination, hand in:

- 1. Optical Answer Sheet; and
- 2. Question booklet **separately**.

1 Hydrogen chloride gas (M_r = 36.5) is released at P in the apparatus shown.

The Universal Indicator paper turns red after 38 s.



The experiment is repeated under the same conditions using sulfur dioxide ($M_r = 64$).

Which shows the result for sulfur dioxide?

	Universal Indicator	time for Universal Indicator
	turns	to change colour/ s
Α	blue	26
В	blue	51
С	red	26
D	red	51

2 Substance M melts at –7.0 °C and is a brown liquid at room temperature.

At which temperature(s) will pure M boil?

- **A** –77.0 °C
- **B** –7.0 °C to 7.0 °C
- **C** 48.0 °C to 65.0 °C
- **D** 59.0 °C
- **3** A student is asked to measure the time taken for 0.4 g of magnesium carbonate to react completely with 20.0 cm³ of dilute hydrochloric acid.

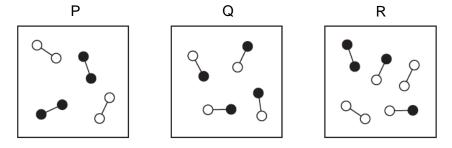
Which pieces of apparatus does the student need?

- A electronic balance, burette, stopwatch
- **B** electronic balance, pipette, stopwatch
- **C** electronic balance, stopwatch, thermometer
- D stopwatch, pipette, thermometer
- 4 $R_{\rm f}$ values are used to identify unknown substances using paper chromatography.

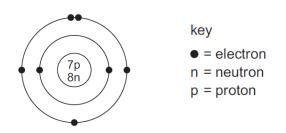
Which statements about R_f values are correct?

- 1 $R_{\rm f}$ values are always less than 1.0.
- 2 $R_{\rm f}$ value = distance travelled by solvent ÷ distance travelled by unknown substance.
- 3 The higher the $R_{\rm f}$ value, the further the unknown substance travels.
- 4 $R_{\rm f}$ values are not affected by the solubility of the unknown substance.
- A 1 and 2 only
- B 1 and 3 only
- **C** 2 and 3 only
- **D** 3 and 4 only

- 5 Which physical property is used to separate the nitrogen and oxygen from air?
 - A boiling point
 - **B** density
 - **C** electrical conductivity
 - D molecular mass
- 6 Which statement about P, Q and R is correct?



- A P contains two compounds and R contains a mixture.
- **B** P contains two elements and Q contains a mixture.
- **C** P contains two elements and Q contains one compound.
- **D** Q contains two compounds and R contains a mixture.
- 7 The structure of an atom is shown.



Which element is the atom an isotope of?

- A nitrogen
- B oxygen
- **C** phosphorus
- D titanium
- 8 Which row describes the structure of the positive ion in sodium chloride?

	protons	electrons	neutrons
Α	11	11	12
В	11	10	12
С	17	17	18
D	17	18	18

9 Which row describes what happens to the electrons when lithium and nitrogen atoms form ions?

	lithium atoms	nitrogen atoms	
Α	each lithium atom loses one electron to form a Li* ion	each nitrogen atom gains three electrons to form a N ³⁻ ion	
в	each lithium atom loses one electron to form a Li⁻ ion	each nitrogen atom loses three electrons to form a N ³⁺ ion	
С	each lithium atom gains one electron to form a Li* ion	each nitrogen atom gains five electrons to form a N ⁵⁻ ion	
D	each lithium atom gains one electron to form a Li⁻ ion	each nitrogen atom loses five electrons to form a N ⁵⁺ ion	

- 10 Which statement about metals is correct?
 - **A** Layers of positive ions can slide over one another making metals malleable.
 - B Metallic bonding consists of a lattice of negative ions in a sea of delocalised electrons.
 - **C** Metallic bonding consists of a lattice of positive ions in a sea of delocalised negative ions.
 - **D** Metals conduct electricity because positive ions are free to move.
- 11 Which statement is correct about the structures of both diamond and silicon(IV) oxide?
 - A Molecules of both diamond and silicon(IV) oxide are held together by weak intermolecular forces of attraction.
 - **B** The carbon in diamond and the silicon in silicon(IV) oxide each form four covalent bonds.
 - **C** They both contain atoms arranged in planes held together by weak intermolecular forces of attraction.
 - **D** They both contain ions that are free to move.
- 12 What is the total number of electrons in one molecule of ammonia, NH₃?
 - **A** 6
 - **B** 8
 - **C** 10
 - **D** 11
- **13** Four fertilisers are each supplied in 100 kg bags.

Which fertiliser supplies the greatest mass of nitrogen per 100 kg bag?

- A ammonium nitrate, NH₄NO₃
- **B** ammonium phosphate, (NH₄)₃PO₄
- **C** ammonium sulfate, (NH₄)₂SO₄
- D urea, CO(NH₂)₂
- 1 g of calcium carbonate is added to 50.0 cm³ of 0.050 mol / dm³ hydrochloric acid. The reaction is as shown.

$$CaCO_3 + 2HC/ \rightarrow CaCl_2 + H_2O + CO_2$$

Which volume of carbon dioxide is produced in this reaction?

- **A** 30 cm³
- **B** 60 cm³
- **C** 120 cm³
- **D** 240 cm³

15 A tablet contains 0.080 g of ascorbic acid (Mr = 176).

What is the concentration of ascorbic acid when one tablet is dissolved in 200 cm³ of water?

- A 0.0000909 mol / dm³
- **B** 0.000455 mol / dm³
- **C** 0.00227 mol / dm³
- **D** 0.0909 mol / dm³
- 16 Which statement about amphoteric oxides is correct?
 - A They are made by combining an acidic oxide with a basic oxide.
 - **B** They react with water to give a solution of pH 7.
 - **C** They react with both acids and bases.
 - **D** They do not react with acids or bases.
- 17 Ethanoic acid is a weak acid. Hydrochloric acid is a strong acid.
 - 1 Ethanoic acid molecules are partially dissociated into ions.
 - 2 1.0 mol / dm³ ethanoic acid has a higher pH than 1.0 mol / dm³ hydrochloric acid.
 - 3 Ethanoic acid is always more dilute than hydrochloric acid.
 - 4 Ethanoic acid does not produce hydrogen ions.

Which statements are correct?

- A 1 and 2 only
- **B** 1 and 3 only
- C 2 and 4 only
- D 3 and 4 only
- **18** When blue-green crystals of nickel(II) sulfate are heated, water is produced and a yellow solid remains. When water is added to the yellow solid, the blue-green colour returns.

Which process describes these changes?

- A combustion
- **B** corrosion
- **C** neutralisation
- **D** reversible reaction
- **19** Lead(II) sulfate is prepared by mixing two substances, X and Y. When the reaction is complete, the mixture is filtered.

Which row shows the best way to prepare pure lead(II) sulfate?

	substance X	substance Y	method after filtration
Α	aqueous lead(II) nitrate	aqueous sodium sulfate	crystallise the filtrate
В	aqueous lead(II) nitrate	aqueous sodium sulfate	wash and dry the residue
С	solid lead(II) carbonate	dilute sulfuric acid	crystallise the filtrate
D	solid lead(II) carbonate	dilute sulfuric acid	wash and dry the residue

20 The thermite reaction can be used to produce iron from iron(III) oxide. The equation for the reaction is shown.

$$2AI + Fe_2O_3 \rightarrow 2Fe + AI_2O_3$$

Which statements about this reaction are correct?

- 1 Aluminium is the oxidising agent.
- 2 Aluminium oxidises iron(III) oxide.
- 3 Electrons are transferred from aluminium to iron(III) ions.
- 4 Iron in iron(III) oxide is reduced.
- A 1 and 3 only
- **B** 1 and 4 only
- **C** 2 and 3 only
- **D** 3 and 4 only
- 21 Which pair of compounds shows that transition elements have variable oxidation states?
 - A Cr₂O₃ and CrBr₃
 - **B** CuSO₄ and CuC*l*₂
 - **C** Fe₂O₃ and FeC l_2
 - D NiO and NiCl₂
- 22 Which statement about the uses of metals is not correct?
 - A Aluminium is used in aircraft because of its strength and good electrical conductivity.
 - **B** Copper is used in electrical wiring because of its good electrical conductivity.
 - **C** Stainless steel resists corrosion and is used to make cutlery.
 - D Transition elements are often used as catalysts.
- 23 Heating copper(II) carbonate produces copper(II) oxide and carbon dioxide. Heating the copper(II) oxide with carbon produces copper.

Which processes are involved in the conversion of copper(II) carbonate to copper?

- A sublimation followed by oxidation
- B sublimation followed by reduction
- **C** thermal decomposition followed by oxidation
- D thermal decomposition followed by reduction
- 24 Which statement about the hydrogen fuel cell is not correct?
 - A Chemical energy is converted into electrical energy.
 - **B** Hydrogen is oxidised.
 - **C** Reaction only involves bond formation.
 - **D** Water is the only product.
- 25 Which statement about the electrolysis of copper(II) sulfate solution using carbon electrodes is correct?
 - A colourless gas is produced at the anode.
 - **B** A colourless gas is produced at the cathode.
 - **C** The colour of the electrolyte remains the same.
 - **D** The mass of both electrodes remains constant.

26 Elements in Group I of the Periodic Table react with water.

Which row describes the products formed in the reaction and the trend in reactivity of the elements?

	products	trend in reactivity
Α	metal hydroxide and hydrogen	less reactive down the group
В	metal hydroxide and hydrogen	more reactive down the group
С	metal oxide and hydrogen	less reactive down the group
D	metal oxide and hydrogen	more reactive down the group

27 An inert gas E is used to fill weather balloons.

Which descriptions of E are correct?

	number of valence electrons in an atom of E	structure of gas E
Α	2	diatomic molecules
В	2	monatomic atoms
С	8	diatomic molecules
D	8	monatomic atoms

28 Nitrogen reacts with hydrogen to produce ammonia.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

The reaction is exothermic. The bond energies are shown in the table.

bond	bond energy in kJ / mol
N≡N	945
H–H	436
N–H	390

Which shows the overall energy change for this reaction?

- A –959 kJ / mol
- **B** –87 kJ / mol
- **C** 87 kJ / mol
- D 959 kJ / mol

29 Which statements about endothermic reactions are correct?

- 1 The energy of the products is greater than the energy of the reactants.
- 2 The energy of the reactants is greater than the energy of the products.
- 3 The temperature of the surroundings increases during the reaction.
- 4 The temperature of the surroundings decreases during the reaction.
- A 1 and 3 only
- **B** 1 and 4 only
- C 2 and 3 only
- D 2 and 4 only

- **30** Which change in reaction conditions increases both the collision frequency and the proportion of molecules with sufficient energy to react?
 - **A** addition of a catalyst
 - **B** increasing the concentration of a reactants
 - **C** increasing the surface area of a reactants
 - **D** increasing the temperature of the reactants
- **31** The rate of reaction between magnesium ribbon and 2 mol / dm³ hydrochloric acid at 25 °C to produce hydrogen gas is measured.

In another experiment, either the concentration or the temperature of hydrochloric acid is changed. All other conditions are kept the same.

Which conditions would increase the rate of reaction?

- A 1 mol / dm³ hydrochloric acid at 25 °C
- **B** 2 mol / dm³ hydrochloric acid at 10 °C
- C 2 mol / dm³ hydrochloric acid at 20 °C
- **D** 3 mol / dm³ hydrochloric acid at 25 °C
- 32 Which statements about the Haber process are correct?
 - 1 An increase in pressure increases the speed of reaction.
 - 2 An iron catalyst is used to increase the yield of ammonia.
 - 3 A higher temperature of 450 °C is used to decrease the yield of ammonia.
 - 4 A relatively low pressure of 250 atm is used because it is costly to maintain a high pressure.
 - A 1 and 4 only
 - **B** 1, 3 and 4 only
 - C 2 and 3 only
 - **D** 1, 2, 3 and 4
- **33** Oxides of nitrogen are formed in car engines and are a source of air pollution. To decrease this pollution, catalytic converters are fitted to car exhausts.

What happens to the oxides of nitrogen in the catalytic converter?

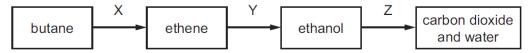
- A combustion
- **B** cracking
- C oxidation
- **D** reduction
- 34 Which statement/s about sulfur dioxide pollution is/ are correct?
 - 1 It increases the pH of rivers.
 - 2 It damages limestone buildings.
 - 3 It causes respiratory problems.
 - A 1 only
 - B 2 only
 - C 1 and 3 only
 - D 2 and 3 only

- 35 Which chemical equation shows a correct reaction of methane?
 - $\textbf{A} \quad CH_4 + CI_2 \rightarrow CH_3CI + HCI$
 - $\mathbf{B} \quad \mathrm{CH}_4 + \mathrm{C}_2 \to \mathrm{CH}_4\mathrm{C}_2$
 - $\textbf{C} \quad CH_4 + C\mathit{I}_2 \rightarrow CH_2C\mathit{I}_2 + H_2$
- 36 Which two compounds are molecules containing a double bond?
 - A ethane and ethanoic acid
 - B ethane and ethanol
 - **C** ethene and ethanoic acid
 - **D** ethene and ethanol
- **37** Ethanol can be formed using the two following methods.
 - 1 fermentation
 - 2 reaction between ethene and steam

Which row correctly shows the condition for the two methods?

	1	2
Α	uses a catalyst	uses a catalyst
В	uses a catalyst	does not use a catalyst
С	does not use a catalyst	uses a catalyst
D	does not use a catalyst	does not use a catalyst

38 The diagram shows a reaction sequence.

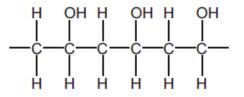


Which row shows the processes X, Y and Z?

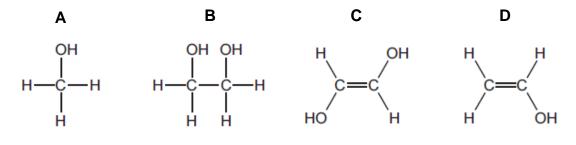
	Х	Y	Z
Α	cracking	fermentation	respiration
В	cracking	hydration	combustion
С	distillation	fermentation	respiration
D	distillation	hydration	combustion

- 39 Which reaction can be used to make ethanoic acid?
 - A oxidation of ethanol
 - B oxidation of ethene
 - C reduction of ethanol
 - **D** reduction of ethene

40 The structure of an addition polymer is shown.



Which monomer is used to make this?



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The Periodic Table of Elements

11

The volume of one mole of any gas is $24\,\text{dm}^3$ at room temperature and pressure (r.t.p.).



LOYANG VIEW SECONDARY SCHOOL

Preliminary Examination 2022 Secondary Four Express

CANDIDATE NAME	:		
CLASS	:	INDEX NUMBER	:

CHEMISTRY

Paper 1 Multiple Choice

6092/01

12 September 2022

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid. Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are forty questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

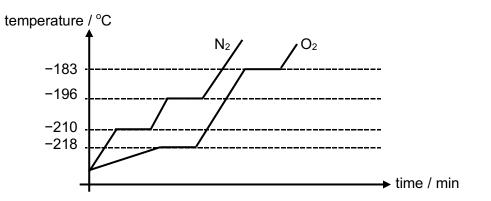
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet. A copy of the Periodic Table is printed on page 17. The use of an approved scientific calculator is expected, where appropriate.

Setter: Ms Imma Wong

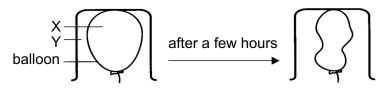
- 1 Which group of substances consists of mixtures only?
 - A air, petroleum and steel
 - **B** nylon, glucose and ethanol
 - C limestone, seawater and ozone
 - D haematite, brass and sodium chloride
- 2 The graph (not drawn to scale) shows how the temperature of oxygen and nitrogen changes when they are heated.



At which temperature will there be two different states of matter in a mixture of oxygen and nitrogen under similar conditions?

A -180 °C **B** -200 °C **C** -215 °C **D** -220 °C

3 A balloon filled with gas X is placed inside a beaker that is filled with gas Y as shown. The balloon shrinks in size after a few hours.



Which could be the identities of gases X and Y?

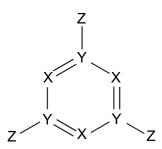
	X	Y
Α	nitrogen	ammonia
В	ammonia	argon
С	argon	oxygen
D	oxygen	nitrogen

4 An element J has a nucleon number of 45. The ion, J^{3+} , contains 18 electrons.

How many neutrons are there in an atom of J?

A 18 **B** 21 **C** 24 **D** 45

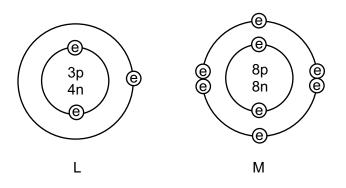
- **5** Which statement describes the arrangement and movement of particles of sodium hydroxide in water?
 - A lons are closely packed and does not move.
 - **B** lons are widely spaced and move randomly.
 - **C** Molecules are widely spaced and move randomly.
 - D Molecules are closely packed and move randomly.
- 6 A stable molecule containing atoms of elements X, Y and Z has the structure shown.



What could elements X, Y and Z be?

	Х	Y	Z
Α	carbon	sulfur	hydrogen
В	nitrogen	silicon	sulfur
С	nitrogen	silicon	hydrogen
D	silicon	sulfur	chlorine

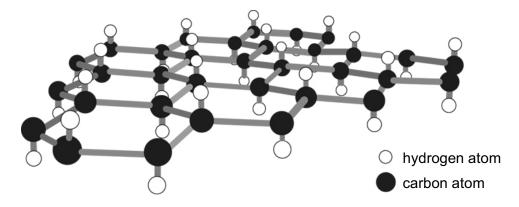
- 4
- 7 The structures of atoms of elements L and M are shown.



What is the mass of 1 mole of the compound formed by L and M?

Α	11 g	В	12 g	С	23 g	D	30 g
		_	·- 9	•		_	<u> </u>

8 Graphane, an allotrope of carbon has a similar structure to graphite, except that it has one hydrogen atom attached to each carbon as shown in the diagram.



Which of the properties listed below are properties of graphane?

- 1 It has a giant molecular structure.
- 2 It has a high melting point.
- 3 It is 'slippery' in nature.
- 4 It conducts electricity in the solid state.
- **A** 1, 2 and 3
- **B** 1, 2 and 4
- **C** 1, 3 and 4
- **D** 2, 3 and 4

9 Naphthalene is the main ingredient of mothballs. It contains 93.75 % of carbon and 6.25 % of hydrogen.

If the relative molecular mass of naphthalene is 128, what is its molecular formula?

[relative atomic masses, A_r : H, 1; C, 12]

A CH **B** C_5H_4 **C** $C_{10}H_8$ **D** $C_{10}H_{10}$

10 A pure hydrocarbon is used to heat homes.

When 10 cm³ of the hydrocarbon is burned in 70 cm³ of oxygen, the final gaseous mixture contains 30 cm³ of carbon dioxide and 20 cm³ of unreacted oxygen. All gaseous volumes are measured under identical conditions.

What is the chemical formula of the hydrocarbon?

[relative atomic masses, A_r : H, 1; C, 12; O, 16]

 $\label{eq:constraint} \textbf{A} \quad C_2H_6 \qquad \qquad \textbf{B} \quad C_3H_6 \qquad \qquad \textbf{C} \quad C_3H_8 \qquad \qquad \textbf{D} \quad C_4H_{10}$

11 The equation for the reduction of iron ore in the blast furnace is shown.

 $Fe_2O_3 \ \text{+} \ 3CO \ \rightarrow \ 2Fe \ \text{+} \ 3CO_2$

When 90 tonnes of the iron ore were reduced, 56 tonnes of molten iron were produced.

What is the percentage purity of the iron ore used?

[relative atomic masses, A_r : C, 12; O, 16; Fe, 56]

A 11.1 % **B** 42.2 % **C** 56.3 % **D** 88.9 %

12 What is the ionic equation for the reaction between sodium carbonate and sulfuric acid?

$$\mathbf{A} \quad \mathbf{H}^+ + \mathbf{O}\mathbf{H}^- \to \mathbf{H}_2\mathbf{O}$$

- $\textbf{B} \quad 2Na^{\scriptscriptstyle +} + SO_4{}^{2-} \rightarrow Na_2SO_4$
- $\mathbf{C} \quad \mathrm{CO_3}^{2^-} + 2\mathrm{H}^+ \to \mathrm{CO_2} + \mathrm{H_2O}$
- $\mathbf{D} \quad 2CO_3^{2-} + 2H^+ \rightarrow 2CO_2 + H_2O$

рН	colour
0 – 3.5	red
3.5 – 5	green
5 - 14	purple

13 The colour changes of a recently discovered indicator is shown in the table.

Which pair of substances could be distinguished by the new indicator?

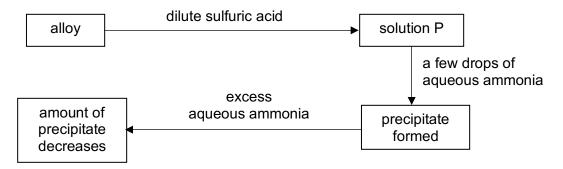
- A hydrochloric acid and ethanoic acid
- B aqueous sodium chloride and water
- C aqueous ammonia and aqueous sodium hydroxide
- **D** aqueous potassium nitrate and aqueous potassium hydroxide
- 14 Which statement about oxides is true?
 - A Nitrogen dioxide is a neutral oxide.
 - **B** Zinc oxide dissolves readily in water to form an alkaline solution.
 - **C** Copper(II) oxide reacts with dilute sulfuric acid to give a blue solution.
 - **D** Carbon monoxide reacts with aqueous sodium hydroxide to form a salt and water.
- **15** A student recorded the following observations when he mixed two substances:

"no effervescence, solution changes colour, no precipitate forms"

Which two substances could have been used?

- A dilute nitric acid and lead(II) carbonate
- B dilute hydrochloric acid and iron(II) oxide
- C aqueous sodium hydroxide and dilute sulfuric acid
- **D** aqueous potassium chloride and aqueous silver nitrate

16 A sample of an alloy containing two metals was subjected to the following tests.



What are the two metals present in the alloy?

- A iron and zinc
- B iron and lead
- **C** iron and copper
- D copper and zinc
- 17 Which salts are best prepared by adding excess acid to an insoluble base?
 - A magnesium chloride, zinc sulfate, lead(II) nitrate
 - **B** sodium chloride, copper(II) nitrate, calcium sulfate
 - **C** copper(II) carbonate, barium sulfate, silver chloride
 - D sodium chloride, ammonium nitrate, potassium sulfate
- **18** Hydrogen peroxide was added to separate test tubes containing aqueous potassium iodide and aqueous acidified potassium manganate(VII). The iodide ions were oxidised and the manganate(VII) ions are reduced.

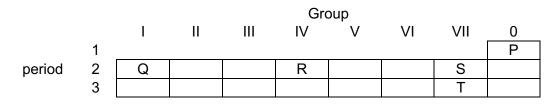
What are the colour changes seen?

	potassium iodide	acidified potassium manganate(VII)
Α	brown to colourless	purple to colourless
В	brown to colourless	colourless to purple
С	colourless to brown	purple to colourless
D	colourless to brown	colourless to purple

19 A mineral, Jarosite, has the molecular formula KFe₃(OH)₆(SO₄)₂.

What is the oxidation state of iron in Jarosite?

- **A** +2 **B** -2 **C** +3 **D** -3
- **20** A part of the Periodic Table is shown below. P, Q, R, S and T do not represent the actual symbols of the elements.



Which statement is correct?

- **A** T is a strong oxidising agent.
- **B** R forms an ionic compound with S.
- C P has eight electrons in its outermost shell.
- **D** The metallic character of the elements in period 2 increases from Q to S.
- **21** Rubidium, Rb, is an element in the same group of the Periodic Table as lithium, sodium and potassium.

Which statement about rubidium is correct?

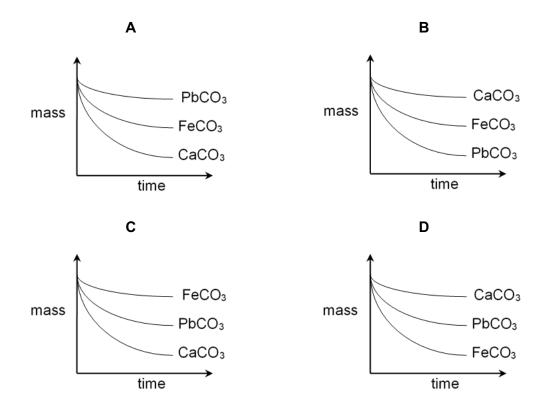
- **A** It forms an insoluble hydroxide.
- **B** Its melting point is lower than lithium.
- **C** It reacts slowly with water at room temperature.
- **D** It can be produced during the electrolysis of aqueous rubidium chloride.

22 Excess zinc is added into a solution containing magnesium nitrate and copper(II) chloride. After the reaction, the mixture is filtered.

Which cations would be present in the filtrate?

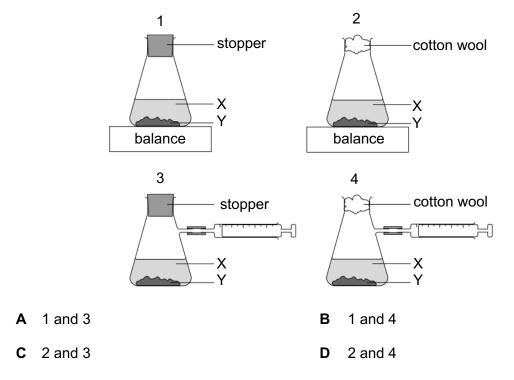
- 1 Cu²⁺
- 2 Mg²⁺
- 3 Zn²⁺
- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- **D** 1, 2 and 3
- **23** Equal masses of three different metal carbonates were placed in separate open crucibles and heated for two minutes.

Which graph shows what happens to the mass of the crucible and its contents?



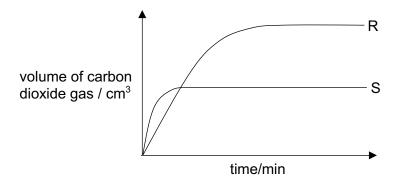
24 A liquid X reacts with solid Y to form a gas.

Which two diagrams show suitable methods for investigating the speed of the reaction?



25 A student investigates the rate of reaction between copper(II) carbonate and excess nitric acid. The volume of carbon dioxide gas given off in the reaction is measured over time.

The graph shows the results of two experiments, R and S.



Which change in conditions would cause the difference between R and S?

- A catalyst is added in S only.
- **B** The temperature of the solution in R is lower than in S.
- **C** Half the volume of a more concentrated nitric acid is used in S than in R.
- **D** Twice the mass of less finely powdered copper(II) carbonate used in R than in S.

26 A reaction takes place in two stages:

Stage 1 S₂O₈²⁻(aq) + 2I⁻(aq) + 2Fe²⁺(aq) → 2SO₄²⁻(aq) + 2I⁻(aq) + 2Fe³⁺(aq) Stage 2 2SO₄²⁻(aq) + 2I⁻(aq) + 2Fe³⁺(aq) → 2SO₄²⁻(aq) + I₂(aq) + 2Fe²⁺(aq)

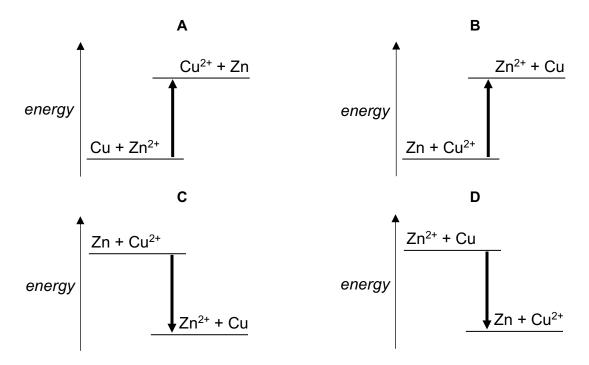
Which ion is the catalyst in the reaction?

A Fe^{2+} **B** Fe^{3+} **C** I^- **D** SO_4^{2-}

- 27 Which statements about the Haber process are correct?
 - 1 The catalyst used is a transition metal.
 - 2 Unreacted nitrogen and hydrogen are circulated back into the system.
 - 3 Both reactants are obtained from the fractional distillation of liquefied air.
 - 4 The reaction is reversible and the yield achieved is only about 10 15%.
 - A
 1 and 2 only
 B
 2 and 4 only

 C
 1, 2 and 4 only
 D
 1, 3 and 4 only
- 28 The reaction between zinc and aqueous copper(II) nitrate is exothermic.

Which energy level diagram represents the reaction?



	electrode	electrolyte	product at the anode	product at the cathode
Α	carbon	concentrated hydrochloric acid	chlorine	hydrogen
В	carbon	concentrated sulfuric acid	sulfur	hydrogen
С	copper	aqueous copper(II) sulfate	oxygen	copper
D	platinum	aqueous copper(II) sulfate	hydrogen	copper

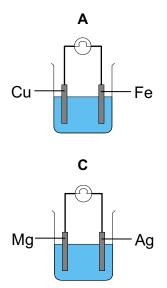
29 Which combination of electrode, electrolyte and products are correct?

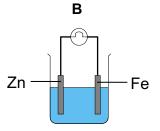
30 During the electrolysis of an aqueous solution of a cerium salt, 70 g of cerium is deposited at the cathode by 2 moles of electrons.

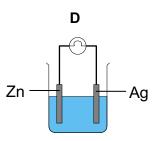
What is the formula of the cerium ion? [relative atomic mass, A_r : Ce, 140]

Α	Ce⁺	В	Ce ²⁺	С	Ce ³⁺	D	Ce ⁴⁺
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31 In which cell will the light bulb be the dimmest?







32 Waste gases from a coal-burning power station are passed through powdered calcium carbonate to reduce atmospheric pollution.

Which waste gas will not be removed by the powdered calcium carbonate?

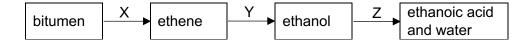
- A carbon dioxide
- **C** phosphorus(V) oxide

- B carbon monoxide
- D sulfur dioxide
- **33** Four environmental problems are listed.
 - 1 acid rain
 - 2 depletion of the ozone layer
 - 3 presence of greenhouse gases
 - 4 incomplete combustion of carbon compounds

Which atmospheric pollutant is responsible for each problem?

	1	1 2 3				
Α	chlorofluorocarbons	sulfur dioxide	carbon dioxide	carbon monoxide		
В	carbon dioxide	carbon monoxide	sulfur dioxide	chlorofluorocarbons		
С	sulfur dioxide	carbon dioxide	chlorofluorocarbons	carbon monoxide		
D	sulfur dioxide	chlorofluorocarbons	carbon dioxide	carbon monoxide		

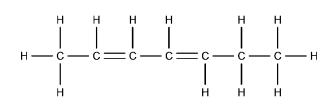
34 The diagram below shows a reaction sequence.



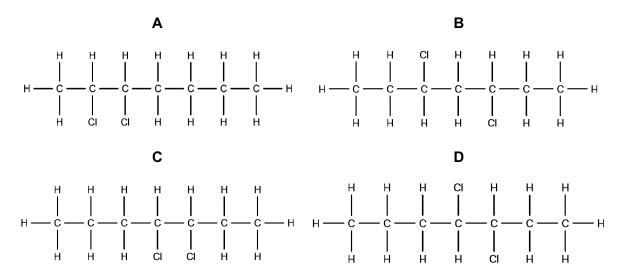
Which processes describe the above reactions?

	X	Y	Z
Α	cracking	fermentation	combustion
В	cracking	hydration	oxidation
С	distillation	fermentation	oxidation
D	distillation	hydration	combustion

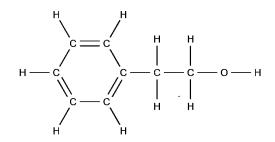
35 The hydrocarbon shown is heated with hydrogen chloride gas under catalysed conditions.



What compound could be formed during the reaction?



36 One substance responsible for the fragrance of roses is 2-phenylethanol. The structure of the molecule is shown below.



Which statement about this molecule is incorrect?

- A It is an unsaturated molecule.
- **B** It can decolourise aqueous bromine at room temperature.
- **C** It can undergo condensation polymerisation to form a polyester.
- **D** It can be oxidised by acidified potassium manganate(VII) solution.

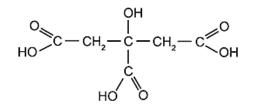
37 Propanal is a member of a homologous series called the alkanals. The chemical formula of propanal is CH₃CH₂CHO.

What is the general formula of alkanals?

- A C_nH_{3n}CO
- $C C_n H_{2n+1} CHO$

B $C_nH_{2n}CHO$ **D** $C_nH_{2n+1}CH_2OH$

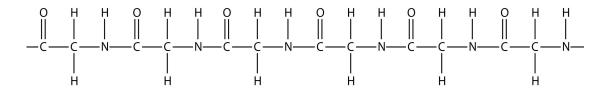
- **38** The structure of citric acid is shown.



How many moles of sodium hydroxide is needed to neutralise one mole of citric acid?



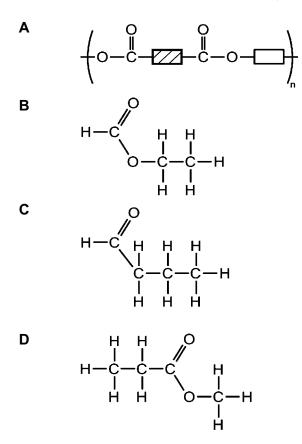
39 A section of a polymer is shown.



Which statement explains why this polymer should not be disposed by burning?

- A It produces pollutants that can form acid rain.
- **B** The polymer does not burn well even at high temperature.
- **C** It is highly flammable and may cause an explosion during burning.
- **D** It produces pollutants such as carbon dioxide and carbon monoxide.

40 Which compound cannot be prepared by reacting a carboxylic acid and an alcohol?



	0	4 He Helium	10 Ne 20	18 Ar 40	36	ypton 2	04 24	t A	enon 131	86	Rn	adon -				71	Lu	Iutetium 175	103	-
		Ĕ		17 Cl Shlorine a														ytterbium lut 173		
		-		16 S sulfur 32 32		<u> </u>							116	Lv	1			thulium ytte 169 1		
	>	-		15 P hosphorus 31			_			-			-	live				erbium th		
	≥	-		28 silicon ph		_	_			-			-	F/ flerovium	I			holmium 165		
	=	-	5 Boron 11	13 A <i>l</i> aluminium 27	31	gallium g		r u	115	81	Τl	thallium 204						dysprosium 163		
3				I	30	Zn zinc	60 Q	e o	cadmium 112	80	Нa	mercury 201	112	Cn conernicium	I			terbium 159		
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	5				27	Co cobalt	AC AF	f F	rhodium 103	22	L	iridium 192	109	Mt meitnerium	I	62	Sm	samarium 150	94	Ċ
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		Key	proton (atomic) numbe atomic symbol name relative atomic mass		23	V vanadium	5	+ qN	niobium 93	73	Та	tantalum 181	105	D b dubnium	I	1	С С	0		Ē
			proton ato relati			Ti titanium						hafnium 178		Rut	I	57	La	lanthanum 139	89	
				-		Sc scandium					_		89 – 103							
	=		4 Be beryllium 9	12 Mg magnesium 24	20	calcium Ca	940	ა გ	strontium 88	56	Ba	barium 137	88	Ra	I	anthanoids			actinoids	
	_		3 Li 7	11 Na ^{sodium} 23										Ε		<u></u>	-			

The Periodic Table of Elements

66 67 Dy Ho dysprosium holmium 163 165 98 99 Cf Es californium einsteinium Tb terbium 159 97 BK berkelium -Gd 157 157 96 Cm curium Eu europium 152 95 Am americium The volume of one mole of any gas is $24 \, \text{dm}^3$ at room temperature and pressure (r.t.p.). n Promethium Samarium 6 n promethium Samarium 6 150 93 94 Np Pu neptunium ai Nd 144 92 92 uranium 138 Pr praseodymium 141 91 Pa protactinium 231 Ce cerium 140 90 Th Th 232 La lanthanum 139 89 89 Ac actinium

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 Class:



MONTFORT SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2022

Secondary 4 Express

CHEMISTRY	6092/01
Paper 1	19 Aug 2022 (Fri)
	1 hour

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in. Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs, tables or rough working. Do not use staples, paper clips, glue or correction fluid.

There are **forty** questions in this section. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in soft pencil on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

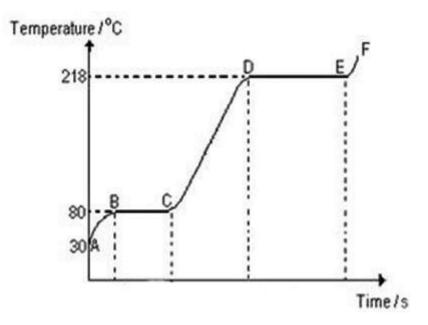
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 18.

The use of an approved scientific calculator is expected, where appropriate.

1 The graph shows how the temperature changes when naphthalene is heated gently until it melts.



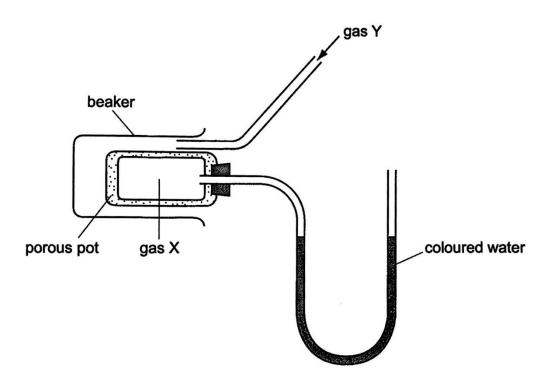
In which section of the curve is the heat energy that is absorbed not heating up the naphthalene?

- A AB
- **B** AB and BC
- C BC and DE
- D EF
- 2 A salt, Q, on warming with excess aqueous sodium hydroxide, evolved a gas that turned damp red litmus paper blue. When no more gas was evolved, aluminium powder was added and a further evolution of the same gas occurred.

What was salt Q?

- **A** (NH₄)₂CO₃
- B NH₄Cl
- C NH₄NO₃
- **D** (NH₄)₂SO₄

3 The apparatus can be used to show the diffusion of gases.

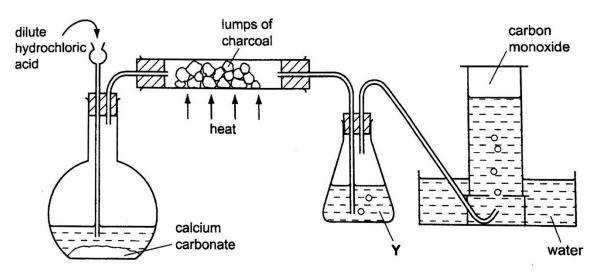


Which pair of gases X and Y would cause **no** movement of water?

	Х	Y		
Α	ethene	ethane		
В	ethene	nitrogen		
С	carbon dioxide	ethane		
D	carbon monoxide	nitrogen dioxide		

- 4 Which of the following is a pure compound?
 - A ethene
 - B kerosene
 - **C** brass
 - **D** dilute sulfuric acid

5 The diagram shows apparatus used to obtain carbon monoxide.



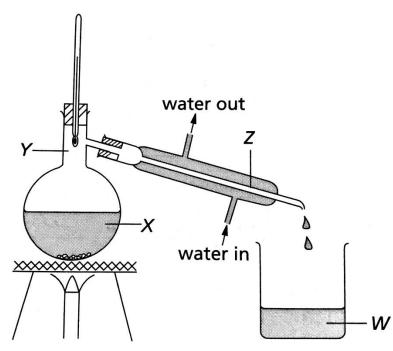
What is the main purpose of Y?

- A to dry the gas
- **B** to remove hydrogen chloride from the gas
- **C** to remove carbon dioxide from the gas
- **D** to prevent water from being sucked back onto the hot carbon
- 6 An ion is discharged at the cathode during the electrolysis of a molten salt containing the ion.

What could describe this ion?

	proton number	electronic configuration
Α	11	2.8
В	12	2.8.2
С	16	2.8.8
D	17	2.8.8

7 The diagram shows the apparatus used to obtain water from a solution of copper (II) sulfate.



Which statement about the separation is true?

- A The temperature at Y is 100 °C at first then steadily rises as liquid *W* is collected.
- **B** Liquid *W* changes from colourless to blue.
- **C** Liquid *X* gets darker blue in colour.
- **D** The temperature at Z will be greater than 100 °C.
- **8** Which statement explains why sodium chloride has a lower melting point than magnesium oxide?
 - A Sodium chloride is covalent but magnesium oxide is ionic.
 - **B** Sodium is more reactive than magnesium.
 - **C** The melting point of sodium is lower that that of magnesium.
 - **D** The attraction between Na⁺ and Cl⁻ is weaker than that between Mg²⁺ and O²⁻.

- 9 Four covalent compounds are given below.
 - 1 water
 - 2 carbon dioxide
 - 3 methanol
 - 4 ethanoic acid

In which pair of molecules does oxygen form at least one double bond in both molecules?

- **A** 1 and 2
- **B** 1 and 3
- **C** 2 and 4
- **D** 3 and 4
- 10 Which bonding does **not** correspond to its description of physical properties?

	bonding type	physical property
Α	giant covalent	high melting point, conducts electricity when in solution but not when solid
В	simple covalent	low melting point, does not conduct electricity in any state
С	metallic	variety of melting points, conducts electricity when solid and when molten
D	ionic	high melting point, conducts electricity when molten but not when solid

11 The fertiliser ammonium nitrate is manufactured from ammonia by a two-stage process:

Stage 1: ammonia + oxygen \rightarrow nitric acid + water

Stage 2: nitric acid + ammonia \rightarrow ammonium nitrate

What is the maximum mass of fertiliser that can be made if only 8.5 tonnes of ammonia is available.

A 16 tonnes B 20 tonnes C 38 tonnes D 97 tonnes

12 A 0.2 mol/dm³ aqueous solution of phosphoric (V) acid is mixed with a 0.2 mol/dm³ aqueous solution of sodium hydroxide.

Which mixture will form the salt Na₃PO₄ only?

	volume of 0.2 mol/dm ³ phosphoric (V) acid	volume of 0.2 mol/dm ³ sodium hydroxide		
Α	5 cm ³	5 cm ³		
В	5 cm ³	15 cm ³		
С	15 cm ³	5 cm ³		
D	20 cm ³	10 cm ³		

13 Ammonia gas decomposes naturally to form two other gases.

What is the total volume of gases formed if all 100 cm³ of a sample of ammonia was decomposed at room temperature and pressure?

- **A** 25 cm³
- **B** 100 cm³
- **C** 200 cm³
- **D** 400 cm³
- 14 An excess of dilute sulfuric acid reacts with both aqueous barium hydroxide and aqueous barium chloride. In what way are the two reactions the same?
 - **A** A gas is produced.
 - **B** An insoluble salt is produced.
 - **C** The final pH is 7.
 - **D** Water is produced.
- **15** What could be the possible pH values for the following aqueous solutions all of which have the same concentration?

	potassium chloride	nitric acid	ammonia	methanoic acid
Α	6	8	13	1
В	7	4	10	1
С	8	4	11	5
D	7	1	10	4

- 16 Which solution will form a yellow precipitate with aqueous silver nitrate?
 - A ammonium chloride
 - **B** copper (II) nitrate
 - **C** potassium iodide
 - **D** sodium carbonate
- **17** *Disproportionation* is a reaction in which the same element is both oxidised and reduced.

Which reaction is an example of disproportionation?

- A $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$
- **B** $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$
- **C** Fe₂(SO₄)₃ + 2KI \rightarrow 2FeSO₄ + K₂SO₄ + I₂
- **D** $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$
- 18 Which substance **cannot** reduce iron (III) oxide to iron?
 - A coke B hydrogen C magnesium D limestone
- **19** The thermal stability of metal nitrates is related to the position of the metal in the reactivity series in the same way as carbonates.

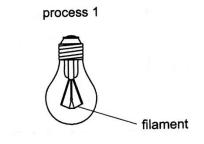
Which metal nitrate, on heating, will decompose to form the metal?

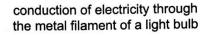
- A zinc nitrate
- **B** silver nitrate
- **C** potassium nitrate
- **D** calcium nitrate

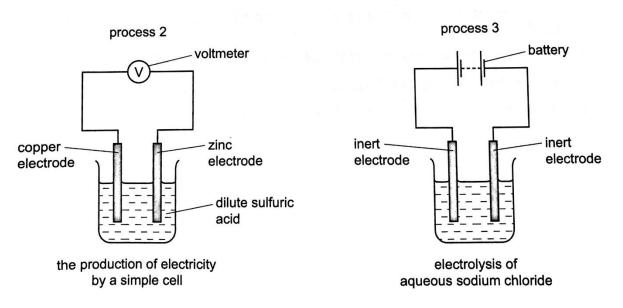
20 Most aluminium cans are made from recycled aluminium.

Why are some aluminium cans still made from aluminium extracted from its ore?

- A Aluminium ore produces better quality aluminium.
- **B** Demand is not met by the recycling of aluminium alone.
- **C** Extraction from the ore uses electricity and is expensive.
- **D** There are only a limited number of times that aluminium can be recycled.
- **21** Processes 1, 2 and 3 each involve the movement of charged particles.







Which processes involve the movement of electrons?

- A process 1 only
- B process 2 only
- **C** processes 1 and 2
- **D** processes 1, 2 and 3

22 A molten chloride of a Group I metal, XCl, and a molten chloride of a Group II metal, YCl₂ are separately electrolysed using the same current for the same time.

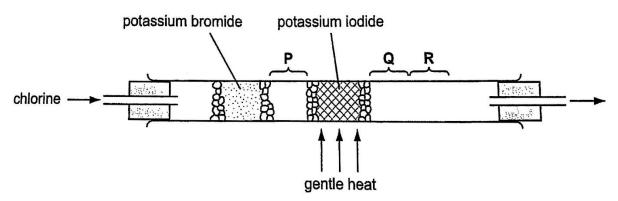
Which statement about this experiment is correct?

- A An equal number of moles of X and Y are deposited.
- **B** Equal masses of X and Y are deposited.
- **C** The number of moles of Y deposited is half the number of moles of X deposited.
- **D** YCl₂ gives off twice the volume of chlorine gas as XCl, measured under the same conditions of temperature and pressure.
- **23** Which statement describes what happens when hydrogen and oxygen are used in a fuel cell?
 - A Electricity is generated directly.
 - **B** Electricity is used to produce water.
 - **C** Hydrogen is burned to form steam.
 - **D** Hydrogen reacts to form a hydrocarbon fuel.
- 24 Many properties of an element and its compounds can be predicted from the position of the element in the Periodic Table.

What property could **not** be predicted in this way?

- A the acidic or basic nature of its oxide
- **B** the charge on its ion
- **C** the formula of its oxide
- **D** the number of isotopes it has

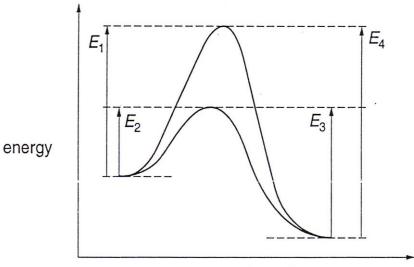
25 Using the apparatus shown, chlorine is passed through the tube. After a short time, coloured substances are seen at **P**, **Q** and **R**.



What are these coloured substances?

	at P	at Q	at R
Α	green gas	violet vapour	black solid
В	green gas	red brown vapour	violet vapour
С	red brown vapour	violet vapour	black solid
D	violet vapour	red brown vapour	red brown vapour

26 The energy diagram represents the reaction occurring with and without a catalyst.



progress of reaction

Which statement is correct?

- **A** E₄ is the activation energy for the reverse catalysed reaction.
- **B** The forward reaction, with catalyst, is endothermic.
- **C** The enthalpy change of reaction is $(E_2 E_3)$.
- **D** The enthalpy change of reaction is reduced by using a catalyst.

27 An equation for respiration is shown.

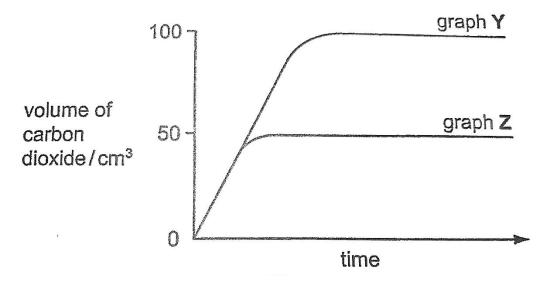
 $C_6H_{12}O_6(s) + 6O_2(g) \longrightarrow 6H_2O(g) + 6CO_2(g) \quad \Delta H = -2830 \text{ kJ/mol}$ What can be deduced from the equation?

- **A** ΔH for photosynthesis is +2830 kJ/mol.
- **B** Energy from sunlight is needed for this reaction.
- **C** Respiration is carried out by animals.
- **D** The equation shows the reaction between one volume of glucose and six volumes of oxygen to produce six volumes of carbon dioxide and six volumes of water.
- **28** Some crystals of sodium carbonate were added to an excess of sulfuric acid at room temperature.

The volume of carbon dioxide produced was measured over a period of time.

The results are shown in graph Y.

The experiment was repeated and graph Z was obtained.



Which one change was used to obtain the results shown in graph Z?

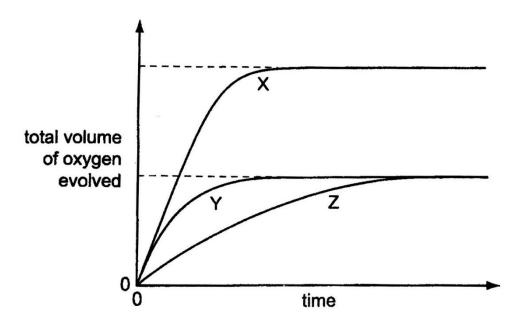
- A Acid of half the concentration was used.
- **B** A lower temperature was used.
- **C** Half the amount of sodium carbonate was used.
- **D** Larger crystals of sodium carbonate were used.

29 Hydrogen peroxide solution is catalytically decomposed by manganese (IV) oxide.

 $2H_2O_2 \rightarrow 2H_2O + O_2$

To study the effect of concentration of the solutions on the rate of reaction, the total volume of oxygen evolved was recorded against time. Three experiments were performing using a fixed mass of catalyst but with

- (i) 50 cm³ of 2.0 mol/dm³ hydrogen peroxide
- (ii) 100 cm³ of 1.0 mol/dm³ hydrogen peroxide
- (iii) 100 cm³ of 2.0 mol/dm³ hydrogen peroxide.



On the graph above, which of the curves, X, Y and Z relate to the solutions in (i), (ii) and (iii)?

	(i)	(ii)	(iii)
Α	Х	Y	Z
В	Х	Z	Y
С	Z	Х	Y
D	Y	Z	Х

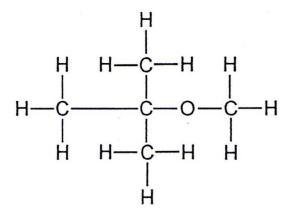
- 30 Ammonia is manufactured by the Haber process, using an iron catalyst.It is not possible to obtain 100 % yield.What is the reason for this?
 - **A** A high pressure is used.
 - **B** Nitrogen is unreactive.
 - **C** The iron catalyst is poisoned by ammonia.
 - **D** The reaction is reversible.
- 31 Nitrogen dioxide and sulfur dioxide have some properties in common.Which property is shown by one of these compounds, but not by the other?
 - A forms 'acid rain'
 - B reacts with litmus
 - **C** is soluble in water
 - D is colourless
- **32** A catalytic converter in a car exhaust system changes pollutants into less harmful products.

Which change does not occur in a catalytic converter?

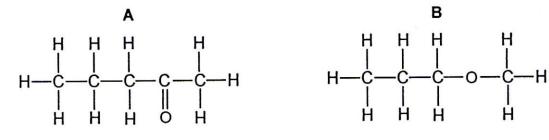
- A carbon dioxide \rightarrow carbon
- **B** carbon monoxide \rightarrow carbon dioxide
- **C** nitrogen oxides \rightarrow nitrogen
- **D** unburnt hydrocarbons \rightarrow carbon dioxide and water
- **33** Which physical property of the alkanes does **not** increase as relative molecular mass increases?
 - **A** boiling point
 - B flammability
 - **C** melting point
 - D viscosity

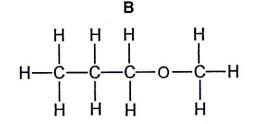
34 Methyl tertiary-butyl ether (MTBE) is used medically to treat gallstones.

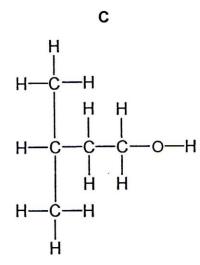
The structural formula of MTBE is shown.

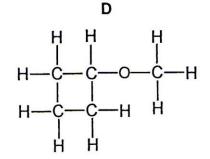


Which compound is an isomer of methyl tertiary-butyl ether?









- 35 Which pair of organic compounds can be distinguished in a chemical test by using acidified potassium manganate (VII)?
 - Α C₂H₆, C₃H₈
 - В $C_{3}H_{8}, C_{4}H_{8}$
 - С C₂H₅OH, CH₃COOH
 - D $C_8H_{18}, C_{10}H_{22}$

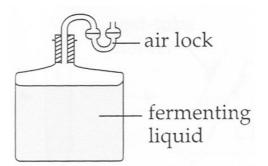
36 A vegetable oil is polyunsaturated.

Which statement about this vegetable oil is correct?

- A It has double bonds between carbon and hydrogen atoms.
- **B** It reacts with hydrogen to form a solid compound.
- **C** It reacts with steam to form margarine.
- **D** It turns aqueous bromine from colourless to brown.
- **37** Which set contains the **correct** process for converting substance **S** to the product/(s)?

	process	S	product (s)
A	addition polymerization	an ester	Terylene
В	condensation polymerization	vinyl chloride	poly(chloroethene)
С	cracking	octane	ethene
D	substitution	ethene	tetrachlorethane

38 The diagram below is used for fermentation.



The function of the air lock is to stop substance X from getting into the jar and to let substance Y out. What are X and Y?

	Х	Y
Α	carbon dioxide	oxygen
В	ethanol	carbon dioxide
С	nitrogen	carbon dioxide
D	oxygen	carbon dioxide

39 A polymer **X** was hydrolysed and the two products were



What can be deduced about **X**?

- **A** It was a condensation polymer.
- **B** It was made from one type of monomer.
- **C** It was made by addition polymerization.
- D It was Terylene.
- 40 In the polymerisation of ethene to form poly(ethene), there is no change in
 - A boiling point
 - **B** density
 - **C** mass
 - D empirical formula

END OF PAPER

2022 CHEMISTRY GCE ORDINARY LEVEL SYLLABUS

The Periodic Table of Elements

0

VII 0	He He	σı	fliorine	19	17	CI	chlorine 35.5	35	Br	bromine 80	53	Ι	iodine 127	85	At	astatine _					20	2.4	ytterbium lutetium 173 175		102
N					-			-			_		tellurium 128	_			_	2	livermorium	1	60	s E	thulium 169		101
>		2	Nitronan	14	15	٩	phosphorus 31	33	As	arsenic 75	51	Sb	antimony 122	83	Bi	bismuth 200					89	Зů	erbium 167		100
2		90	Corton	12	14	Si	silicon 28	32	Ge	germanium 73	50	Sn	119 119	82	Pb	207	114	Ъ	flerovium	ï	67	Ē	holmium 165		66
=		ں م	B	11	13	AI	aluminium 27	31	Ga	gallium 70	49	IJ	indium 115	81	11	204	2				99	82	dysprosium 163		98
					-			30	Zn	zine 65	48	PO	cadmium 112	80	Hg	mercury 201	110	5	copernicium	1	ц.	3 f	terbium 159		97
								E			T		silver 108						E	1	ВA	5 2	gadolinium 157		96
ă								28	īŻ	nickel 59	46	Pd	palladium 106	78	đ	platinum 105	110	e e	armstadtium	1	63	3 =	europium 152		95
10													rhodium 103				_			1	62	ES.	samarium 150		94
	hydrogen 1							26	Fe	iron 56	44	Ru	ruthenium 101	76	So	osmium 100	108	S #	hassium	1	51	, E	promethium		93
		1						25	Mn	manganese 55	43	Tc	technetium -	75	Re	thenium 186	107	5 8	bohrium	1	60	PN	neodymium 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	92
		umber	0	nass					ç	chromium 52		Mo	molybdenum 96			tungsten 184		0	E	1		3 4	Enic		91
	Key	proton (atomic) number	atomic symbol	relative atomic mass				23	>	vanadium 51	41	qN	niobium 93	73	Та	tantalum 181	105	90	dubnium	1	58	80	-	1	90
		proton	ato	relativ				22	Ħ	titanium 48	40	Zr	ziroonium 91	72	Ŧ	hafnium 178	104	R	rutherfordium	1	57	5_7	lanthanum 139		89
					I S			21	Sc	scandium 45	39	≻	yttrium 89	57 - 71	anthanoids		89 - 103	actinoids							
=		4	Be	6	12	Mg	magnesium 24	20	Ca	calcium 40	38	Sr	strontium 88	+		barium 137	T		radium	1	obiocodio	Idi in Idi Ioins			actinoids
		с С		7	11		23 23	19	×	potassium 39	37	Rb	rubidium 85	55	S	caesium 133	87	5 LL	francium	1	्	ā			**

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.)



南洋白古中学校

Nanyang Girls' High School

Preliminary Examination 2022 Secondary 4

CHEMISTRY

Paper 1 Multiple Choice

Friday 26 August

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue, correction fluid or tape.

Write your name, register number and class in the spaces at the top of this page and on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 15.

The use of an approved scientific calculator is expected, where appropriate.

This document consists of 15 printed pages and 1 blank page.

Setter(s): FKD

NANYANG GIRLS' HIGH SCHOOL

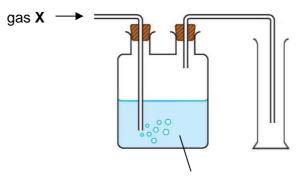
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1200 - 1300

- 1 Which apparatus would be most suitable for measuring 24.5 cm³ of a liquid?
 - A burette
 - **B** measuring cylinder
 - **C** pipette
 - D syringe
- 2 The diagram shows an experimental setup to produce and collect a dry sample of gas **X**.



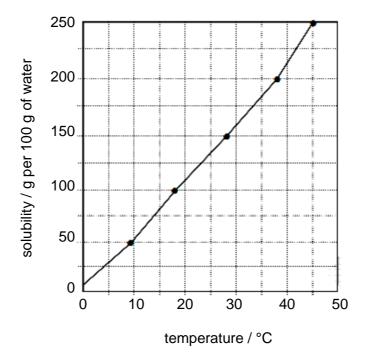
concentrated sulfuric acid

Which of the following is most likely to be gas X?

- A ammonia gas
- **B** hydrogen gas
- **C** hydrogen chloride gas
- D steam
- 3 Which is not correctly matched with the apparatus needed for each separation?

	separation	apparatus						
Α	oil from a mixture of oil and water	er separating funnel						
в	salt from a mixture of salt and sand	filter paper, filter funnel, evaporating dish, retort stand, Bunsen burner						
С	blue dye from black ink filter paper, beaker, lid							
D	water from seawater	thermometer, fractionating column, condenser						

4 The graph shows the solubility curve of potassium nitrate in water.



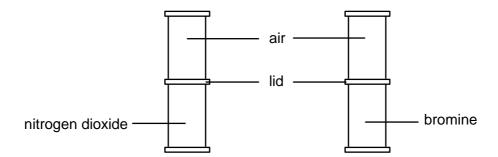
Potassium nitrate solid was dissolved in 400 g of water at 45°C to obtain a saturated solution.

Upon cooling the solution to room temperature (25°C), what is the maximum approximate mass of crystals that can be obtained?

Α	113 g	В	138 g	C 452 g	D	552 g
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- **5** Which of the following tests would be able to distinguish between sulfur dioxide and carbon dioxide gas?
 - 1 Bubble the gas into a test tube containing aqueous acidified KMnO₄.
 - 2 Bubble the gas into a test tube containing limewater.
 - 3 Place a damp blue litmus paper over the gas.
 - 4 Place a lighted splint over the gas.
 - **A** 1 only **B** 1 and 2 **C** 1 and 3 **D** 2 and 4

6 A student carried out an experiment, at room temperature, involving two gas jars filled with equal volumes of nitrogen dioxide gas and bromine gas respectively. The gas jars are sealed with a lid and placed below another gas jar containing air.



The student removed the lids at the same time and observed that the gas jar containing nitrogen dioxide gas fills up the other gas jar more quickly than the gas jar containing bromine gas.

What could be the possible explanation to the difference in the rate of diffusion?

- **A** Bromine has a higher boiling point than nitrogen dioxide.
- **B** Nitrogen dioxide has greater kinetic energy than bromine gas.
- **C** Nitrogen dioxide has smaller molecular mass than bromine gas.
- **D** There are more atoms in a molecule of nitrogen dioxide than in a bromine molecule.
- 7 An element from the Periodic Table has the following properties.
 - It has *x* number of protons and *x*+1 number of neutrons.
 - It forms an ion with *x*+3 number of electrons.

Which element is this most likely to be?

- A aluminium
- B boron
- **C** nitrogen
- D phosphorus

- 8 Some properties of substance Y are listed.
 - It has a high melting point.
 - It does not conduct electricity in solid state.
 - When fluorine gas is bubbled into its solution, a brown solution is obtained.

Which of the following is a possible identity of Y?

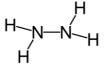
- A calcium chloride
- B graphite
- **C** potassium iodide
- D sodium
- **9** Epsom salts contain magnesium sulfate and are often used as a natural remedy for muscle aches, inflammation, and stress.

A student wrote down some statements about magnesium sulfate.

- 1 It is made up of a giant lattice structure.
- 2 Strong electrostatic forces of attraction exist between Mg^{2+} , S^{2-} and O^{2-} ions.
- 3 There is both ionic and covalent bonding present.
- 4 The ratio of positive to negative ions is 1:2.

Which of the above statements are correct?

- **A** 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 1, 3 and 4
- **10** Dihydrogen tetrahydride has the following structure.



What is the total number of valence electrons not involved in bonding?

- **A** 2
- **B** 4
- **C** 6
- **D** 8

- 11 Which of the following enables a metal to conduct electricity?
 - A atoms
 - B electrons
 - **C** ions
 - D protons
- 12 Vanillin is the main chemical compound present in vanilla bean extract. It contains 63.16 % of carbon, 5.26 % of hydrogen and 31.58 % of oxygen by mass.

What is the empirical formula of vanillin?

- **A** C₃H₃O
- $\mathbf{B} \qquad \mathsf{C}_5\mathsf{H}_5\mathsf{O}_2$
- **C** C₈H₈O₃
- $D C_8H_8O_6$
- **13** Four moles of sulfur dioxide reacted with three moles of oxygen gas according to the following equation at room temperature and pressure.

$$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$$

What is the total volume of gas in the reaction mixture after the reaction is complete?

A 48.0 dm^3 **B** 72.0 dm^3 **C** 96.0 dm^3 **D** 120 dm^3

14 When 12.4 g of copper(II) carbonate, CuCO₃, was heated, 20 cm³ of carbon dioxide gas, measured at room temperature and pressure, was released.

What was the percentage yield of carbon dioxide?

- **A** 0.833 % **B** 4.17% **C** 41.7 % **D** 83.3 %
- **15** Three electrochemical cells are set up using zinc metal and three other unknown metals P, Q and R as electrodes.

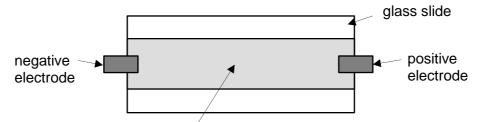
The results of the experiment are shown in the table below.

metal tested	voltmeter reading / V	direction of electron flow
Р	0.200	zinc to metal P
Q	0.500	metal Q to zinc
R	1.100	zinc to metal R

Which of the following shows the three unknown metals in increasing order of reactivity?

Α	P. Q. R	В	Q, P, R	С	R. P. Q	D	R. Q. P
~	, x , x		$\infty, 1, 1$	•	1, 1, , x		ix, œ, i

16 A piece of blue litmus paper was soaked in dilute aqueous potassium bromide and supported on a glass slide. The paper was connected to an electrical supply as shown in the diagram.



blue litmus paper soaked in dilute aqueous potassium bromide

Which of the following shows the correct observations near each electrode after some time?

	negative electrode	positive electrode
Α	remain blue	turn red
в	remain blue	turn red and then bleached
С	turn red	remain blue
D	turn red and then bleached	remain blue

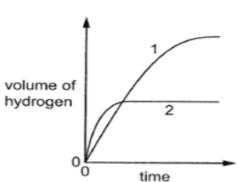
- 17 Which of the following would involve overall energy being released?
 - A action of light on silver bromide
 - B conversion of water to steam
 - **C** rusting of iron
 - D thermal decomposition of calcium carbonate
- **18** When 17.75 g of Cl_2 is reacted with excess H_2 , 45.5 kJ of energy is given out according to the following equation.

$$H_2 + Cl_2 \rightarrow 2HCl$$

What is the enthalpy change, ΔH , for the reaction?

- **A** +91
- **B** -91
- **C** +182
- **D** -182
- **19** 100 cm³ of 1 mol/dm³ dilute hydrochloric acid reacted with an excess of magnesium ribbon to produce hydrogen gas according to the equation below.

The volume of hydrogen gas produced was recorded against time in experiment 1.



 $2\text{HC}l + \text{Mg} \rightarrow \text{MgC}l_2 + \text{H}_2$

What could be the quantities of acid and metal used in experiment 2?

	quantity of acid used	metal used
Α	100 cm ³ of 1 mol/dm ³ HC <i>l</i>	Mg powder
в	100 cm ³ of 2 mol/dm ³ HC <i>l</i>	Mg ribbon
С	50 cm ³ of 1 mol/dm ³ HC <i>l</i>	Mg powder
D	50 cm ³ of 1 mol/dm ³ HC <i>l</i>	Mg ribbon

9

20 The rate of a reaction increases when the temperature is increased.

Which of the following statements best explain why this is so?

- 1 The activation energy decreases.
- 2 There are more particles with energy equal to or greater than the activation energy.
- 3 The frequency of effective collisions between particles increases.
- 4 The particles in the reaction mixture expand and have a greater surface area to collide.
- **A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4
- 21 Which of the following will **not** have their rate of reaction affected by a change in pressure?
 - $\textbf{A} \qquad H_2(g) + O_2(g) \rightarrow H_2O_2(l)$
 - $\mathbf{B} \qquad l_2(s) + Cl_2(g) \rightarrow 2lCl(l)$
 - **C** $N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(l)$
 - **D** Na₂CO₃(aq) + H₂SO₄(aq) \rightarrow Na₂SO₄(aq) + H₂O(l) + CO₂(g)
- 22 Small portions of aqueous acidified potassium manganate(VII) and aqueous potassium iodide were added separately to four solutions **A** to **D**. The original colour of these solutions was colourless.

The final colours of the solutions are shown in the table below.

Which solution acts as both an oxidising and a reducing agent?

	aqueous acidified potassium manganate(VII)	aqueous potassium iodide
Α	colourless	colourless
в	colourless	brown
С	purple	colourless
D	purple	brown

23 The Ostwald process involves the manufacture of nitric acid. Ammonia is first manufactured from nitrogen gas before being used as a raw material for the Ostwald process.

A summary of the manufacturing process is shown below.

$$N_2 \xrightarrow{A} NH_3 \xrightarrow{B} NO \xrightarrow{C} NO_2 \xrightarrow{D} HNO_3$$

Which stage above shows the greatest change in the oxidation state of nitrogen?

24 In which row are the oxides correctly identified?

	acidic	amphoteric
Α	nitrogen monoxide, carbon monoxide	phosphorus oxide, selenium oxide
в	nitrogen dioxide, silicon dioxide	aluminium oxide, calcium oxide
с	phosphorus oxide, carbon dioxide	lead(II) oxide, zinc oxide
D	sulfur dioxide, manganese oxide	nitrogen monoxide, lithium oxide

25 When excess calcium carbonate was reacted with dilute hydrochloric acid, the reaction gradually became slower and eventually stopped.

Which statement best explains this observation?

- A An insoluble layer of calcium chloride is formed.
- **B** As carbon dioxide is produced, it forms a white precipitate with calcium carbonate.
- **C** Calcium carbonate was used up completely.
- **D** There were no more hydrogen ions present in the reaction mixture.

26 Which substances produce an insoluble salt when aqueous solutions of them are mixed?

- A barium chloride and aluminium nitrate
- B calcium nitrate and potassium chloride
- **C** lead(II) nitrate and zinc chloride
- **D** sodium carbonate and ammonium sulfate

- 27 Which statement about the Haber process is correct?
 - A Hydrogen used is obtained from fractional distillation of air.
 - **B** Iron is used as a catalyst.
 - **C** Nitrogen used is obtained from nitrates in the soil.
 - **D** The reaction takes place at room temperature and pressure.
- **28** T and U are two elements located in Period 4 of the Periodic Table.

Which statement best proves that element U is located on the right side of element T?

- **A** T is less reactive than U.
- **B** T loses electrons more easily than U.
- **C** T forms an acidic oxide while U forms a basic oxide.
- **D** T has two unpaired valence electrons while U has four unpaired valence electrons.
- 29 Which statements about rubidium is correct?
 - A It reacts with water to form an oxide.
 - **B** It reacts with water to produce a colourless and pungent gas that turns red litmus blue.
 - **C** It reacts with chlorine explosively to form a giant molecular structure.
 - **D** It is a stronger reducing agent than potassium.
- 30 Which of the following show a decreasing trend down the group VII elements?
 - A atomic radius
 - B colour intensity
 - C melting and boiling point
 - D reactivity
- **31** Some properties of silver and its compounds are stated below.
 - 1 Silver can form compounds like Ag₂O and AgF₂.
 - 2 Silver has a high melting point of 962°C.
 - 3 Silver is an important catalyst in the production of formaldehyde.
 - 4 Silver reacts with chlorine to form a white crystalline solid of silver chloride.

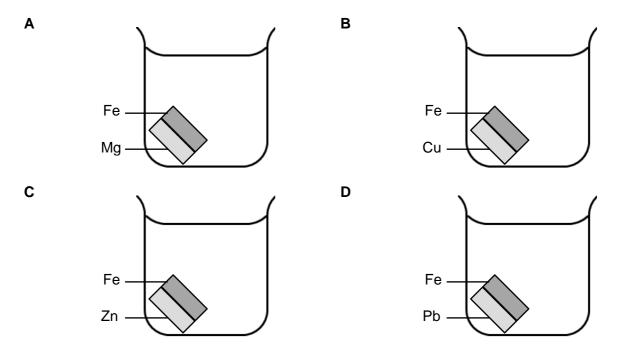
Which of the above statements do not agree with the typical properties of transition metals?

Α	2 only	В	4 only	С	1 and 3	D	2 and 4
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32 Four beakers of dilute sodium chloride solution were set up as shown.

In each beaker, a piece of iron was attached on one side by another piece of metal.

In which beaker would the iron take the shortest time to rust?



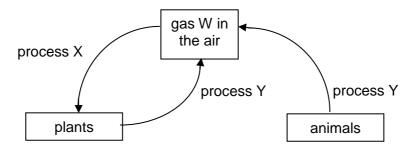
33 When heated strongly, metal X turns red hot and reacts slowly with steam. Metal Y reacts slowly with dilute sulfuric acid and stops reacting halfway through the reaction. Metal Z reacts very slowly with cold water but reacts violently with steam.

Which method of metal extraction from its ores is most likely to be used?

	electrolysis of molten ore	reduction by carbon
Α	Z	X and Y
в	Y	X and Z
С	X and Z	Y
D	Y and Z	Х

- 34 Which statements about the extraction of iron from haematite is correct?
 - **A** At the bottom of the furnace, molten slag floats on top of molten iron.
 - **B** At the top of the furnace, hot waste gases such as oxygen escape.
 - **C** Carbon monoxide acts as the oxidising agent in the process.
 - **D** The other raw materials used are coke and quicklime.

35 The diagram below shows part of the carbon cycle.



What is the correct combination of the identity of gas W and processes X and Y?

	gas W	process X	process Y
Α	carbon dioxide	photosynthesis	respiration
в	carbon dioxide	respiration	photosynthesis
С	carbon monoxide	photosynthesis	respiration
D	carbon monoxide	respiration	photosynthesis

- **36** When fossil fuels are burnt incompletely in a motor car, which gases can be found in its exhaust gases?
 - L carbon monoxide carbon dioxide Ш ||| sulfur dioxide IV nitrogen Α С I, II and III В I and II D all of the above I only
- **37** Which formula below best represents a straight-chain hydrocarbon that contains only single covalent bonds?
- **38** Catalytic cracking is a process where long chain alkanes are broken into smaller, more useful molecules.

Which of the following equations correctly represents catalytic cracking?

- $\label{eq:alpha} \mbox{A} \mbox{C_{16}H_{32}$} \rightarrow 2\mbox{$C_{3}H_{6}} + 2\mbox{C_{5}H_{10}$}$
- $\textbf{B} \qquad C_{16}H_{32} \rightarrow 16C \, \textbf{+} \, 16H_2$
- $\textbf{C} \qquad C_{16}\textbf{H}_{34} \rightarrow 4C_4\textbf{H}_8 + \textbf{H}_2$
- $\textbf{D} \qquad C_{16}H_{34} \rightarrow 2C_2H_4 + 2C_6H_6 + 7H_2$

- 39 Which statements about alcohols are correct?
 - 1 Alcohols decolourise aqueous acidified potassium manganate(VII).
 - 2 All alcohols contain the hydroxide ion, OH⁻.
 - 3 Ethanol can be formed from ethene using a reaction catalysed by yeast.
 - 4 Propanol can be oxidised to propanoic acid.
 - **A** 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4
- **40** A carboxylic acid of molecular formula $C_4H_8O_2$ reacts with an alcohol of molecular formula C_3H_8O to form an ester.

What could be the formula of the ester formed?

$$A \qquad \begin{array}{c} CH_3 - CH_2 - C = O \\ \downarrow \\ O - CH_2 - CH_2 - CH_2 - CH_3 \end{array}$$

$$\begin{array}{c} \mathbf{C} \qquad \mathbf{CH}_{3} - \mathbf{CH}_{2} - \mathbf{CH}_{2} - \mathbf{C} = \mathbf{O} \\ | \\ \mathbf{O} - \mathbf{CH}_{2} - \mathbf{CH}_{2} - \mathbf{CH}_{2} - \mathbf{CH}_{2} - \mathbf{CH}_{3} \end{array}$$

$$\begin{array}{c} \mathbf{D} \qquad \mathbf{CH}_3 - \mathbf{CH}_2 - \mathbf{C} = \mathbf{O} \\ & | \\ \mathbf{O} - \mathbf{CH}_2 - \mathbf{CH}_2 - \mathbf{CH}_3 \end{array}$$

End of paper

The Periodic Table of Elements

0	He 7	helium 4	10	Ne	neon	20	18	Ar	argon	40	36	Ϋ́	kryptor	84	54	Xe	xenon	2 2	8	Ч Ч	radon -				
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-			ю	:=	lithium	7	11	Na	sodium	23	19	×	potassium	39	37	Rb	rubidium o.c		n n	S	caesium 133	87	Ļ	francium	I

The volume of one mole of any gas is 24 ${
m dm}^3$ at room temperature and pressure (r.t.p.).

71 Lu Iutetium 175 103 Lr lawrencium

70 Yb ytterbium 173 No No

69 Tm thulium 169 101 Md mendelevium

68 Er erbium 167 100 Fm fermium

67 Ho holmium 165 99 ES einsteinium

65 66 Tb Dy terbium dysprosium 159 163 97 98 Bk Cf berkelium californium e

64 Gd 157 96 Cm curium

63 Eu europium 152 95 Am americium

61 62 Pm Fm Sm - 150 93 94 Np Pu aptunium a

60 Nd 144 92 U uranium 238

59 Pr praseodymium 141 91 Pa protactinium 231

58 Cerium 140 90 232 232

57 La lanthanum 139 89 Ac actinium

actinoids

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ORCHID PARK SECONDARY SCHOOL Preliminary Examination 2022

CHEMISTRY		6092/01
CLASS	INDEX NUMBER	
CANDIDATE NAME		
1999	 	

Paper 1 Multiple Choice30 August 2022Secondary 4 Express1 hourSetter: Mr Goh Chye Joo40 MarksAdditional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil. Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class and register number on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in soft pencil on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

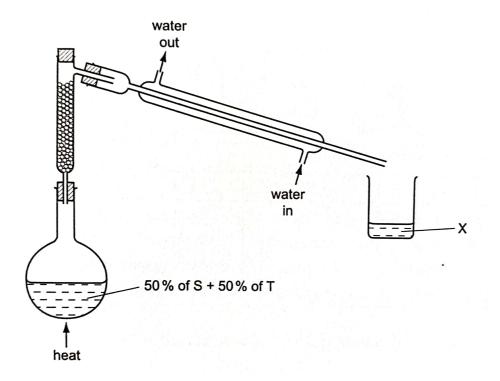
A copy of the Periodic Table is provided on page 17.

The use of an approved scientific calculator is expected, where appropriate.

- **1** What is the **most** suitable method of investigating the different food colourings in some drinks?
 - A crystallisation
 - **B** filtration
 - **C** fractional distillation
 - **D** paper chromatography
- 2 A mixture contains equal volumes of two liquids.

Liquid S has a boiling point of 75 °C. Liquid T has a boiling point of 69 °C.

The mixture is heated in the apparatus shown.



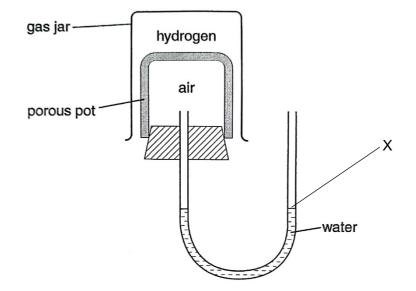
What is the initial composition of X?

- A 10 % S and 10 % T
- **B** 50 % S and 50 % T
- **C** 100 % S
- **D** 100 % T

3 If, in volumetric analysis between an acid (in the burette) and an alkali, you needed to re-use the same titration flask after the first titration.

Which is the best procedure for rinsing the flask?

- **A** rinse with a little of the acid
- B rinse with a little of the alkali
- **C** rinse with tap water and then with acid
- D rinse with tap water and then with distilled water
- 4 The apparatus shown in the diagram was set up.



How will the water level at X change after a period of time?

- **A** It will fall and remain at a lower level.
- **B** It will fall, then rise and return to X.
- **C** It will rise and remain at a higher level.
- **D** It will rise, then fall and return to X.

A student carried out the following series of tests on an aqueous solution of sodium carbonate and recorded his results as shown in the table.

Which test should be repeated because of an incorrect observation entered in the table?

	test	observation
Α	add barium chloride solution	white precipitate formed
В	add copper(II) sulfate solution	blue precipitate formed
С	add dilute hydrochloric acid	effervescence occurred
D	add sodium hydroxide solution	white precipitate formed

6 When testing for a chloride ion using silver nitrate, the solution must be acidified with dilute nitric acid.

What is the purpose of acidifying with nitric acid?

- A to neutralise hydroxide ions
- **B** to oxidise the chloride ion
- C to prevent the decomposition of any silver chloride formed
- **D** to prevent the precipitation of silver carbonate
- 7 One mole of hydrated copper(II) sulfate, CuSO₄.5H₂O, is dissolved in water.

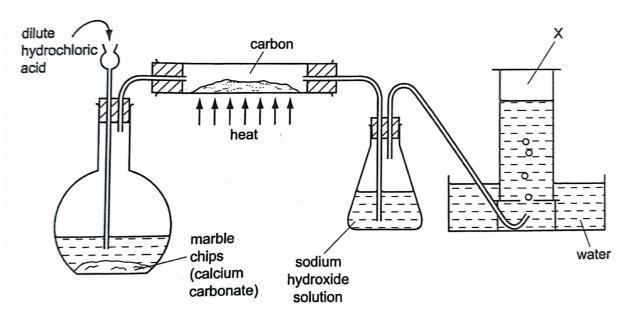
How many moles of ions does the solution contain?

- **A** 1
- **B** 2

5

- **C** 6
- **D** 7

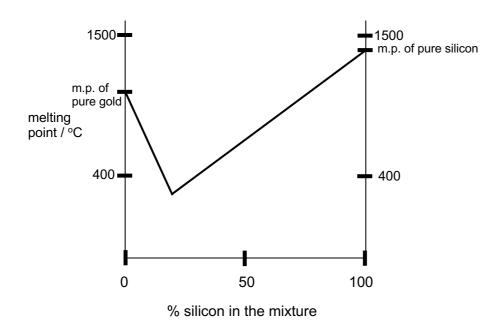
8 The diagram shows an experiment for the formation of gas X.



What is gas X?

- A carbon dioxide
- B carbon monoxide
- C chlorine
- D hydrogen
- 9 In which pair of substances does each have a giant molecular structure?
 - A diamond, iodine
 - B diamond, silica (sand)
 - C iodine, methane
 - **D** methane, silica (sand)

10 The graph gives the melting points of mixtures of silicon and gold.



The graph shows that any mixture of silicon and gold must have a melting point

- A above that of gold.
- **B** below that of silicon.
- **C** below that of both gold and silicon.
- **D** between that of gold and silicon.
- **11** Which ion has the same number of electrons as a krypton atom? [relative atomic mass, A_r : Kr, 36]
 - A chlorine
 - **B** rubidium
 - **C** sodium
 - D xenon
- **12** An isotope of element Q has 40 nucleons and 19 protons.

What is element Q?

- A argon
- B calcium
- C cobalt
- D potassium

13 Hydrogen can form both H^+ and H^- ions.

Which statement about these two ions is correct?

- A An H⁺ ion has no electrons in its first shell.
- **B** An H^+ ion has more protons than an H^- ion.
- **C** An H^- ion has one more electron than an H^+ ion.
- **D** An H^- ion is formed when a hydrogen atom loses an electron.
- **14** A volume of ethane, at room temperature and pressure, has a mass of 10 g.

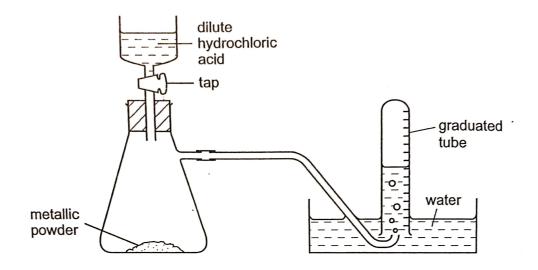
What is the mass of an equal volume of propene at room temperature and pressure?

- **A** 10 g
- **B** 10.5 g
- **C** 14 g
- **D** 21 g
- **15** A compound X is the only substance formed when two volumes of ammonia react with one volume of carbon dioxide (both volumes being measured at room temperature and pressure).

What is the most likely formula of X?

- A NH₂CO₂NH₄
- **B** (NH₂)₂CO
- **C** $NH_4CO_2NH_4$
- **D** $(NH_4)_2CO_3$

16 The diagram shows apparatus for measuring the volume of hydrogen given off when an excess of dilute hydrochloric acid is added to powdered metal. The volume of gas is measured at room temperature and pressure.



The experiment is carried out three times, using the same mass of powder each time but with different powders:

- pure magnesium
- pure zinc
- a mixture of magnesium and zinc

Which powder gives the greatest volume of hydrogen and which the least volume?

	greatest volume of H ₂	least volume of H ₂
Α	magnesium	zinc
в	magnesium	the mixture
С	zinc	magnesium
D	zinc	the mixture

17 How does the mass of a sample of copper(II) oxide change when it is heated in hydrogen and oxygen separately?

	mass after heating in hydrogen	mass after heating in oxygen
Α	decreases	decreases
в	decreases	unchanged
с	unchanged	decreases
D	unchanged	unchanged

- **18** Some of the general physical properties of metals are shown.
 - 1 Metals are good conductors of electricity.
 - 2 Metals are hard solids.
 - 3 Metals have high densities.
 - 4 Metals have very high melting points

Which of these properties does rubidium have?

- A 1 only
- **B** 1 and 2 only
- **C** 1, 2 and 3 only
- **D** 1, 2, 3 and 4
- **19** From your knowledge of the manufacture of both aluminium and iron, what is the order of chemical reactivity of aluminium, carbon and iron towards oxygen?

	most reactive		► least reactive
Α	aluminium	carbon	iron
В	aluminium	iron	carbon
С	carbon	aluminium	iron
D	carbon	iron	aluminium

20 Metal carbonates decompose when heated.

Which carbonate is most stable to heat?

- A calcium carbonate
- **B** copper(II) carbonate
- **C** lead(II) carbonate
- D zinc carbonate

21 *Disproportionation* is a reaction in which the same element is both oxidised and reduced.

Which reaction is an example of disproportionation?

- A $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$
- **B** $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$
- **C** $Fe_2(SO_4)_3 + 2KI \rightarrow 2FeSO_4 + K_2SO_4 + I_2$
- **D** $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$
- **22** A colourless gas is passed into each of the two different solutions. The results are shown in the table.

solution	acidified potassium manganate(VII)	potassium iodide
result	purple to colourless	stays colourless

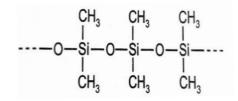
What is the colourless gas?

- A a catalyst
- B an alkali
- **C** an oxidising agent
- D a reducing agent
- 23 How many periods do the elements of atomic number 1 to 18 occupy in the Periodic Table?
 - **A** 2
 - **B** 3
 - **C** 6
 - **D** 8
- 24 Chlorine is an element in Group VII of the Periodic Table.

Which statement about chlorine is not correct?

- **A** It is a pale yellow gas at room temperature and pressure.
- **B** Its molecules are diatomic at room temperature.
- **C** It is a less powerful oxidising agent than fluorine.
- **D** It gains electrons from a metal to form an ionic compound.

25 The structure of a silicon polymer is shown.



Which element in the polymer is present in the highest percentage by mass?

- A carbon
- B hydrogen
- C oxygen
- D silicon
- 26 How many moles of iron can be extracted from 58 g of Fe₃O₄?
 - A 0.5 mol
 - **B** 0.75 mol
 - **C** 1.0 mol
 - **D** 1.5 mol
- 27 The equation for one method of making copper(II) carbonate is shown.

 $CuSO_4 + Na_2CO_3 \rightarrow CuCO_3 + Na_2SO_4$

The reaction is an example of

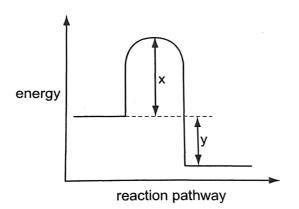
- A combustion.
- **B** neutralisation.
- **C** oxidation and reduction.
- D precipitation.

28 The formation of hydrogen iodide from hydrogen and iodine is an endothermic reaction.

H-H + I-I \rightarrow H-I + H-I

What may be deduced from this information?

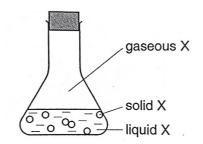
- A The number of bonds broken is greater than the number of bonds formed.
- **B** The breaking of H–H bonds gives out energy.
- **C** The products possess less energy than the reactants.
- **D** The total energy change in bond formation is less than that in bond breaking.
- **29** The energy profile diagram for a chemical reaction is shown.



Which statement is correct?

- **A** The overall enthalpy change is x y.
- **B** The reaction is endothermic.
- **C** The value of x would decrease in the presence of a catalyst.
- **D** The value of y would increase in the presence of a catalyst.

30 The conical flask contains compound X which is present in the solid, liquid and gaseous states.



Which statement is correct?

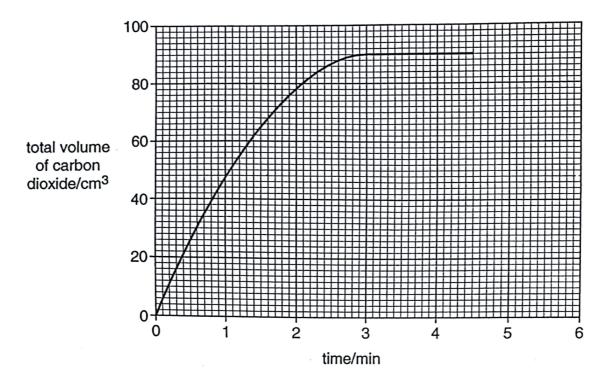
- **A** A gaseous X molecule has a lower mass than a liquid X molecule.
- **B** Energy is released when X changes from liquid to solid.
- **C** Liquid X is at a higher temperature than solid X.
- D Liquid X molecules vibrate about fixed positions.
- 31 The heat-reflecting shields of some space rockets are gold plated using electrolysis. Which electrodes and electrolyte would be used to gold-plate the heat shield?

	negative electrode	positive electrode	electrolyte
Α	carbon	heat shield	gold compound
в	gold	heat shield	copper compound
с	heat shield	carbon	copper compound
D	heat shield	gold	gold compound

- 32 Why is cryolite, Na₃A/F₆, used in the extraction of aluminium from aluminium oxide?
 - A to dissolve aluminium oxide
 - **B** to prevent the anodes from burning away
 - **C** to prevent the oxidation of aluminium
 - D to remove the impurities from the aluminium oxide

- **33** When sodium chloride was electrolysed, sodium was produced at the negative electrode. In what form was sodium chloride during the electrolysis process?
 - A concentrated aqueous solution
 - B dilute aqueous solution
 - **C** molten
 - D solid
- **34** The rate of the reaction between a given mass of calcium carbonate and an excess of hydrochloric acid was studied by collecting the carbon dioxide in a graduated syringe.

The results are shown in the graph.



How much time was required for half the calcium carbonate to react?

- **A** 0.95 min
- **B** 1.5 min
- **C** 2.0 min
- **D** 3.0 min

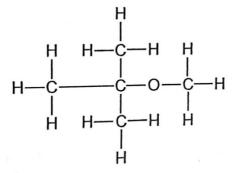
- 35 Which compound, on combustion, never forms soot?
 - A carbon monoxide
 - B ethanol
 - **C** ethene
 - D methane
- 36 When must a substance be an alkane?
 - A when it burns easily in oxygen
 - **B** when it contains carbon and hydrogen
 - C when it has the general formula C_nH_{2n+1}
 - D when it is generally unreactive
- 37 In the polymerisation of ethene to form poly(ethene), there is no change in
 - A boiling point.
 - **B** density.
 - C mass.
 - **D** molecular formula.
- 38 What is the general formula of the homologous series of carboxylic acids?

methanoic acid	HCO ₂ H
ethanoic acid	CH ₃ CO ₂ H
propanoic acid	$C_2H_5CO_2H$
butanoic acid	$C_3H_7CO_2H$

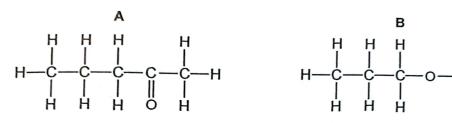
- $\boldsymbol{A} \quad C_n H_{2n\text{-}2}O_2$
- $\boldsymbol{B} \quad C_n H_{2n\text{-}1} O_2$
- $\boldsymbol{C} \quad C_n H_{2n} O_2$
- $\boldsymbol{D} \quad C_n H_{2n+1} O_2$

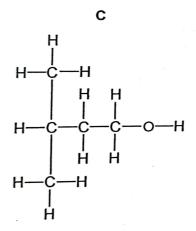
39 A compound known in industry as 'MTBE' is used as an additive in 'lead-free' petrol.

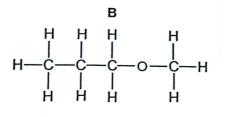
The structural formula of MTBE is shown.

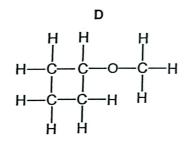


Which compound is an isomer of MTBE?









- The list shows reactions in which ethanol is either a reactant or a product. 40
 - 1 combustion of ethanol
 - 2 conversion of ethene to ethanol
 - 3 fermentation of glucose
 - 4 oxidation of ethanol

In which reactions is water also either a reactant or a product?

- **A** 1, 3 and 4 only
- В 2, 3 and 4 only
- 1, 2 and 4 only С
- **D** 3 only

(r.t.p.)
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				25	MIN manganese 55	43	TC technetium -	75	Re	rhenium 186	107 Bh				neodymium 144	92	Э.	238
		umber ool mass		24	chromium 52	42	m	74		~		seaborgium -	59		praseodymium 141		1	231
	Key	proton (atomic) number atomic symbol name relative atomic mass		23	v vanadium 51	41	ND midoium 93	73	Та	tantalum 181	105 Db		58	0e	cerium 140	06	μ	232
		proton ato relativ		21	titanium 48		ZIL.	72	Ŧ	hafnium 178	104 Rf	rutherfordium	57	La	lanthanum 139	68	Ac	acunum
				54	scandium 45	39	yttrium 89	57 - 71	lanthanoids		89 – 103 actinoids		s					
=		4 Be 9	12 Mg magnesium 24	50	calcium 40 m	38	Sr strontium 88	56	Ba	barium 137	88 Ra	radium I	lanthanoids			actinoids		
_		3 Li 7	11 Na ^{sodium} 23	19	Potassium 39	37	rubidium 85	55	S	caesium 133	87 Fr	Trancium –	0					

The Periodic Table of Elements

17



Paya Lebar Methodist Girls' School (Secondary) Preliminary Examination 2022 Secondary 4 Express

CANDIDATE NAME	CLASS		CLASS INDEX NUMBER	
CENTRE NUMBER		INDEX NUMBER		

CHEMISTRY

6092/01

Paper 1 Multiple Choice

26 August 2022

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, class and class index number on the separate Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer all questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in soft pencil on the separate Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this paper.

A copy of the Periodic Table is printed on page 2.

The use of an approved scientific calculator is expected, where appropriate.



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											Al	Si	Ъ		CI	Ar
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	Sc	F	>	ວັ	Mn	Fe	8	ïZ		Zn	Ga	Ge	As		В	Ł
0)	scandium	titanium	vanadium 51	Ę	manganese	iron	cobalt	nickel		zinc	gallium	germanium 73	arsenic		bromine	krypton
+	39	40	41		43	44	45	46		48	49	202	51		53	24
	7	Zr	qN	Mo	Lo	Ru	Ł	Pd		B	5	Sn	Sb		I	Xe
strontium	c	zirconium 01	niobium	molybdenum technetium	technetium	ruthenium	rhodium	palladium	silver 108	cadmium	indium 115	tin 110	antimony		iodine 107	xenon
+-	-	72		74	75	-	11	78		80	81	82	83		85	86
Ba	anthanoids	Ť		3	Re		L	đ		P	11	P Q	Ē		At	Ru
		hafnium		tungsten	rhenium		iridium	platinum		mercury	thallium	lead	bismuth		astatine	radon
-		0/1		104		130	132	22	_		204	INT	SUS		I	I
^۳ ۵۵	89 – 103 actinoids	104	105 40	106 Sa	107 Bh	108 He	109	110		112		114		116		
	-	Rutherfordium	Ε	seaborgium		hassium	meitnerium	darmstadtium	_	copernicium		flerovium		livermorium		
		ı	1	I		1	I	I		I		I		1		
anthanoids		57	58	59	60	61	62	63	64	65	99		68	69	70	71
		La	Ce	ፈ	PN	Pm	Sm	Ш	Gd	Tb	D		ш	Tm	Υb	Р
		lanthanum 139	cerium 140	praseodymium 141	praseodymium neodymium pro	promethium -	samarium 150	europium 152	gadolinium 157	terbium 159	dysprosium 163	holmium 165	erbium 167	thulium 169	ytterbium 173	175
actinoids	1	89	06	91	92	<mark>93</mark>	94	95	<u>96</u>	67	98		100	101	102	103
		Ac		Pa	D	dN	Pu	Am	E C U	¥	Ç		Fm	pM	No	5
		actinium	thorium	protactinium	uranium	neptunium	plutonium	americium	curium	berkelium	californium		fermium	mendelevium	nobelium	lawrencium
		1		22.	0000	20.00	-									

The Periodic Table of Elements

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

3

Use the following information to answer Questions 1 and 2.

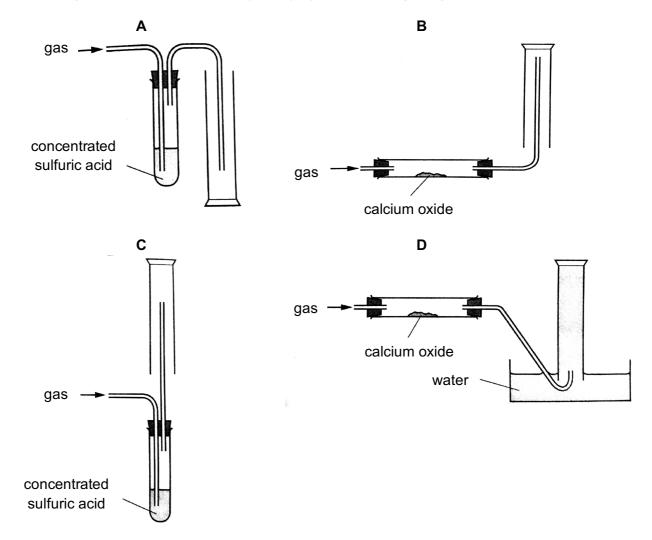
When solid hydrated barium hydroxide is added to a known quantity of solid ammonium chloride, the temperature of the mixture decreases. The chemical reaction is represented by the balanced chemical equation shown below.

 $Ba(OH)_{2}.8H_{2}O(s) + 2NH_{4}Cl(s) = 2NH_{3}(g) + 10H_{2}O(l) + BaCl_{2}(s)$

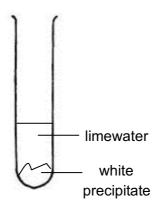
- 1 An experiment is designed to measure the temperature change when all the solid hydrated barium hydroxide reacts with the ammonium chloride. The following pieces of apparatus are available.
 - 1 gas syringe
 - 2 stopwatch
 - 3 balance
 - 4 Styrofoam cup

Other than a thermometer, which piece(s) of apparatus is(are) likely needed for this experiment?

- **A** 1, 2 and 3 only
- **B** 1 and 2 only
- **C** 3 and 4 only
- D 4 only
- 2 Which diagram shows the correct way of drying and collecting the gas produced?



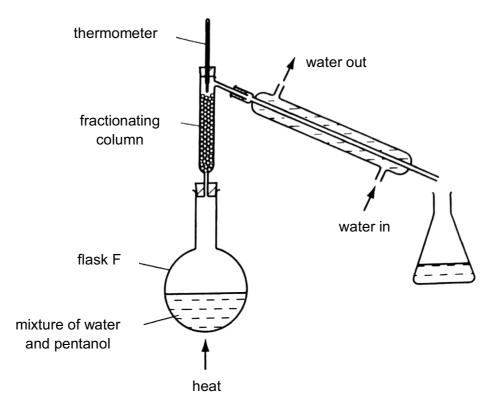
3 A solution of X is added to 1 cm³ of sulfuric acid. Effervescence is seen. The gas produced is bubbled into a test tube of limewater. The following observation is made.



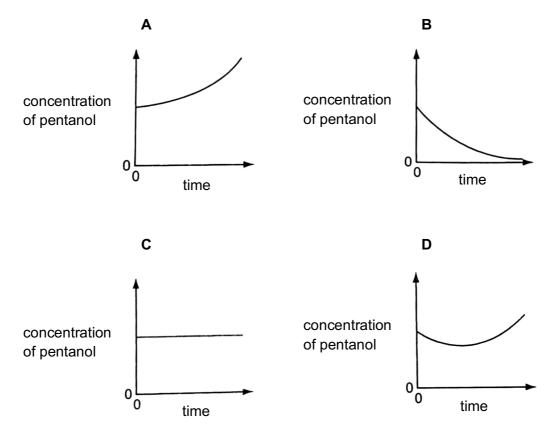
What could X be?

- A barium carbonate
- B sodium hydroxide
- **C** barium nitrate
- D sodium carbonate

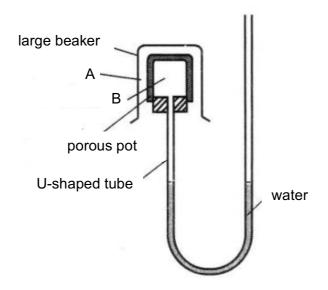
4 The apparatus shown is used to distil pentanol (boiling point 138 °C) from a mixture of water and pentanol.



Which graph shows the change in concentration of the pentanol in flask F as the distillation proceeds?



5 The diagram shows the experimental set-up to investigate the movement of gases A and B. After a while, the water on the left side of the U-shaped tube moved up.



If gas A is fluorine, what could gas B be?

- A chlorine
- **B** carbon dioxide
- **C** neon-19
- **D** argon-38
- **6** Four elements are shown as P, Q, R and S. The letters do not represent the chemical symbols of the elements.

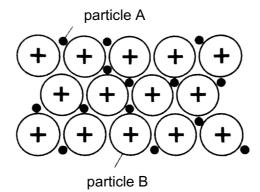
An ion is formed from the atom of one of the four elements. The ratio of the number of atoms to the number of electrons gained is 1:2. The ion formed consists of 2 electron shells.

Which element is the ion formed from?

A 1224*P* **B** 818*Q* **C** 1632*R* **D** 410*S*

- 7 Which two substances have similar molecular structures?
 - **A** sodium chloride and potassium chloride
 - B silicon and diamond
 - **C** carbon dioxide and sodium oxide
 - **D** diamond and methane

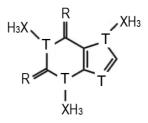
8 The following diagram shows the structure of substance Y.



What could substance Y and particles A and B be?

	substance Y	particle A	particle B
Α	potassium chloride	anion	cation
В	graphite	electron	atom
С	potassium	electron	cation
D	copper	electron	cation

9 A caffeine molecule has the following structure as shown below, with three unknown elements R, T and X. H represents hydrogen atoms.



What could element R, S and X be?

	R	Т	Х
Α	sulfur	carbon	silicon
В	oxygen	carbon	chlorine
С	chlorine	boron	carbon
D	oxygen	nitrogen	carbon

10 20 cm³ of dilute phosphoric acid, H₃PO₄, contains 0.04 mol of the acid. Assuming that phosphoric acid ionises completely in a reaction with sodium hydroxide, what is the concentration of the hydrogen ions in the solution?

A 0.67 mol/dm³

- **B** 2.00 mol/dm³
- **C** 4.00 mol/dm³
- **D** 6.00 mol/dm³
- 11 Fluorine reacts with nitrogen dioxide according to the equation below.

 $F_2(g) + 2NO_2(g) \rightarrow 2NO_2F(g)$

If 90 cm³ of gaseous fluorine is mixed with 110 cm³ of gaseous nitrogen dioxide, what is the total volume of the resultant mixture at room temperature and pressure?

- **A** 55 cm³
- **B** 110 cm³
- **C** 145 cm³
- **D** 165 cm³
- 12 Anhydrous washing soda, Na₂CO₃, is a component of many dry soap powders. The remaining mass of the anhydrous sample after a hydrated sample, Na₂CO₃.10H₂O, is heated to dryness is 15.3 g. What is the mass of oxygen found in the hydrated sample, Na₂CO₃.10H₂O?

[Mr of anhydrous Na₂ $\overrightarrow{CO_3}$ is 106; Mr of H₂ \overrightarrow{O} is 18]

A 9.24 g **B** 23.1 g **C** 30.0 g **D** 81.0 g

- **13** In an electrolysis of an aqueous solution, what effect could increasing its concentration have?
 - **A** The product at the cathode may change.
 - **B** The product at the anode may change.
 - **C** Products at both electrodes may change.
 - **D** There is no effect on the products formed.
- 14 Which of the following correctly describes the electrolysis of molten zinc chloride?

	product formed at the negative electrode	product formed at the positive electrode	terminal of the dry cell that electrons flow out of
Α	zinc	chlorine	negative
В	chlorine	zinc	negative
С	zinc	chlorine	positive
D	chlorine	zinc	positive

15 The equation for the addition reaction of ethene is shown.

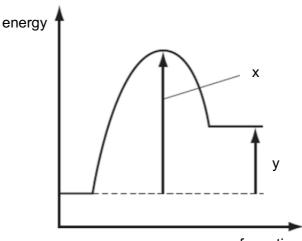
 $C_2H_4 + H_2 \quad C_2H_6 \quad \Delta H = -127 \text{ kJ/mol}$

	C–H	H–H	C–C
bond energy in kJ/mol	413	432	347

What is the energy of the C=C bond found in ethene?

A 307 kJ/mol **B** 582 kJ/mol **C** 614 kJ/mol **D** 768 kJ/mol

16 The energy profile diagram for the forward reaction in a reversible reaction is shown.



progress of reaction

Which statement about the energy profile diagram is correct?

- **A** The enthalpy change is the difference between x and y.
- **B** The value of y is unaffected by the addition of a catalyst.
- **C** The value of x remains the same when a catalyst is added.
- **D** The activation energy of the backward reaction is y x.
- **17** Which pair of substances, when mixed together, will produce the lowest initial rate of reaction?

	volume of nitric acid / cm ³	concentration of nitric acid / cm ³	size of zinc
Α	30	0.1	powder
В	30	0.2	granules
С	120	0.2	powder

D	120	0.1	granules
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Use the following information to answer Questions 18 and 19.

A student investigated the rate of reaction when acid reacted with excess powdered copper(II) carbonate. He used the same volume of monobasic acid each time. The table below showed the results he obtained.

experiment	type of acid	concentration / mol/dm ³	time taken to collect 10 cm ³ of gas / s	total volume of gas / cm ³
1	Х	0.5	15	40
2	Х	0.5	7	40
3	Х	1.0	8	80
4	Y	0.5	15	40

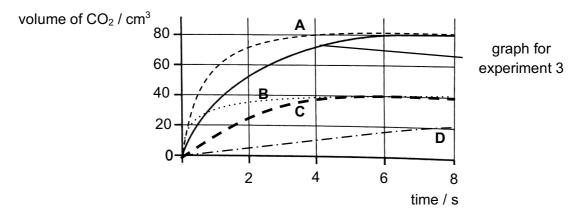
18 Three experiments were carried out at room temperature and one experiment was carried out at 60 °C.

Which experiment was carried out at 60 °C?

A 1 B 2 C 3 D 4

19 The student conducted a fifth experiment using half the volume of 1.0 mol/dm³ of acid X.

Assuming all other variables were kept constant, which graph would the fifth experiment produce, compared to the graph for experiment 3?



20 Peroxodisulfuric acid, H₂S₂O₈, reacts with potassium iodide, KI, according to the equation:

 $H_2S_2O_8(aq) + 2KI(aq) - K_2SO_4(aq) + H_2SO_4(aq) + I_2(aq)$

Two statements were made about the above reaction.

Statement I: Peroxodisulfuric acid is an oxidising agent.

Statement II: Brown solution turns colourless due to the change in oxidation state of iodine.

- **A** Both statements are incorrect.
- **B** Both statements are correct and statement II explains statement I.
- **C** Both statements are correct but statement II does not explain statement I.
- **D** Statement I is correct, but statement II is incorrect.

Ethene undergo several reactions. Which of the following is(are) formed from a non-redox reaction of ethene?

- A C₂H₅OH
- **B** C₂H₆

21

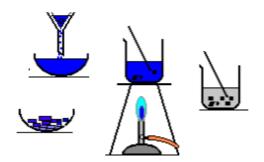
- **C** C₆H₆
- D CO₂ and H₂O
- **22** Ammonia is produced industrially by the Haber process. Which of the following statements is **not** true about the Haber process?
 - A Unreacted nitrogen is fed back to the reactor to reduce waste.
 - **B** The product can decompose to form simpler molecules.
 - **C** A catalyst is added to increase the yield of ammonia.
 - **D** High temperature is applied to overcome the activation energy.
- **23** A student found a bottle of limewater contaminated with calcium carbonate. What particles cannot be found in the bottle?
 - **A** carbonate ions only
 - **B** calcium ions and carbonate ions
 - **C** water molecules and hydroxide ions
 - **D** calcium ions and hydroxide ions
- 24 The formulae of some oxides are shown below.

 $K_2O \qquad NO_2 \qquad ZnO \qquad CuO \qquad CO$

Which of the following gives the correct number of each type of oxides?

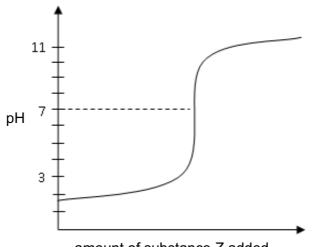
	numb	er of each type	of oxide
	acidic	amphoteric	basic
Α	1	1	2
В	1	1	1
С	2	0	3
D	2	1	2

25 These were diagrams drawn by a student to illustrate the steps of a salt preparation method. However, they are not in order of sequence.



Which reagents can be used to prepare a large quantity of salt that would involve the above steps?

- A potassium oxide and hydrochloric acid
- **B** lead(II) carbonate and nitric acid
- **C** calcium nitrate and sulfuric acid
- **D** calcium oxide and sulfuric acid
- **26** An aqueous solution of Z was added a little at a time, with stirring to substance Y. The changes in pH of the mixture are shown in the graph below.

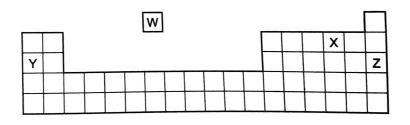


amount of substance Z added

What could Y and Z be?

	Y	Z	
Α	barium oxide	sulfuric acid	
В	zinc oxide	sulfuric acid	
С	calcium oxide	ethanoic acid	
D	hydrochloric acid	calcium oxide	

27 The diagram shows part of the Periodic Table.



Which row is correct?

	valency of 1	smallest atom
Α	Y	Z
В	W, Y	W
С	Х	Y
D	Y, Z	Х

28 A student carried out several tests and made the following observations of two unknown ionic chlorides of P and Q.

test	observation			
	chloride P	chloride of Q		
(a) Add half a spatula of P and Q to each of two test tubes containing 2 cm ³ distilled water.	P dissolved to give a colourless solution.	Q dissolved to give a coloured solution.		
(b) Add 2 cm ³ aqueous silver nitrate to each salt solution from (a).	A white precipitate is formed.	A white precipitate is formed.		

She then made the following deductions about the groups P and Q could be found in.

I: P could be a group I metal.

II: P could be a group II metal.

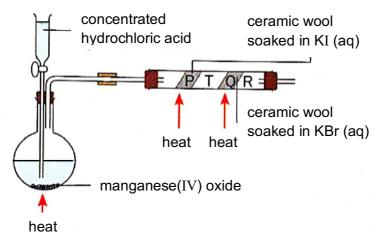
III: Q could be a group III metal.

IV: Q could be a transition metal.

Which deductions are correct?

Α .	I and II only	В	I and IV only	С	I,II and III only	D	I,II and IV only
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29 Chlorine gas can be made by reacting concentrated hydrochloric acid with manganese (IV) oxide (MnO₂) using the apparatus below.



What are the observations at T and R?

	observation at T	observation at R
Α	no vapour	no vapour
В	brown vapour	no vapour
С	violet vapour	no vapour
D	violet vapour	reddish brown vapour

30 Which of the following does **not** correctly show why lithium and sodium are in the same Group?

	evidence	lithium	sodium
Ι	density	low	low
Π	reaction with copper(II) nitrate	Copper is displaced.	Copper is displaced.
III	pH of the solution formed from its reaction with water	12	13
IV	formula of its sulfate salt	Li ₂ SO ₄	Na ₂ SO ₄
A I	and IV B I and III	C II and III	D II and IV

31 The formulae of some metal carbonates are shown below.

K₂CO₃ ZnCO₃ PbCO₃ CuCO₃ Ag₂CO₃

How many thermally stable carbonates are there?

A 1 B 2 C 3 D 4

32 Which pairs of statements correctly describe the differences between the conduction of electricity by metals and during electrolysis?

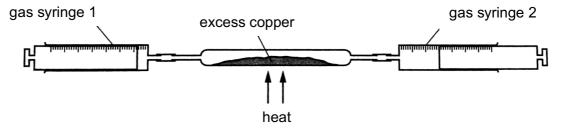
	conduction by metals	conduction in the electrolytes
		during electrolysis
т	charged particles move in	charged particles move towards
1	one direction only	both electrodes
П	it does not result in a	it results in a
11	chemical change	chemical change
ш	current is due to the	current is due to movement of
111	movement of electrons	oppositely charged ions

- A I only B I and II only C II and III only D all correct
- **33** Iron is extracted from iron ore in a blast furnace in several chemical reactions, some of which are redox reactions.

Which of the following shows an **incorrect** chemical reaction involved in the extraction of iron from the iron ore?

	chemical reaction	ls it a redox reaction?
Α	$CaCO_3 + SiO_2$ $CaSiO_3 + CO_2$	\checkmark
в	C + O ₂ CO ₂	\checkmark
С	Fe ₂ O ₃ + 3CO 2Fe + 3CO ₂	\checkmark
D	CaCO ₃ CaO + CO ₂	×

34 The oxygen in air can be removed by passing air over heated copper using the apparatus in the diagram.



80 cm³ of air is collected in gas syringe 1. Each syringe, 1 and 2, is pushed alternatively so that the air passes repeatedly over the heated copper.

When the volume of gas no longer changes, and the gas has cooled to room temperature, what volume of air will remain?

A 20 cm³ **B** 40 cm³ **C** 64 cm³ **D** 80 cm³

35 Biodiesel, made by vegetable oil, can be used as a fuel for cars. Even though carbon dioxide is released when biodiesel is combusted, some scientists still claimed that biodiesel is a carbon neutral fuel. What is the basis for this argument?

A Biodiesel is not a carbon compound.

- **B** Plants release carbon dioxide in respiration.
- **C** Biodiesel produces less carbon dioxide when burnt.
- **D** Plants take up carbon dioxide as they photosynthesize.
- 36 Crude oil is separated into different fractions by fractional distillation. Fraction X is obtained from near the top of the fractionating column. Fraction Y is obtained from near the bottom of the fractionating column. Which row of the table shows the ease of ignition and viscosity of fraction X compared with fraction Y?

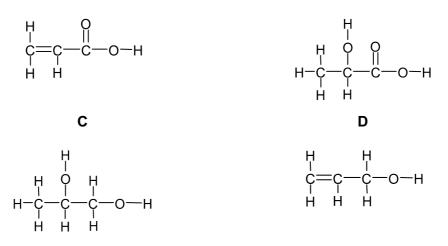
	ease of ignition	viscosity
Α	easier than Y	higher than Y
В	easier than Y	lower than Y
С	more difficult than Y	higher than Y
D	more difficult than Y	lower than Y

37 How many other isomers does butan-1-ol have?

A 1 **B** 2 **C** 3 **D** 4

- 38 An organic compound S has the following reactions:
 - oxidised by potassium manganate(VII)
 - decolourises aqueous bromine at room temperature

Which of the following structures represents S?

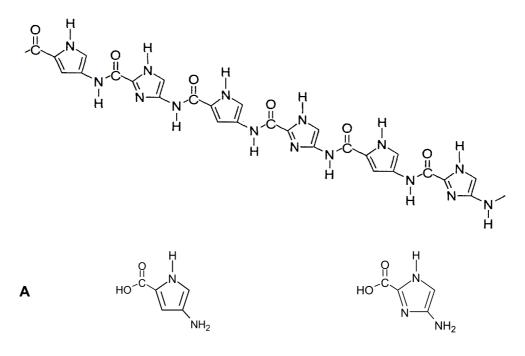


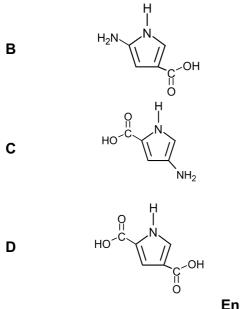
39 A food chemist wants to create the odour of pineapples using the organic compound $CH_3COOCH_2CH_2CH_2CH_3$.

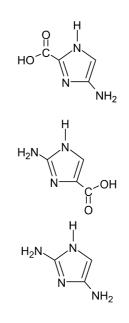
Which of the following pairs of reactants would react to form this compound and what is the name of the compound formed?

	reactant 1	reactant 2	name of compound
Α	CH₃CH₂OH	$CH_3CH_2CH_2CH_2OH$	ethyl butanoate
В	CH₃CH₂OH	CH ₃ CH ₂ CH ₂ COOH	ethyl butanoate
С	CH₃COOH	CH ₃ CH ₂ CH ₂ CH ₂ OH	butyl ethanoate
D	CH ₃ CH ₂ CH ₂ COOH	CH₃COOH	butyl ethanoate

40 The structure below shows part of a polymer. Which one of the following options show the correct monomers?









correct answer will score one ma	ark. A mark will not be deducted
ouah workina should be done in	this booklet.

A copy of the Periodic Table is printed on page 19.

QUEENSWAY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2022

SECONDARY 4 EXPRESS

CHEMISTRY

Paper 1 Multiple Choice

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil. Do not use staples, paper clips, glue or correction fluid.

Write your name and index number on the Answer Sheet in the spaces provided.

There are forty questions on this paper. Answer all questions. For each question, there are four possible answers, A, B, C and D.

Choose the one you consider correct and record your choice in soft pencil on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.



NAME:

INDEX NO:

Parent's Signature:

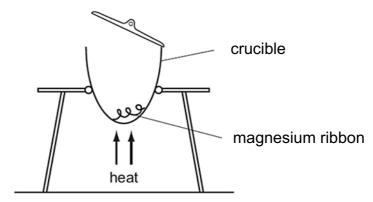
16 September 2022

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1 hour

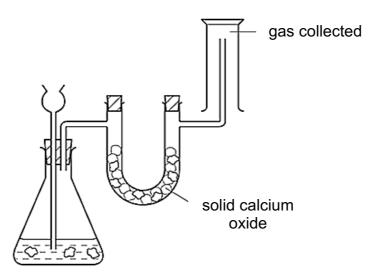
CLASS:

1 The diagram shows an experiment to find the empirical formula of magnesium oxide.



Which of the following pieces of apparatus is needed in addition to those shown above?

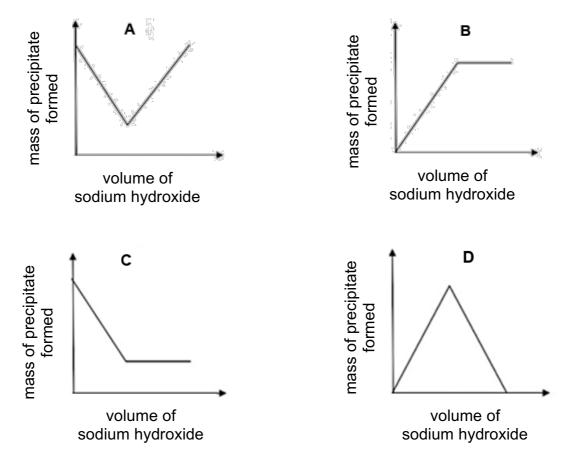
- A electronic balance
- **B** measuring cylinder
- **C** stopwatch
- **D** thermometer
- 2 The diagram below shows the setup for a chemical reaction which produces a gas. The gas is then dried and collected.



What could the gas be?

- A hydrogen
- **B** nitrogen dioxide
- **C** oxygen
- **D** sulfur dioxide

- **3** Which of the following solid mixtures can be separated into its components by adding water, stirring, and filtering?
 - A ammonium carbonate and sodium chloride
 - B calcium nitrate and barium chloride
 - C copper and silver iodide
 - **D** iron(II) carbonate and lithium sulfate
- 4 Which graph shows how the mass of precipitate changes with the volume of sodium hydroxide solution added to zinc nitrate solution?

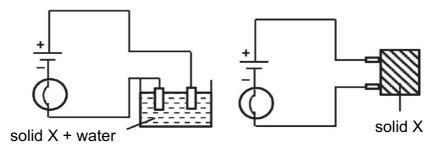


- 5 Under the same conditions, which gas diffuses at the same rate as nitrogen gas?
 - A carbon dioxide
 - B carbon monoxide
 - **C** neon
 - D sulfur dioxide

6 The electronic configuration of an ion M³⁺ is 2, 8, 8. There are 21 neutrons in the nucleus of M.

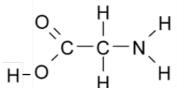
What is the mass number of M?

- **A** 36
- **B** 39
- **C** 42
- **D** 57
- 7 Two circuits are shown below. The light bulb lights up in only one of the circuits.



What is the identity of X?

- A barium sulfate
- **B** potassium bromide
- **C** sodium
- D sugar
- 8 The amino acid, glycine, has the structure shown below.



How many electrons are not involved in bonding?

- **A** 8
- **B** 10
- **C** 20
- **D** 22

9 0.5 mol of sodium chloride and 0.5 mol of sodium sulfate are dissolved together in water and made up to 500 cm³ of solution.

What is the concentration of sodium ions in the solution?

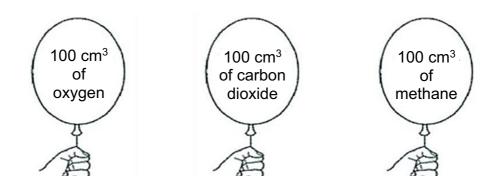
- **A** 0.5 mol/dm³
- **B** 1.0 mol/dm³
- **C** 2.0 mol/dm³
- **D** 3.0 mol/dm³
- **10** Ammonium nitrate, NH₄NO₃, decomposes to form dinitrogen oxide and water upon heating as shown in the equation below.

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$

When an impure sample of ammonium nitrate is heated, 27 g of water is formed.

Which expression shows the mass of ammonium nitrate in the impure sample?

- **A** $44 \times \frac{27}{36}$ g **B** $80 \times \frac{27}{18}$ g **C** $80 \times \frac{27}{36}$ g **D** $80 \times \frac{54}{18}$ g
- 11 The diagram shows three balloons filled with different gases.



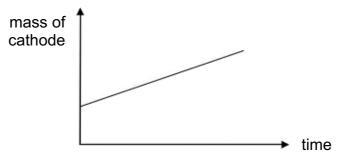
Three statements were made about the balloons.

- 1 The number of moles of gases in the three balloons is the same.
- 2 The number of molecules in the three balloons is different.
- 3 The mass of gases in the three balloons is different.

Which statements are correct?

- A 1 and 2 only
- **B** 1 and 3 only
- C 2 and 3 only
- **D** 1, 2 and 3

12 An aqueous solution T is electrolysed. The current is constant, and the cathode is weighed at regular intervals. The graph shown is obtained when the mass of cathode is plotted against time.



Which combination of anode, cathode and solution T will not produce the graph shown?

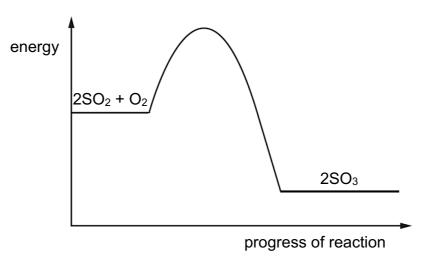
	cathode	anode	solution T
Α	copper	copper	copper(II) nitrate solution
В	graphite	graphite	copper(II) nitrate solution
С	graphite	graphite	dilute sulfuric acid
D	graphite	silver	silver nitrate solution

13 In an experiment, 2 moles of aluminium ions, Al^{3+} , were discharged in the electrolysis of molten aluminium oxide.

Which row shows the correct number of moles of metal ions discharged by the same amount of electricity?

_	amount of metal ions discharged	electrolyte
Α	2 moles of Cu ²⁺	copper(II) nitrate solution
В	3 moles of Ag⁺	silver nitrate solution
С	3 moles of Pb ²⁺	molten lead(II) nitrate
D	6 moles of Zn ²⁺	molten zinc nitrate

14 The energy profile diagram for the reversible reaction $2SO_2 + O_2 \rightleftharpoons 2SO_3$ is shown.



Which statements about this reaction are both correct?

	statement 1	statement 2		
Α	The reverse reaction is endothermic.	The activation energy is different for the forward and reverse reactions.		
в	The reverse reaction is endothermic.	The activation energy is the same for the forward and reverse reactions.		
с	The reverse reaction is exothermic.	The activation energy is different for the forward and reverse reactions.		
D	The reverse reaction is exothermic.	The activation energy is the same for the forward and reverse reactions.		

15 Halogens can react with hydrogen to form hydrogen halides. Hydrogen fluoride, HF, can be made from the reaction of hydrogen with fluorine.

$$\mathsf{H}_{2}\left(g\right)+\mathsf{F}_{2}\left(g\right)\rightarrow2\mathsf{HF}\left(g\right)$$

The table lists some bond energies involved.

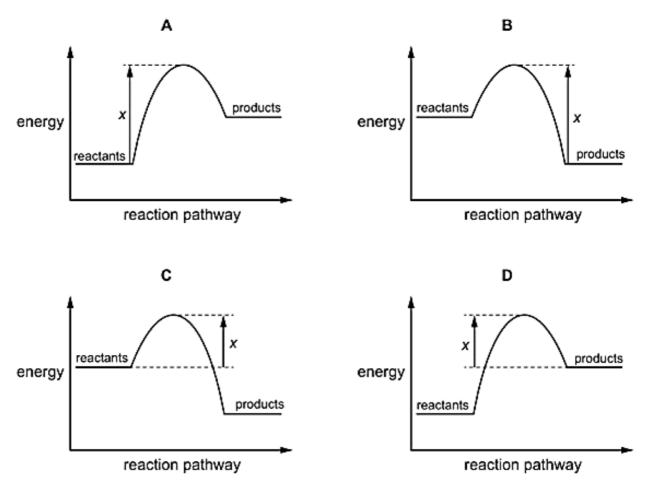
bond	bond energy / kJ/mol		
F – F	159		
H–H	436		
H – F	569		

What is the enthalpy change for the formation of hydrogen fluoride from its elements?

- **A** -543 kJ
- **B** -26 kJ
- **C** +26 kJ
- **D** +543 kJ

16 An endothermic reaction has an activation energy of x.

Which energy profile diagram is correct for this reaction?



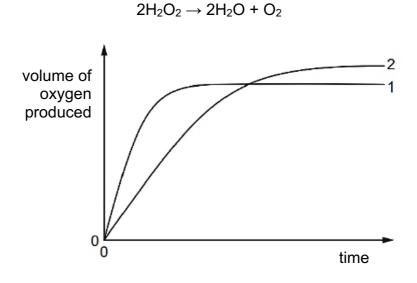
17 Equations for some reactions of iron and iron compounds are shown.

$\begin{array}{c} \mathsf{Fe}+\mathsf{2HC}l \rightarrow \mathsf{FeC}l_2 + \mathsf{H}_2\\ \mathsf{2FeC}l_2 + \mathsf{C}l_2 \rightarrow \mathsf{2FeC}l_3\\ \mathsf{FeSO}_4 + \mathsf{Mg} \rightarrow \mathsf{Fe} + \mathsf{MgSO}_4\\ \mathsf{FeSO}_4 + \mathsf{2NaOH} \rightarrow \mathsf{Fe}(\mathsf{OH})_2 + \mathsf{Na}_2\mathsf{SO}_4 \end{array}$

How many of these are redox reactions?

- **A** 1
- **B** 2
- **C** 3
- **D** 4

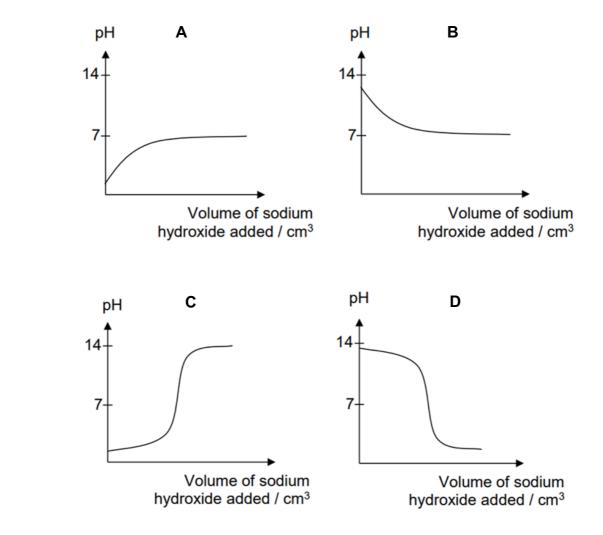
18 In the graph shown, curve 1 was obtained from the decomposition of 100 cm³ of 1.0 mol/dm³ hydrogen peroxide solution, catalysed by manganese(IV) oxide.



Which change to the original experimental conditions would produce curve 2?

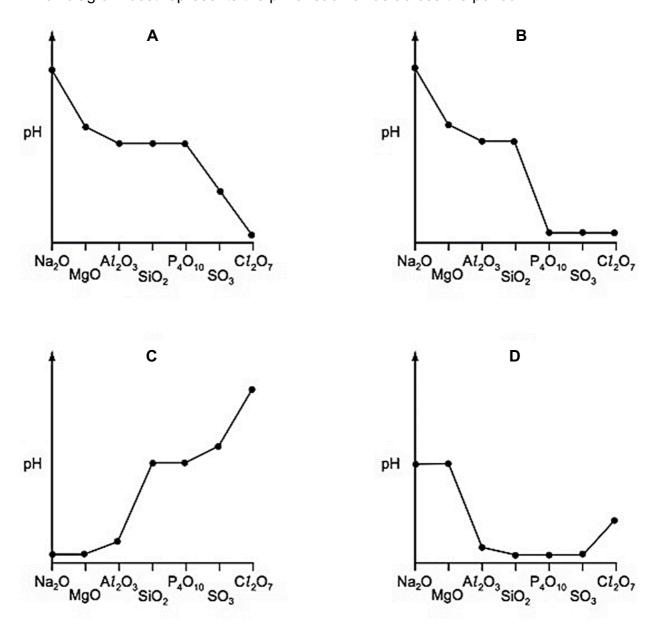
- A adding some 0.1 mol/dm³ hydrogen peroxide solution
- B lowering the temperature
- **C** using a different catalyst
- **D** using less manganese(IV) oxide

19 Which graph shows the changes in pH as aqueous sodium hydroxide is added gradually until it is in excess to dilute hydrochloric acid in a conical flask?



- 20 Which of the following methods will **not** produce ammonia as a product?
 - A heating concentrated aqueous ammonia
 - **B** heating solid ammonium chloride
 - **C** warming aqueous ammonium nitrate with calcium hydroxide
 - **D** warming aqueous sodium nitrate with sodium hydroxide

21 Some oxides of the elements from sodium to chlorine are separately added to water. Which diagram best represents the pH of each oxide across the period?



- 22 Which of the following reactions will produce the highest yield of calcium sulfate?
 - A add excess calcium to sodium sulfate solution
 - **B** add excess calcium carbonate to dilute sulfuric acid
 - **C** add excess calcium nitrate to dilute sulfuric acid
 - D mix solid calcium nitrate and solid potassium sulfate

- **23** Ammonia is produced via the Haber process. Three statements on the Haber process are shown below.
 - I The Haber process is usually carried out at 450 °C and 200 atm.
 - II Unreacted hydrogen and nitrogen are recycled back to the reaction chamber.
 - III The chemical reaction becomes irreversible when finely divided iron catalyst is used.

Which of these statement(s) is/are correct?

- A I only
- **B** I and II only
- C II and III only
- **D** I, II and III
- **24** Elements X, Y and Z are in the same period of the Periodic Table.

The properties of the oxides formed by these elements are shown below.

oxide X	reacts with dilute hydrochloric acid
oxide Y	reacts with aqueous sodium hydroxide
oxide Z	reacts with both dilute hydrochloric acid and
	aqueous sodium hydroxide

What is the order of the elements X, Y and Z in increasing atomic number?

- **A** X, Y, Z
- **B** X, Z, Y
- **C** Y, X, Z
- **D** Y, Z, X
- **25** Rubidium is below potassium in Group I of the Periodic Table.

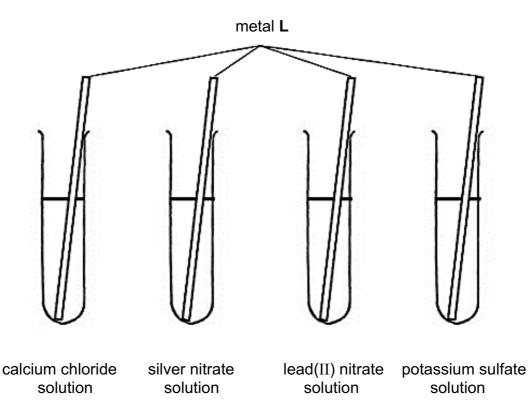
Which statement is most likely to be correct?

- **A** Rubidium is less dense than potassium.
- **B** Rubidium has a higher melting point than potassium.
- **C** Rubidium reacts more vigorously than potassium with water.
- **D** The rubidium ion has a higher positive charge than the potassium ion.

- 26 Element Z has the following properties:
 - forms ZBr₃ when heated with bromine
 - forms ZSO₄ when reacted with dilute sulfuric acid

To which part of the Periodic Table does Z belong?

- **A** Group II
- **B** Group III
- **C** Group IV
- **D** the transition elements
- **27** Four strips of an unknown metal **L** were placed in four test tubes of solutions as shown below.



A deposit was seen on metal L in only two of the test tubes.

What could L be?

- A copper
- **B** silver
- **C** sodium
- D zinc

- **28** The reactions of four metals, P, Q, R and S, are described below.
 - Metals Q and S can be extracted by reacting their metal oxides with carbon, but metals P and R can only be extracted by electrolysis of its molten compounds.
 - Metal Q can be extracted by heating its metal oxide with metal S.
 - The carbonate of P decomposes more readily than the carbonate of R.

Which is the correct order, in decreasing reactivity, of the four metals?

- **A** P, R, Q, S
- **B** P, R, S, Q
- **C** R, P, Q, S
- **D** R, P, S, Q
- **29** Three types of steel have different properties.

steel 1: easily shaped steel 2: brittle steel 3: resistant to corrosion

Which option best describes these three types of steel?

	steel 1	steel 2	steel 3
Α	high carbon	mild	stainless
В	high carbon	stainless	mild
С	mild	high carbon	stainless
D	mild	stainless	high carbon

- 30 Which method is least likely to slow down the rate of rusting of an iron rod?
 - A attaching a silver rod to the iron rod
 - **B** coating a layer of aluminium on the iron rod
 - **C** covering the surface of the iron rod with plastic
 - **D** galvanising the iron rod with zinc

31 The table shows the range of boiling points of four fractions obtained when crude oil is distilled.

fraction	W	Х	Y	Z
boiling point/ °C	35 – 75	80 – 145	150 – 250	greater than 250

Which statement describing the fractions is true?

- A Fraction W is more flammable than fraction Y.
- **B** Fraction W is more viscous than fraction Z.
- **C** The density of fraction X is greater than that of fraction Z.
- **D** The molecules in fraction X have a longer chain length than those in fraction Z.
- **32** An experiment was done to determine the formula of a hydrocarbon, C_xH_y .

10 cm³ of the gaseous hydrocarbon, C_xH_y , was burned in an excess of oxygen to form 20 cm³ of carbon dioxide and 30 cm³ of water vapour.

What is the formula of the hydrocarbon, C_xH_y?

- **A** CH₄
- **B** C₂H₄
- **C** C₂H₆
- **D** C₃H₈
- **33** When tetradecane, C₁₄H₃₀, is cracked, only three hydrocarbons are formed. The hydrocarbons are ethene, propane and propene.

ethene propene propane Α 1 1 1 2 2 В 1 С 3 1 1 D 4 1 1

What is the ratio of the hydrocarbons formed?

34 Linoleic acid is an unsaturated carboxylic acid and is one of two essential carboxylic acids that are required by humans. Linoleic acid has the molecular formula C₁₇H₃₁COOH.

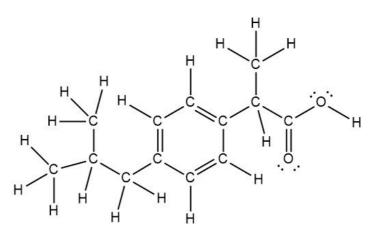
How many carbon-carbon double bond(s) is/are present in a molecule of linoleic acid?

- **A** 1
- **B** 2
- **C** 3
- **D** 4

- **35** The preparations of three substances are given.
 - 1 ethanol from ethene
 - 2 margarine from a vegetable oil
 - 3 an ester from an alcohol and a carboxylic acid

In which preparations are one or more double bonds converted to single bonds?

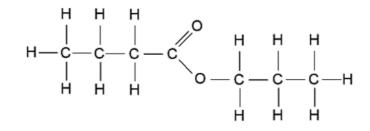
- A 1 only
- **B** 3 only
- **C** 1 and 2 only
- **D** 2 and 3 only
- **36** What is the minimum number of moles of oxygen molecules required for the complete combustion of one mole of propanol?
 - **A** 3.0
 - **B** 4.5
 - **C** 7.0
 - **D** 9.0
- **37** Ibuprofen is a drug used as an alternative to aspirin for the relief of pain, fever and inflammation. The structure of ibuprofen is shown below.



Which one of the following statements about ibuprofen is not correct?

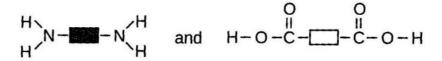
- A It liberates carbon dioxide with sodium carbonate solution.
- **B** It liberates hydrogen with magnesium metal.
- **C** It undergoes esterification with ethanol.
- **D** It undergoes oxidation with acidified potassium manganate(VII).

38 The diagram shows the structure of an ester.

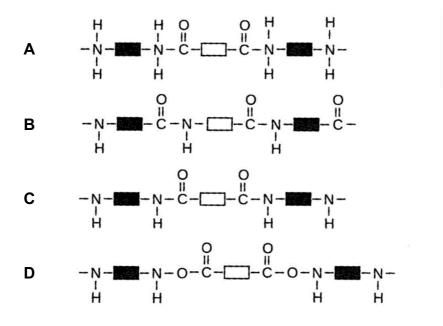


What are the reagents required to produce the ester above?

- **A** butanoic acid and butanol
- **B** butanoic acid and propanol
- **C** propanoic acid and butanol
- **D** propanoic acid and propanol
- **39** A condensation polymer is to be made from the two monomers shown.



Which diagram shows the structure of the polymer?



40 A catalytic converter in a car exhaust system changes pollutants into less harmful products.

Which change does not occur in the catalytic converter?

- **A** carbon dioxide \rightarrow carbon
- $\textbf{B} \quad \text{carbon monoxide} \rightarrow \text{carbon dioxide}$
- **C** nitrogen oxides \rightarrow nitrogen
- **D** unburnt hydrocarbons \rightarrow carbon dioxide and water vapour

END OF PAPER

]						E
	0	2 He ^{helium}	Ne 10	neon 20	18 Ar	argon 40	36	۔ ع	krypton 84	54	Xe	xenon 131	86	Rn	radon -					11	Lu	Iutetium 175	103		
	۸II		௳ட	fluorine 19	C 1	chlorine 35.5	35	Ъ.	bromine 80	53	I	iodine 127	85	At	astatine -							ytterbium 173			
	١٧		∞O	oxygen 16	ე მ	sulfur 32	34	Se.	selenium 79	52	Te	tellurium 128	84	Ро	polonium I	116	<u>ک</u>			69	Tm	thulium 169	101	Md	
	V		≻ Z	nitrogen 14	15 P	phosphorus 31	33	As	arsenic 75	51	Sb	antimony 122	83	Bi	bismuth 209					68	ц	erbium 167	100	Fm	
	N		ဖပ	carbon 12	74 Si 4	silicon 28	32	Ge.	germanium 73	50	Sn	tin 119	82	Pb	lead 207	114	F/ forming			67	위	holmium 165	66	Es	
			Въ	boron 11	13 A <i>1</i>	aluminium 27	31	ga	gallium 70	49	II	indium 115	81	Tl	thallium 204					99	D	dysprosium 163	98	Cf	
							30	Zn	zinc 65	48	B	cadmium 112	80	Hg	mercury 201	112	Cn			65	Tb	terbium 159	97	BK BK	
J							29	Си	copper 64	47	Ag	silver 108	62	Au	gold 197	111	Rg			64	Ъд	gadolinium 157	96	Cm	
												palladium 106						-		63	Ш	europium 152	95	Am	
							27	ပို	cobalt 59	45	Ъ	rhodium 103	17	ľ	iridium 192	109	Mt			62	Sm	samarium 150	94	Pu	
		1 H hydrogen 1					26	е.	1701 56	44	Ru	ruthenium 101			-		Hs			61	Ъп	promethium -	93	Np	
							25	Mn	manganese 55	43	ц	technetium -	75	Re	rhenium 186	107	Bh			60	ΡN	m neodymium pr 144	92	U minor	238 238
			umber ool	mass			24		chromium 52	42	Мо	m molybdenum tech 96	74	≥	tungsten 184	106	Sg				Pr	praseodymium 141	91	Pa	231
		Key	proton (atomic) number atomic symbol	name relative atomic mass			23	> :	vanadium 51	41	qN	niobium 93	73	Ta	tantalum 181	105	Db			58	Ce	cerium 140	06	Th the	232
			proton atc	relativ			22	Ē	titanium 48	40	Zr	zirconium 91	72	Hf	hafnium 178	104	Rf			57	La	lanthanum 139	89	Ac	
								s S	scandium 45	39	≻	yttrium 89	57 - 71	lanthanoids		89 – 103	actinoids			S					
	=		4 Be	beryllium 9	12 Mg	magnesium 24	20	Ca	calcium 40	38	പ്	strontium 88	56	Ba	barium 137	88	Ra			anthanoids			actinoids		
	_		с Гі	lithium 7	11 a	sodium 23	19	¥.	potassium 39	37	Rb	rubidium 85	55	S	caesium 133	87	Er ,								

The Periodic Table of Elements

The volume of one mole of any gas is 24 \mbox{dm}^3 at room temperature and pressure (r.t.p.).

RIVERSIDE SECONDARY SCHOOL



PRELIMINARY EXAMINATION 2022

SUBJECT

: CHEMISTRY

: 6092/01

PAPER

LEVEL/STREAM : 4 Express

DURATION : 1 Hour

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid. Write your name, register number and class on the Answer Sheet in the spaces provided

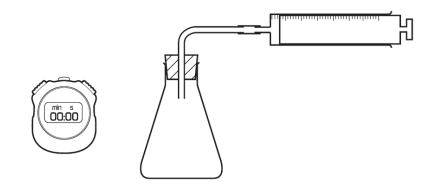
unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C**, and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this question paper. A copy of the Periodic Table is printed on page 18. The use of an approved scientific calculator is expected, where appropriate. 1 The apparatus shown can be used to find the rate of some chemical reactions.



The rate of which reaction can be followed using these apparatus?

- A $Cu + H_2SO_4$
- **B** NaOH + CuSO₄
- **C** $Mg(HCO_3)_2 + HCl$
- D NaOH + HCl
- 2 The melting and boiling points of four substances are shown in the table.

Which substance will be condensed if passed through a water condenser at room temperature?

	hydrocarbon	melting point/ °C	boiling point/ °C
Α	butane	-135	0
В	carbon dioxide	-78.5	-78.5
С	pentane	-130	38
D	propane	-190	-45

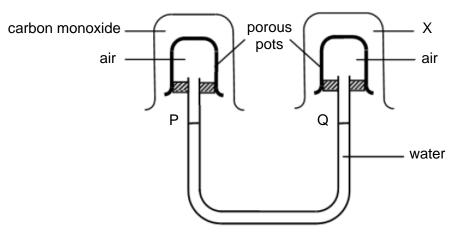
3 An acid, X, was added to a solution of the nitrate of metal Y.

A white precipitate was formed.

What are X and Y?

	Х	Y
Α	dilute hydrochloric acid	calcium
в	dilute hydrochloric acid	zinc
С	dilute sulfuric acid	aluminium
D	dilute sulfuric acid	barium

4 This experiment was set up to investigate the movement of gaseous substances.



The water level at P moved down initially.

What is substance X?

- A helium
- B methane
- **C** nitrogen
- D nitrogen oxide
- 5 A radioactive isotope of carbon has more nucleons than the non-radioactive isotope, ${}_{6}^{12}$ C. Which row is correct for an atom of a radioactive isotope of carbon?

	protons	neutrons	electrons
Α	6	6	6
в	6	8	6
С	12	6	6
D	12	12	12

- 6 Substance T has the properties described below.
 - conducts electricity when molten
 - melting point higher than 600 °C
 - highly soluble in water

What is substance T?

- A ammonia
- **B** copper(II) oxide
- C magnesium chloride
- D zinc
- When solid iodine is heated, it sublimes and changes into a purple gas.Which statement describes the process?

A Attractive forces between iodine molecules are overcome.

- **B** Covalent bonds between iodine molecules are broken.
- **C** Intermolecular forces between iodine atoms are overcome.
- **D** lonic bonds between the iodine atoms are weakened.
- 8 Which molecule has the largest number of electrons involved in covalent bonds?
 - A carbon dioxide
 - B ethene
 - C methanol
 - D nitrogen

9 Which substance is a metal?

	conduct	electricity	physical state of product		
	when solid	when liquid	formed on reaction with oxygen		
Α	\checkmark	\checkmark	solid		
В	\checkmark	\checkmark	gas		
С	X	\checkmark	no reaction		
D	X	×	solid		

10 The formula for hydrated sodium carbonate is Na₂CO₃.*x*H₂O. It contains 62.9% water of crystallisation by mass.

Which other information is needed to determine the value of x?

- A atomic numbers of carbon, oxygen and sodium
- **B** atomic numbers of carbon, oxygen, sodium and hydrogen
- **C** relative atomic masses of carbon, oxygen and sodium
- **D** relative atomic masses of carbon, oxygen, sodium and hydrogen
- **11** A 25.0 cm³ sample of dilute sulfuric acid contains 0.05 moles of the acid.

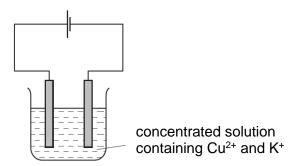
What is the concentration of hydrogen ion in the solution?

- **A** 1.0 mol/dm³
- **B** 2.0 mol/dm³
- **C** 4.0 mol/dm³
- **D** 8.0 mol/dm³
- **12** 126 g of potassium manganate(VII), KMnO₄, is needed for the complete oxidation of 46 g of ethanol, C₂H₅OH, under acidic conditions.

How many moles of ethanol can be completely oxidised by one mole of potassium manganate(VII) under these conditions?

- **A** 0.37
- **B** 0.80
- **C** 1.00
- **D** 1.25

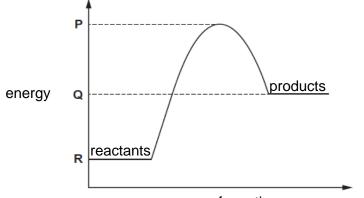
13 The diagram shows the electrolysis of a concentrated aqueous solution containing both copper(II) ions and potassium ions.



Which metal is deposited at the negative electrode and why?

	metal deposited	reason
Α	copper	copper is less reactive than hydrogen
В	copper	copper is more reactive than hydrogen
С	potassium	potassium is less reactive than hydrogen
D	potassium	potassium is more reactive than copper

14 The energy profile diagram for the **forward** reaction of a reversible reaction is shown.



progress of reaction

For the reverse reaction, which statement is correct?

- **A** It is endothermic and the activation energy is P Q.
- **B** It is endothermic and the activation energy is P R.
- **C** It is exothermic and the activation energy is P Q.
- **D** It is exothermic and the activation energy is P R.

15 0.24 g of magnesium ribbon was allowed to react at 25 °C with 20 cm³ of 1.0 mol/dm³ dilute hydrochloric acid.

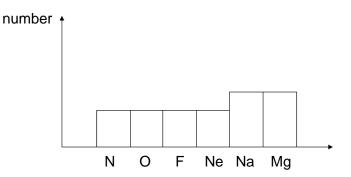
Which factor would not result in an increase in the initial rate of the reaction?

- A carrying out the reaction at 30 °C
- **B** using 40 cm³ of 1.0 mol/dm³ dilute hydrochloric acid
- **C** using a catalyst
- **D** using powdered magnesium
- **16** At the start of a reaction, 1.00 dm³ of a solution contains 0.300 mol of ethanol.

After 100 seconds, the concentration of the ethanol decreased to 0.297 mol/dm³.

What is the rate of reaction over the first 100 seconds?

- **A** 2.96 x 10⁻³ mol/dm³ / s
- **B** 3.00 x 10⁻⁵ mol/dm³ / s
- **C** 4.00 x 10⁻⁵ mol/dm³ / s
- D 8.00 x 10⁻⁵ mol/dm³ / s
- **17** The chart shows the variation for a specific 'number' related to the elements, nitrogen to magnesium.



According to the trend, what is this 'number'?

- A the number of electron shells
- **B** the number of protons and neutrons
- **C** the number of valence electrons
- D the oxidation number

18 Oxidising strength is a relative term used to denote how certain elements oxidise other elements with respect to each other.

Which list represents the halogen in decreasing order of oxidising strength?

	decreasing oxidising strength				
Α	chlorine	bromine	iodine		
В	chlorine	iodine	bromine		
С	iodine	bromine	chlorine		
D	iodine	chlorine	bromine		

- **19** The list gives four oxides.
 - 1 carbon dioxide
 - 2 copper(II) oxide
 - 3 magnesium oxide
 - 4 zinc oxide

Which pair of oxides can react with sodium hydroxide?

- A 1 and 2
- **B** 1 and 4
- **C** 2 and 4
- **D** 3 and 4
- 20 Salt P is prepared by reacting aqueous metal carbonate and dilute acid.Which is salt P?
 - A copper(II) chloride
 - B silver chloride
 - **C** sodium nitrate
 - D zinc sulfate

21 The reaction in the Haber process is represented as

 $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta H = -92 \text{ kJ}$

Which statement about the Haber process is incorrect?

- A 92 kJ of heat is given off when 2 mol of ammonia are formed.
- **B** Iron is used as catalyst.
- **C** The process is carried out at a high pressure of 250 atm.
- **D** When 2 mol of N_2 and 6 mol of H_2 are used, 4 mol of NH_3 are collected.
- 22 The list gives four pairs of compounds.
 - 1 ammonium nitrate and calcium hydroxide
 - 2 ammonium nitrate and calcium nitrate
 - 3 ammonium sulfate and calcium carbonate
 - 4 ammonium sulfate and calcium oxide

Which pairs will produce ammonia when warmed together?

- A 1 and 2 only
- **B** 1 and 4 only
- C 2 and 4 only
- **D** 3 and 4 only
- **23** The table shows data for atoms or ions of the elements P, Q, R and S. The letters do not represent the chemical symbols of the elements.

	number of electrons	number of protons
Р	11	11
Q	10	13
R	18	17
S	18	18

Which statement is correct?

- A P and S are inert.
- **B** Q and R form a compound with a formula QR₃.
- **C** P combines with oxygen to form acidic oxides.
- **D** R and S have different number of valence electrons.

- 24 Which statement(s) is/are true about all the noble gases?
 - 1 The number of protons in their atoms equals the number of neutrons.
 - 2 They all have eight electrons in their outer shell.
 - 3 They do not react to form ionic compounds.
 - **A** 1, 2 and 3 only
 - **B** 1 and 2 only
 - C 2 only
 - D 3 only

25	Which element in the table is like	ly to be a transition metal?

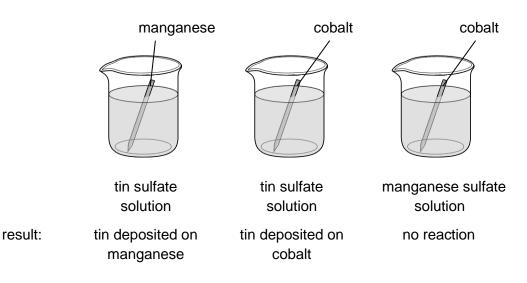
	melting point	colour of chloride	variable oxidation state	use as catalyst
Α	high	blue	yes	yes
В	low	green	no	yes
С	high	white	yes	no
D	low	white	no	no

26 Properties of an element and its compounds can be predicted from the position of the element in the Periodic Table.

What property cannot be predicted in this way?

- A The catalytic property of the element or its compound.
- **B** The nature of the oxide of the element.
- **C** The number of isotopes the element has.
- D The reactivity of the element.

27 Three experiments to compare the reactivity of three metals are shown in the diagram. Arrange them from least reactive to most reactive.



	least reactive		most reactive
Α	cobalt	tin	manganese
в	tin	cobalt	manganese
С	manganese	cobalt	tin
D	manganese	tin	cobalt

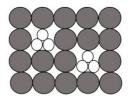
В

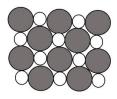
D

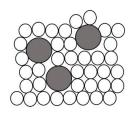
28 Which diagram best represents an alloy?



С







29 A block of magnesium is attached to an underground steel pipe.

Which will happen if a block of lead is used instead of magnesium?

- A All of the lead will be oxidised.
- **B** Iron in steel will be oxidised to form Fe³⁺.
- **C** The steel will corrode as it gets reduced.
- **D** The steel will produce green deposits.
- **30** The metal beryllium does not react with cold water.

It reacts with dilute hydrochloric acid but cannot be extracted from its ore by using carbon.

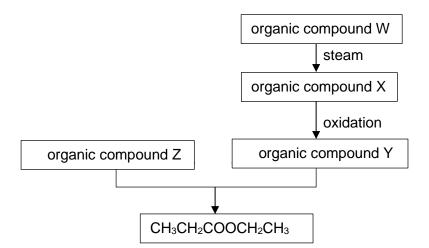
Where should it be placed in the reactivity series?



31 Which row correctly compares carbon dioxide and water vapour?

	both formed during respiration	both present in unpolluted air
Α	\checkmark	\checkmark
В	\checkmark	X
С	X	\checkmark
D	X	X

- **32** Which molecule is **not** formed when pentane reacts with chlorine in the presence of sunlight?
 - **A** $C_5H_6Cl_6$ **B** $C_5H_{10}Cl_2$ **C** $C_5H_5Cl_4$ **D** $C_5H_4Cl_8$
- **33** An odour of pineapple comes from the organic compound, CH₃CH₂COOCH₂CH₃. It can be made using the reaction scheme below.

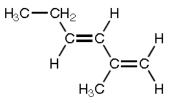


Which row correctly identifies X and Z?

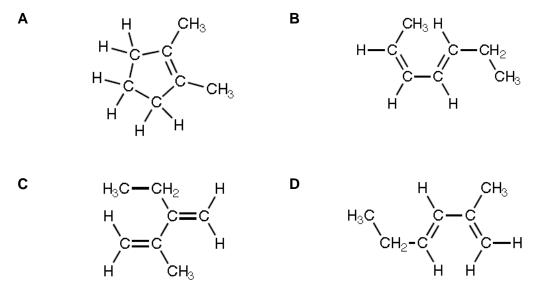
	Х	Z
Α	CH ₃ CH ₂ OH	CH ₃ CH ₂ OH
в	CH ₃ CH ₂ COOH	CH₃CH₂OH
С	CH ₃ CH ₂ OH	CH ₃ CH ₂ COOH
D	$CH_3CH_2CH_2OH$	CH ₃ CH ₂ OH

- **34** Which pair of substances are possible products when 1 mole of C₈H₁₈ undergoes cracking in the presence of aluminium oxide and silicon dioxide?
 - 1 2 mole of C_4H_8 only
 - 2 1 mole of C_2H_4 and 1 mole of C_6H_{14}
 - 3 1 mole of C_3H_6 and 2 mole of H_2
 - 4 3 mole of CO_2 and 4 mole of H_2O
 - A 1, 3 and 4 only
 - **B** 1 and 4 only
 - C 1 only
 - D 2 only

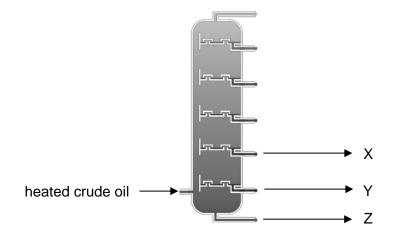
35 The diagram shows a long-chain molecule.



Which structure is not an isomer of the molecule?



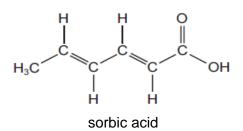
36 The diagram below shows the fractional distillation of crude oil.



Which statement is correct?

- **A** Fraction X is used as fuel for cooking.
- **B** Fractions X, Y and Z are each obtained as mixture of hydrocarbons.
- **C** Fraction Y is more flammable than fraction X.
- **D** Fraction Z has the lowest boiling point of the three fractions.

37 Sorbic acid is used as a food preservative because it kills fungi and moulds.



Which are the reaction(s) that sorbic acid can undergo?

- 1 decolourises bromine in an organic solvent
- 2 reacts with aqueous sodium carbonate to produce carbon dioxide
- 3 reacts with hydrogen in the presence of a nickel catalyst
- A 1 only
- **B** 1 and 2 only
- C 1 and 3 only
- D all of the above

38 Three beakers contain the following acid solutions.

beaker A	50 cm ³ 1.00 mol/dm ³ dilute hydrochloric acid
beaker B	50 cm ³ 1.00 mol/dm ³ dilute sulfuric acid
beaker C	50 cm ³ 1.00 mol/dm ³ ethanoic acid

A 10 cm length of magnesium is added to each beaker. The magnesium reacted completely in each case.

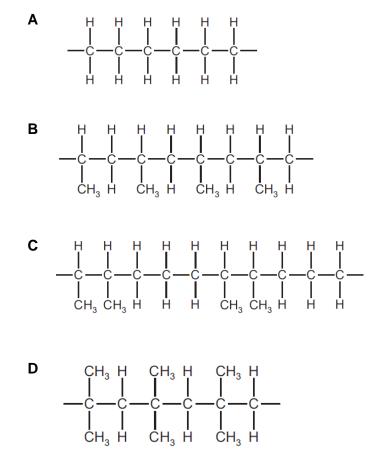
Each reaction produced 100% yield of the products.

It was observed that 100 cm³ hydrogen gas was formed when the magnesium reacted with dilute hydrochloric acid.

Which row shows the correct observations when beakers B and C were compared with beaker A?

	speed o	f reaction	volume of hydrogen formed at the end of the reaction					
	beaker B	beaker C	beaker B	beaker C				
Α	faster	slower	more	less				
В	faster	slower	same	same				
С	slower	faster	more	less				
D	slower	faster	same	same				

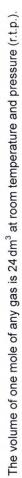
39 What is the partial structure of the polymer formed by the polymerisation of propene, CH₃CH=CH₂?



40 Which bond is present in both nylon and Terylene?

- **C** N C
- **D** N H

	0	2 He helium	4	10	Ne	neon	18	Ar	argon 40	36	Kr	krypton 84	54	Xe	xenon	131	86	Rn	radon –					71	Lu	175	103	2	awrencium	1
	VII			0	ш	fluorine 10	17	Cl	chlorine 35.5	35	Br	bromine 80	53	Ι	iodine	127	85	At	astatine -					70	Υb	erbium 173	00		pelium	1
	N								sulfur 32												>	livermorium	1	69	Tm	thulium ytte	101		mendelevium	1
	>			7	z	nitrogen 1.1	<u>ד ה</u>	2 ם	phosphorus 31	33	As	arsenic 75	51	Sb	antimony	122	83	Bi	bismuth 209	221				68	ய்	erbium 167	1001	<u>B</u> <u>E</u>	fermium	1
	N			9	U	carbon	14	Si	silicon 28	32	Ge	germanium 73	50	Sn	tin	119	82	Pb	207	114	F/	flerovium	1	67	Ч	holmium 165	00	ם מ ע	einsteinium	1
	≡			5	В	boron	- 6	Al	aluminium 27															66	Dy	dysprosium 163	80	2 2	californium	1
										30	Zn	zinc 65	48	Cd	cadmium	112	80	Нg	mercury 201	112	10	copernicium	1	65	Tb	150	07	n n	berkelium	1
										29	Cu	copper 64	47	Ag	silver	108	62	Au	gold 197	111	- Ba	roentgenium	1	64	Gd	gadolinium 157	ao	2 2	curium	I
Group	2									28	īZ	nickel 59	46	Pd	palladium	106	78	đ	platinum 195	110		darmstadtium	1	63	Еu	europium 150	OF	dm M	americium	
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e llo		1 H hydrogen	, -									iron 56											1	61	Pm	promethium	03	CN Nn	neptunium	
							_			25	Mn	n chromium manganese	43	ЦС	technetium		75	Re	rhenium 186	107	2 Ha	bohrium	1	59 60 61	PN	neodymium 144	6	76	uranium	238
				number	pol		111033			24	ъ	chromium 52	42	Mo	molybdenum	96	74	3	tungsten 184	106	200	seaborgium	1	59	Pr	praseodymium 1.1.1	10	- c	protactinium	231
			Key	proton (atomic) number	atomic symbol	name rolotivo otomio mose				1	>	vanadium 51	41	qN	niobium	93	73	Ta	tantalum 181	105	26	-	1	58	Ce	cerium 140		0 4 7	thorium	232
				proton	ato	itolot	וכומו			22	Ē	titanium 48	40	Zr	zirconium	91	72	Ŧ	hafnium 178	104	2 2	Rutherfordium	1	57	La	lanthanum 130	00	00	actinium	I
											Sc	C	39	7	yttrium	89	57 - 71	lanthanoids		89 - 103	actinoids			S						
	=			4	Be	beryllium	12	Ma	n magnesium 24	20	Ca	calcium 40	38	S	strontium	88	56	Ba	barium 137	88	Ba Ba	radium	1	lanthanoids				actinoids		
	-			e	:	lithium 7	11	Na	sodium 23	19	×	potassium 39	37	Rb	rubidium	85	55	Cs	caesium 133	87	Ъ	francium	1							





SINGAPORE CHINESE GIRLS' SCHOOL Preliminary Examination Secondary Four

CANDIDATE NAME					
CLASS	4		REGISTER NUMBER		
CENTRE NUMBER			INDEX NUMBER		

Chemistry

Paper 1 Theory

Wednesday

31 August 2022

1 hour

6092/01

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction tape/fluid.

Write your name, class and index number on the Question Paper and Answer Sheet in the spaces provided.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C**, **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

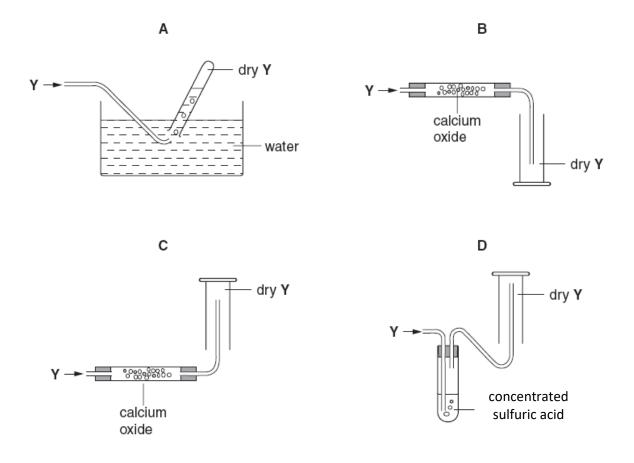
Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 15.

The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of 15 printed pages and 1 blank page.

A gas Y, is less dense than air, very soluble in water and is alkaline.
 Which method is used to collect a dry sample of the gas?



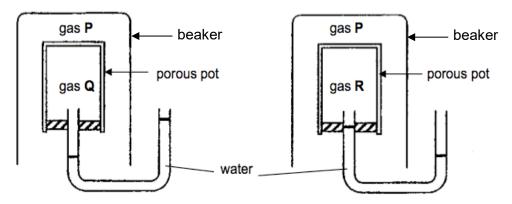
2. The following measurements are made on a sample pure water: its boiling point, its freezing point, and its pH.

Sodium chloride is now dissolved in the water and the measurements repeated.

How do the measurements change?

	boiling point	freezing point	рН
Α	higher	lower	no change
в	higher	higher	increases
С	lower	higher	no change
D	lower	lower	decreases

The apparatus can be used to show the diffusion of gases. Two beakers containing gas P were placed over two porous pots containing gases Q and R respectively. The results are shown below.



What is the correct order of the relative molecular mass of gases P, Q and R?

	Lowest M _r		Highest M _r
Α	R	Р	Q
В	R	Q	Р
С	Q	Р	R
D	Р	Q	R

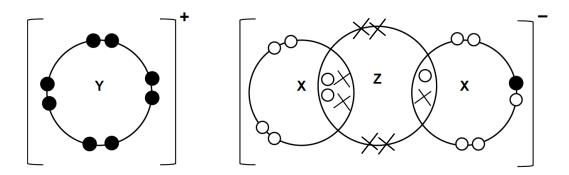
4. A particle contains 31 protons, 40 neutrons and 28 electrons. Which symbol is correct for this particle?

A ${}^{59}_{28}Ni^{3+}$ B ${}^{71}_{31}Ga^{3+}$ C ${}^{70}_{31}Ga$	D $^{59}_{28}Ni^{3-}$
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5. How many electrons in total are shared between the atoms in a molecule of ethene, C_2H_4 , and in a molecule of water, H_2O ?

	ethene	water
Α	6	2
в	10	4
С	12	4
D	14	8

- 6. Which element forms a positive ion with the same electronic configuration as an atom of neon?
 - A chlorine
 - **B** magnesium
 - **C** lithium
 - D oxygen
- 7. X, Y and Z are 3 different elements in the Periodic Table. The "dot and cross" diagram of the compound formed from X, Y and Z is shown below. Only the valence electrons are shown.



Which statements are correct?

- I Element **Y** could be lithium.
- II Element X belongs to Group VII of the Periodic Table.
- **III** Elements **X** and **Z** are bonded together by covalent bonds.
- IV There are more electrons than protons in ZX_2^{-} .
- A I and II only
- B III and IV only
- C I, III and IV only
- **D II**, **III** and **IV** only

8. Substance **X** has a high melting point. It is insoluble in water and organic solvents. It is used as a lubricant and is a conductor of electricity.

What is **X**?

- A copper
- **B** graphite
- **C** potassium chloride
- **D** hydrogen chloride
- **9.** What is the ionic equation, including state symbols for the reaction between zinc carbonate and hydrochloric acid?

Α	ZnCO ₃ (s) +	$2H^{+}(aq) \rightarrow$	Zn ²⁺ (aq) +	H ₂ O(I) +	CO ₂ (g)
В	CO32-(aq) +	$2H^{+}(aq) \rightarrow$	H ₂ O(I) +	CO ₂ (g)	
С	Zn ₂ CO ₃ (s) +	$2H^{+}(aq) \rightarrow$	2Zn⁺(s) +	H ₂ O(I) +	CO ₂ (g)
D	Zn²+(aq) +	CO ₃ ²⁻ (aq) +	$2H^{+}(aq) \rightarrow$	Zn(s) +	$H_2O(I)$ + $CO_2(g)$

- **10.** Which quantity contains the least number of atoms?
 - A 0.6 moles of oxygen gas
 - **B** 0.75 moles of lithium
 - **C** 0.25 moles of ammonia
 - **D** 0.25 moles of methane
- **11.** Brass is a mixture of copper and zinc. A sample of brass has a mass of 24.0 g. When reacted with excess dilute sulfuric acid, 1.85 dm³ of hydrogen was collected.

What is the percentage of copper in the sample of brass?

- **A** 20.9% **B** 41.8% **C** 58.2% **D** 79.1%
- **12.** In leaded petrol there is an additive composed of lead, carbon and hydrogen only. This compound contains 29.7 % carbon and 6.19 % hydrogen by mass.

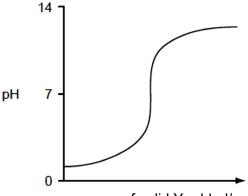
What is the value of x in the empirical formula PbC_8H_X ?

A 5 **B** 6 **C** 16 **D** 20

- **13.** How much sulfuric acid is required to neutralize 100 cm³ of 1.0 mol/dm³ sodium hydroxide?
 - **A** 50 cm³ of 0.5 mol/dm³ sulfuric acid
 - **B** 100 cm³ of 1.0 mol/dm³ sulfuric acid
 - **C** 50 cm³ of 1.0 mol/dm³ sulfuric acid
 - **D** 100 cm³ of 2.0 mol/dm³ sulfuric acid
- **14.** In an experiment, 1 cm³ of gaseous hydrocarbon **X** required 4 cm³ of oxygen for complete combustion to produce 3 cm³ of carbon dioxide. All gas volumes are measured at room temperature and pressure.

Which formula represents X? **A** C_2H_4 **B** C_3H_4 **C** C_3H_8 **D** C_4H_8

15. Solid **Y** was added bit by bit with stirring to an aqueous solution of **Z**. The changes in pH of the mixture are shown in the graph.



mass of solid Y added/g

Identify Y and Z.

	Y	Z
Α	soluble metal oxide	hydrochloric acid
в	soluble metal oxide	ethanoic acid
С	insoluble metal oxide	nitric acid
D	insoluble metal oxide	aqueous ammonia

- **16.** A precipitate of lead(II) hydroxide dissolves in aqueous sodium hydroxide to form a colourless solution. Which property of lead(II) hydroxide can be deduced from the reaction?
 - **A** Lead(II) hydroxide is a reducing agent.
 - **B** Lead(II) hydroxide is basic.
 - **C** Lead(II) hydroxide is soluble in water.
 - **D** Lead(II) hydroxide is amphoteric.
- **17.** The table below shows the properties of five salts, and how they can be prepared.

Which one is magnesium bromide?

	colour	solubility in water	methods to prepare salt
Α	white	soluble	insoluble base and acid
В	brown	soluble	titration
С	white	insoluble	precipitation
D	brown	insoluble	metal and acid

- **18.** Which is a property of the hydroxide ion?
 - **A** It combines with hydrogen to form water.
 - **B** It readily breaks down into hydrogen ions and oxide ions.
 - **C** It is formed when ammonia dissolves in water.
 - **D** It turns methyl orange red.
- **19.** Which statements about sulfuric acid are correct?
 - I A blue precipitate is formed when copper(II) hydroxide is added.
 - II 1.0 mol of sulfuric acid contains 2.0 mol of hydrogen ions.
 - III Sulfuric acid turns Universal Indicator yellow.
 - **IV** Effervescence of a colourless gas is seen when calcium is added.
 - A I and III B II and III C I and IV D II and IV

- 20. Which substances would react with copper?
 - I Dilute hydrochloric acid
 - II Oxygen
 - III Aqueous silver nitrate
 - IV Cold water
 - A I and II only C III and IV only
 - B II and III only D All of the above

21. Which substance could be zinc?

	conducts	electricity	state of product formed when
	when solid	when liquid	heated with oxygen
Α	✓	\checkmark	solid
В	×	\checkmark	no reaction
С	✓	×	solid
D	×	×	gas

22. Metal **M** will displace iron from aqueous iron(II) sulfate solution but not calcium from calcium nitrate. **M** is extracted from its oxide by electrolysis. **M** reacts with water.

What could **M** be?

- A magnesium
- B zinc
- C sodium
- **D** aluminium
- **23.** Magnesium, on the left of Period 3 of the Periodic Table, is more metallic than chlorine on the right of this Period. This is because magnesium has
 - **A** fewer electrons.
 - B fewer protons.
 - **C** fewer full shells of electrons.
 - **D** fewer outermost electrons.

24. Crystals of iodine are heated gently. Which option correctly describes the formula of the particles present, the colour of the vapour produced and the bonds broken in the process?

	formula of particles	colour of vapour	bonds broken
Α	ŀ	purple	covalent bonds between atoms
в	ŀ	brown	covalent bonds between molecules
С	l ₂	purple	Van der Waal's forces between molecules
D	l ₂	brown	Van der Waal's forces between atoms

25. An element has all four of the properties shown.

- solid at room temperature
- variable oxidation states
- forms coloured compounds
- high conductivity

What could this element be?

- A strontium
- B zinc
- **C** graphite
- D cobalt
- **26.** When ammonia is converted into nitric acid on a commercial scale, the following reactions can occur.

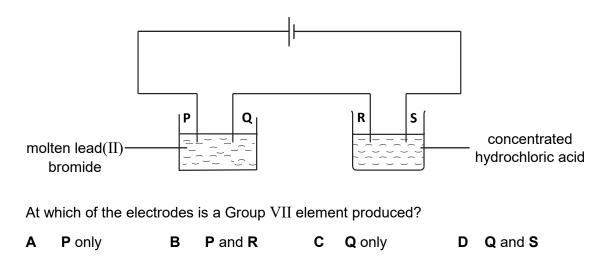
In which reaction does the greatest change in oxidation number of the nitrogen occur?

	reaction										
Α	$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$										
В	$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$										
С	$2NO + O_2 \rightarrow 2NO_2$										
D	$4NH_3 + 6NO \rightarrow 5N_2 + 6H_2O$										

27. In which reaction is sulfur dioxide acting as an oxidizing agent?

$$\mathbf{A} \qquad \mathrm{SO}_2 + 2\mathrm{H}_2\mathrm{O} + \mathrm{Cl}_2 \rightarrow \mathrm{H}_2\mathrm{SO}_4 + 2\mathrm{HCl}$$

- $\textbf{B} \qquad SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$
- $\textbf{C} \qquad 2SO_2 \textbf{+} O_2 \rightarrow 2SO_3$
- $\textbf{D} \qquad SO_2 + 2H_2S \rightarrow 2H_2O + 3S$
- **28.** An electrolytic circuit is set up, using inert electrodes **P**, **Q**, **R** and **S**.



- **29.** A current is passed through each of the following electrolytes using inert electrodes. Which one will produce a neutral solution at the end of the electrolysis?
 - A Aqueous sodium sulfate
 - **B** Concentrated potassium chloride solution
 - **C** Dilute sulfuric acid
 - **D** Aqueous copper(II) nitrate solution

30. The table shows the energy released by the complete combustion of some compounds used as fuels.

	compound	Mr	∆H in kJ/mol
Α	methane	16	-880
В	ethanol	46	-1380
С	propane	44	-2200
D	heptane	100	-4800

Which fuel produces the most energy when 1 g of the compound is completely burned?

- **31.** Which change(s) is/are exothermic?
 - $\label{eq:charged} \textbf{I} \qquad \quad \textbf{CH}_4\left(\textbf{g}\right) \ \textbf{+} \ \ \textbf{2O}_2\left(\textbf{g}\right) \ \rightarrow \quad \textbf{CO}_2\left(\textbf{g}\right) \ \textbf{+} \ \ \textbf{2H}_2\textbf{O}\left(\textbf{g}\right)$
 - $II \qquad H(g) \quad + \quad CI(g) \quad \rightarrow \quad HCI(g)$
 - $III \qquad H_2O~(s) ~\rightarrow ~~H_2O~(l)$

Α	I only	В	I and II only	С	II and III only	D	I, II and III only
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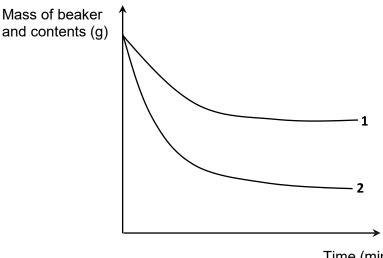
32. The usual conditions of the Haber Process are 250 atm, 450°C and an iron catalyst.

Which change in conditions will give the reactants more energy?

- A Addition of more catalyst
- **B** A decrease in pressure
- **C** An increase in concentration of the reactants
- **D** An increase in temperature

33. Excess magnesium was added to a beaker of dilute hydrochloric acid on an electronic balance.

A graph of the mass of the beaker and contents was plotted against time (curve **1**). What change(s) in the experiment could give curve **2**?



Time (min)

- I The same mass of magnesium but in smaller pieces.
- II The same volume of a more concentrated solution of hydrochloric acid.
- III A lower temperature.

Α	l only.	С	I and II only.
В	ll only.	D	II and III only.

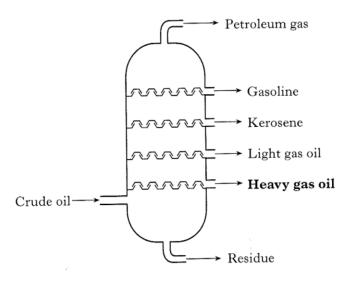
34 Mohr's salt is a pale green crystalline solid which is soluble in water. It is a 'double sulfate' which contains two cations, one of which is Fe²⁺.

The identity of the second cation was determined by heating solid Mohr's salt with aqueous sodium hydroxide. The gas evolved turned moist red litmus blue. A grey-green solid residue was also formed.

What are the identities of the gas and the solid residue?

	gas	residue
Α	H_2	(NH ₄) ₂ SO ₄
в	NH ₃	FeSO ₄
С	NH ₃	Fe(OH) ₂
D	SO ₂	Fe(OH) ₂

35. Heavy gas oil produced by fractional distillation of crude oil has a high viscosity. Which other properties does it also have?



- A Low boiling point and high flammability
- **B** High boiling point and low flammability
- **C** Low boiling point and low flammability
- **D** High boiling point and high flammability
- **36.** $C_{10}H_{22}$ was cracked into a shorter alkane with 6 carbon atoms and an alkene. What would be the molecular formula of the alkene?

A C_6H_{14} **B** C_6H_{12} **C** C_4H_8 **D** C_4H_{10}

37. Under certain conditions, 1 mole of ethane reacts with chlorine.

Which is not a possible product of this reaction?

 38. The diagram shows two compounds.

It can be predicted from their formulae that the compounds have the same

- **A** composition by mass.
- **B** boiling point.
- **C** structural formula.
- **D** density
- **39.** Which substance is formed when propan-1-ol, C_3H_7OH , is reacted with acidified potassium manganate(VII)?

Α	C ₃ H ₈	В	C ₃ H ₇ OK	C C ₃ H ₇ COOH	D	C₂H₅COOH
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- 40. With which substance will ethene react to form more than one product?
 - A bromine
 - B steam
 - **C** hydrogen
 - D oxygen

6092 CHEMISTRY GCE ORDINARY LEVEL SYLLABUS (2018)

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The Periodic Table of Elements

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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uranium 238

91 Pa protactinium 231

90 Th thorium 232

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TEMASEK SECONDARY SCHOOL Preliminary Examination 2022 Secondary 4 Express

CHEMISTRY

6092/01

Paper 1

1 hour

Question Booklet

Additional Material: OTAS

READ THESE INSTRUCTIONS FIRST

Do not open the booklet until you are told to do so.

Write your name, index number and class on the Optical Answer Sheet. Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

You are <u>not required</u> to hand in this booklet at the end of the examination.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

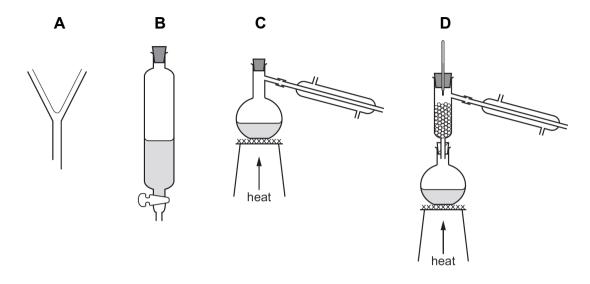
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OTAS.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done on this booklet.

A copy of the Periodic Table is printed on page 17.

1 Hexane and octane are liquid hydrocarbons that mix together.

Which apparatus is used to separate a mixture of these two liquids?



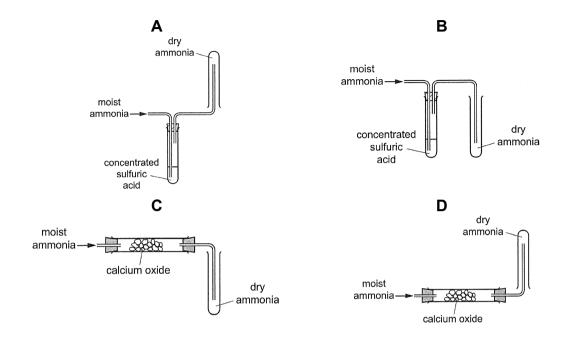
2 When a covalent liquid boils, its molecules become more widely spaced.

Which property of the molecules has the most influence on the energy required to boil a covalent liquid?

- A the strength of the forces of attraction between the molecules
- **B** the reactivity of the molecules
- **C** the shape of the molecules
- **D** the strength of the covalent bonds in the molecules
- 3 In which particle are the number of protons, neutrons and electrons all different?

A ${}^{11}_{5}$ B **B** ${}^{19}_{9}$ F **C** ${}^{23}_{11}$ Na⁺ **D** ${}^{24}_{12}$ Mg²⁺

4 A student is provided with two drying agents: concentrated sulfuric acid and calcium oxide.



Which method should he use to collect a sample of dry ammonia?

5 Silicon carbide, SiC, has a structure similar to diamond. Boron nitride, BN, has a structure similar to graphite. Bronze is an alloy of copper and tin.

Which statements about SiC, BN and bronze are correct?

- 1 All are bonded covalently.
- 2 All have a giant structure.
- 3 All have high melting points.
- A 2 only B 1 and 3 only C 2 and 3 only D 1, 2 and 3

6 Some car paints contain small flakes of silicon dioxide, SiO₂.

In the structure of solid SiO₂,

- each silicon atom is bonded to x oxygen atoms,
- each oxygen atom is bonded to y silicon atoms,
- each bond is a z type bond.

What is the correct combination of x, y and z in these statements?

	Х	У	Z
Α	2	1	covalent
В	2	1	ionic
С	4	2	covalent
D	4	2	ionic

- 7 In which compound does one of the atoms or ions have a different electronic configuration from each other?
 - A carbon dioxide
 - **B** phosphorus trichloride
 - **C** sodium oxide
 - **D** magnesium chloride
- **8** Which solid oxide does **not** lower the pH when added to sodium hydroxide solution?
 - **A** aluminium oxide
 - B silicon dioxide
 - **C** phosphorus oxide
 - **D** lithium oxide

experiment	description	result
1	mix with dilute hydrochloric acid	does not react
2	mix with sodium hydroxide	a salt forms
3	add Universal Indicator	Universal Indicator turns purple
4	add acidified aqueous potassium manganate(VII)	purple solution turns colourless

9 The results of some experiments with sulfur dioxide are shown.

Which results are correct?

- **A** 1, 2 and 4 **B** 2, 3 and 4 **C** 1 and 2 only **D** 3 and 4 only
- **10** The table shows the concentration and pH values of the aqueous solutions L and M.

	L	М
concentration in mol/dm ³	2	2
рН	6	9

Student P concluded that L is a strong acid.

Student Q concluded that the extent of ionisation is low in L and high in M.

Which student(s) is(are) correct?

- **A** both P and Q
- **B** neither P nor Q
- **C** P only
- **D** Q only

11 A student investigates two acids W and X.

The same volumes of W and X are reacted separately with excess magnesium.

The student makes the following observations.

- 1 Hydrogen gas is produced at a faster rate with W than with X.
- 2 The total volume of hydrogen gas produced is the same for both acids.

Which statement explains these observations?

- **A** The pH of W is higher than the pH of X.
- **B** W is an organic acid.
- **C** W is more concentrated than X.
- **D** W is a strong acid while X is a weak acid.
- 12 Which reaction does not involve neutralisation?
 - A $H_2SO_4(aq) + 2NH_3(aq) \rightarrow (NH_4)_2SO_4(aq)$
 - **B** $H_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2HCl(aq)$
 - **C** $H_2SO_4(aq) + CuO(s) \rightarrow CuSO_4(aq) + H_2O(l)$
 - **D** $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$
- **13** Zinc reacts with hydrochloric acid according to the following equation.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

The following statements were made about the reaction.

- 1 A 3.25 g sample of zinc reacts with an excess of hydrochloric acid to give 0.050 mol of zinc chloride.
- 2 A 6.50 g sample of zinc reacts completely with exactly 100 cm³ of 1.00 mol/dm³ hydrochloric acid.
- 3 A 13.0 g sample of zinc reacts with an excess of hydrochloric acid to give 9.60 dm³ of hydrogen at room temperature and pressure.

Which statements are correct?

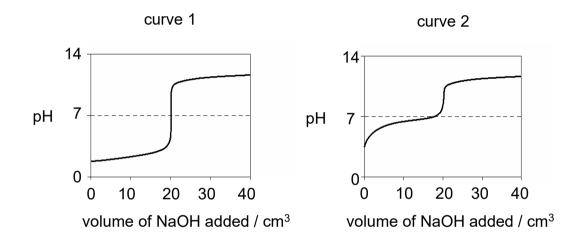
A 1 only	В	1 and 2 only	С	2 and 3 only	D	1, 2 and 3
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	indicator	acidic colour	range of colour change	alkaline colour
r	methyl orange	red	3.1 – 4.4	yellow
	methyl red	red	4.4 - 6.2	yellow
	bromothymol blue	yellow	6.0 – 7.6	blue
С	resolphthalein	colourless	8.1 – 9.7	red
á	alizarin yellow	yellow	10.1 – 12.0	red

14 The table shows appropriate indicators used to identify the endpoint in titrations.

Curve 1 shows the changes in pH when NaOH was titrated to HCl in a conical flask.

Curve 2 shows the changes in pH when NaOH was titrated to a different acid in another conical flask.



The appropriate indicator for titration to obtain curve 1 is bromothymol blue.

Using the table, what is the appropriate indicator for curve 2?

- **A** bromothymol blue
- **B** cresolphthalein
- **C** methyl orange
- **D** methyl red
- **15** Which statement about ammonia is correct?
 - A Ammonia gas turns moist blue litmus paper red.
 - **B** Ammonia is used to increase pH of acidic soil.
 - **C** Ammonia is produced when a nitrate solution is warmed with sodium hydroxide.
 - **D** Ammonia molecule contains two pairs of electrons not involved in bonding.

16 One mole of compound X gives three moles of ions in aqueous solution. X reacts with ammonium carbonate to give an acidic gas.

What is compound X?

- **A** calcium hydroxide
- **B** ethanoic acid
- **C** sodium hydroxide
- **D** sulfuric acid
- **17** A sample of solid magnesium hydroxide is made by adding an excess of aqueous sodium hydroxide to an aqueous solution containing 1.20 g magnesium sulfate.

The mass of magnesium hydroxide formed is 0.26 g.

What is the percentage yield of magnesium hydroxide?

A 10.5 % **B** 21.7 % **C** 44.8 % **D** 61.9 %

18 Sulfur is present in two amino acids that make up proteins.

These are cysteine and methionine.

amino acid	cysteine	methionine
formula	C ₃ H ₇ NO ₂ S	$C_5H_{11}NO_2S$

Cysteine contains a higher percentage of sulfur by mass than methionine.

Which is the correct explanation for the above statement?

- A The mass of sulfur atoms in a molecule of cysteine is greater than that in a molecule of methionine.
- **B** The mass of carbon and hydrogen atoms in a molecule of cysteine is fewer than that in a molecule of methionine.
- **C** The number of sulfur atoms in a molecule of cysteine is greater than that in a molecule of methionine.
- **D** The relative molecular mass of cysteine is greater than the relative molecular mass of methionine.

- **19** Trends are seen in the physical and chemical properties of the elements of Group II and their compounds.
 - 1 the rate of the reaction between the element and dilute hydrochloric acid
 - 2 the solubility of the sulfates
 - 3 the temperature of decomposition of the carbonates

Which trend(s) show(s) a decrease from magnesium to barium?

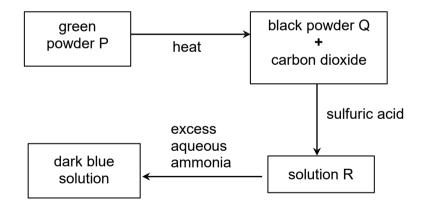
A 1, 2 and 3 **B** 1 and 3 only **C** 3 only **D** 2 only

20 An unknown aqueous solution reacts with aqueous sodium hydroxide to form a reddish-brown precipitate and then aluminium powder is added.

The mixture is heated and a gas that turns damp red litmus paper blue is given off.

What is the unknown solution?

- **A** ammonium chloride
- **B** copper(II) nitrate
- **C** iron(II) chloride
- **D** iron(III) nitrate
- 21 The diagram below shows a series of tests starting with substance P.



Which statement is true?

- **A** P can react directly with dilute sulfuric acid to give R.
- **B** Q reacts with acids to liberate hydrogen gas.
- **C** R is also green in colour.
- **D** R forms a green precipitate with aqueous sodium hydroxide.

22 The following reactions are carried out.

reaction	result
propanoic acid added to aqueous ammonia	compound P formed
propanoic acid is added to ammonium carbonate	gas Q given off
ammonium propanoate is warmed with sodium hydroxide	gas R given off

Which correctly identify the compound and gases?

	compound P	gas Q	gas R
Α	ammonium carbonate	carbon dioxide	hydrogen
в	ammonium propanoate	ammonia	carbon dioxide
С	ammonium carbonate	ammonia	hydrogen
D	ammonium propanoate	carbon dioxide	ammonia

23 The formulae for four substances containing chlorine are given below.

PC/3 Cl₂O ClO₃⁻ ClO₄⁻

Which correctly shows the oxidation numbers of chlorine in the above substances respectively?

		oxidation number of chlorine in			
	PC/ ₃	Cl ₂ O	CIO3 ⁻	CIO4 ⁻	
Α	-1	+1	+5	+7	
в	+1	+1	+5 +5 +6	+7	
С	-1	+1	+6	+8	
D	+3	+2	-3	-4	

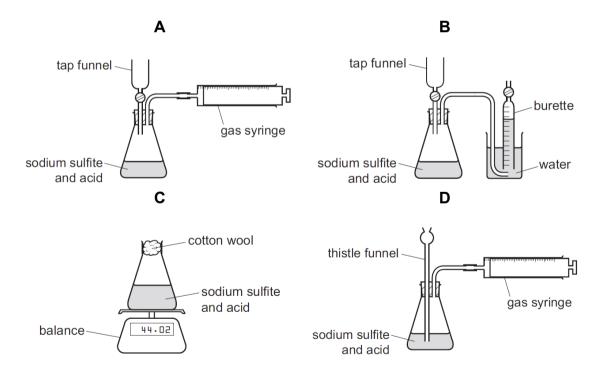
24 Hydrogen peroxide, H₂O₂, reacts with silver oxide according to the following equation.

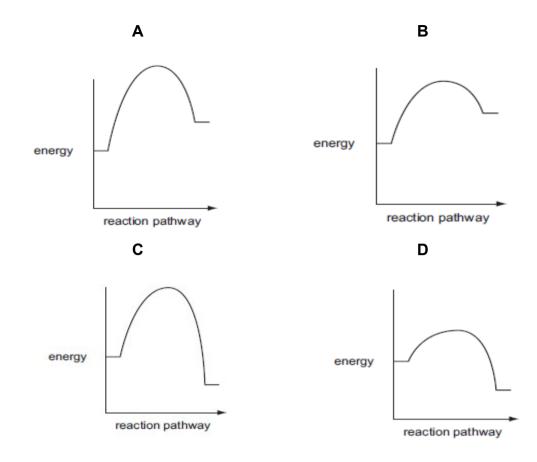
 $Ag_2O(s) + H_2O_2(l) \rightarrow 2Ag(s) + H_2O(l) + O_2(g)$

What is the role played by hydrogen peroxide in this reaction?

- A acid
- **B** dehydrating agent
- **C** oxidising agent
- **D** reducing agent
- 25 In which reaction is sulfur dioxide acting as an oxidizing agent?
 - $A \quad SO_2 + 2H_2O + Cl_2 \rightarrow H_2SO_4 + 2HCl$
 - **B** SO₂ + 2NaOH \rightarrow Na₂SO₃ + H₂O
 - **C** $2SO_2 + O_2 \rightarrow 2SO_3$
 - **D** SO₂ + 2H₂S \rightarrow 2H₂O + 3S
- **26** A student wanted to follow how the rate of the reaction of sodium sulfite with acid varies with time. The reaction produces gaseous sulfur dioxide.

Which apparatus is not suitable?





27 Which reaction profile shows the fastest exothermic reaction?

- 28 Four metals W, X, Y and Z and their compounds behaved as described.
 - 1 Only X, Y and Z reacted with dilute hydrochloric acid.
 - 2 The oxides of W, X and Y were reduced to the metal when heated with carbon powder. The oxide of Z did not react.
 - 3 A displacement reaction occurred when X was added to an aqueous solution of the nitrate of Y.

Which shows the metals arranged in ascending order based on their reactivity?

A W, X, Y, Z
B W, Y, X, Z
C Z, X, Y, W
D Z, Y, X, W

29 Metals can be protected against corrosion by sacrificial protection. In the diagram shown below, metal X is being protected from corrosion by metal Y.



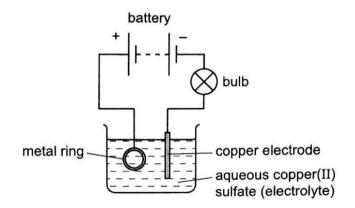
What are the possible identities of metal X and Metal Y?

	metal X	metal Y
Α	aluminum	iron
В	copper	silver
С	iron	copper
D	zinc	magnesium

30 Over 90% of all gold but less than 50% of iron is recycled.

Which is the likely reason for this difference?

- **A** Gold is very scarce.
- **B** Iron does not cause land pollution.
- **C** Iron ores will never run out.
- **D** It is more expensive to purify gold.
- **31** The diagram shows a failed attempt to copper-plate a metal ring.



Which action will plate the metal ring with copper?

- A cooling the copper(II) sulfate solution in an ice bath
- B exchange the position of copper electrode with the ring
- **C** heating the copper sulfate solution to boiling point
- D increasing the voltage from 3V to 6V

32 During the electrolysis of an aqueous solution of a cerium salt, 70 g of cerium is deposited at the cathode by 2 moles of electrons.

What is the formula of the cerium ion that has been discharged?

- **A** Ce^+ **B** Ce^{2+} **C** Ce^{3+} **D** Ce^{4+}
- 33 Which statement is true for both electrolytic cells and simple cells?

	electrolytic cell	simple cell
Α	electrons flow from the positive to negative terminal	electrons flow from the negative to positive terminal
В	it converts chemical energy into electrical energy	it converts electrical energy into chemical energy
С	mass of the positive electrode may remain unchanged	mass of the positive electrode will decrease
D	oxidation occurs at positive electrode	oxidation occurs at negative electrode

34 Petroleum is separated into useful fractions by fractional distillation. The uses of these fractions are shown.

fraction	number of carbon atoms in the molecules	uses
gasoline	$C_{5}-C_{10}$	fuel for cooking and heating
naphtha	C7 — C14	feedstock for chemicals
paraffin	C15 - C25	fuel for large vehicles
lubricating oil	C ₂₀ to C ₃₅	making waxes and polishes
bitumen	>C ₇₀	making road surfaces

Which fractions are indicated wrongly with their corresponding properties and/or uses?

- **A** gasoline and naptha
- **B** lubricating oil and bitumen
- **C** naptha and paraffin
- **D** paraffin and gasoline

35 The table shows some members in the alkanals homologous series.

name	chemical formula
Ethanal	CH₃CHO
Butanal	CH ₃ CH ₂ CH ₂ CHO
Hexanal	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CHO

What is the general formula for alkanals?

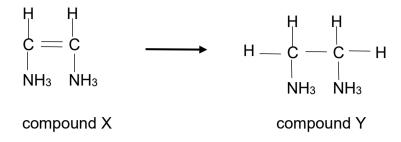
- A C_nH_{2n+1}COOH
- **B** C_nH_{2n}CHO
- C C_nH_{2n+1}CHO
- $D C_{n-1}H_{2n+1}CHO$
- 36 Which of the following must be the same for molecules which are isomers?
 - 1 empirical formula
 - 2 functional group
 - 3 structural formula
 - 4 molecular formula
 - **A** 1, 2 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2, 3 and 4
- **37** Ethanol can be manufactured from ethene or from glucose. The table gives statements about the processes involved.

	process using ethene	process using glucose
1	reaction is faster at 300 °C than at 200 °C	reaction is faster at 100 °C than at 30 °C
2	produces pure ethanol	produces a dilute aqueous solution of ethanol
3	is a catalytic reaction	is a catalytic reaction
4	uses steam	produces carbon dioxide

In which rows are both statements correct?

A 1 and 4 **B** 1, 2 and 3 **C** 2 and 4 **D** 2, 3 and 4

38 Compound X can be converted into compound Y.

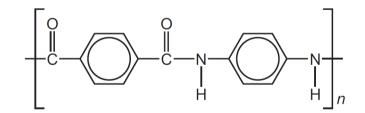


Which row correctly shows the reagents and conditions needed for the conversion?

	reagent	conditions		
Α	hydrogen	200 °C, nickel catalyst		
в	concentrated sulfuric acid	heat		
С	steam	300 °C, 60atm, phosphoric acid		
D	monomer	450 °C; iron catalyst		

39 What remains unchanged in the polymerisation of butene to poly(butene)?

- A boiling point
- **B** density
- **C** molecular formula
- **D** percentage composition of elements by mass
- 40 The diagram shows a polymer called *Kevlar*.



Which statement describes Kevlar?

- **A** It is a polyester.
- **B** It is formed in an addition polymerisation reaction.
- **C** It is formed from the two monomers, a di-carboxylic acid and a di-amine.
- **D** It has the same linkage as Terylene.

The Periodic Table of Elements

								Gro	pup								
													IV	V	VI	VII	0
				Key			1 H hydrogen 1										2 He helium 4
3	4			(atomic) r				•				5	6	7	8	9	10
Li	Be		ato	mic sym	bol							В	С	N	0	F	Ne
lithium 7	beryllium 9		relativ	name ve atomic	mass							boron 11	carbon 12	nitrogen 14	oxygen 16	fluorine 19	neon 20
11	12		Tolati									13	14	15	16	17	18
Na	Mg											Al	Si	P	S	Cl	Ar
sodium	magnesium											aluminium	silicon	phosphorus	sulfur	chlorine	argon
23	24							~7				27	28	31	32	35.5	40
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
n potassium	calcium	scandium	titanium	v vanadium	chromium	manganese	iron	cobalt	nickel	copper	zinc	gallium	germanium	arsenic	selenium	bromine	krypton
39	40	45	48	51	52	55	56	59	59	64	65	70	73	75	79	80	84
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Мо	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Те	Ι	Xe
rubidium	strontium	yttrium	zirconium	niobium 93	molybdenum 96	technetium	ruthenium	rhodium	palladium 106	silver 108	cadmium	indium	tin 119	antimony	tellurium 128	iodine 127	xenon 131
85 55	88 56	89 57 – 71	91 72	73	96 74	- 75	101 76	103 77	78	79	112 80	115 81	82	122 83	84	85	86
Cs	Ba	lanthanoids	Hf	Ta	W W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
caesium	barium		hafnium	tantalum	tungsten	rhenium	osmium	iridium	platinum	gold	mercury	thallium	lead	bismuth	polonium	astatine	radon
133	137		178	181	184	186	190	192	['] 195	Ĭ97	201	204	207	209	· –	-	-
87	88	89 – 103	104	105	106	107	108	109	110	111	112		114		116		
Fr	Ra	actinoids	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn		F <i>l</i>		Lv		
francium	radium		Rutherfordium	dubnium	seaborgium	bohrium	hassium		darmstadtium	roentgenium	copernicium		flerovium		livermorium		
la	anthanoid	S	57	58	59 Dr	60	61	62	63	64	65	66 Du	67	68	69 Tre	70	71
			La lanthanum	Ce cerium	Pr praseodymium	Nd	Pm promethium	Sm samarium	Eu europium	Gd gadolinium	Tb terbium	Dy dysprosium	Ho	Er erbium	Tm thulium	Yb vtterbium	Lu
			139	140	141	144		150	152	157	159	163	165	167	169	173	175
	actinoids		89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
			Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
			actinium	thorium 232	protactinium 231	uranium 238	neptunium	plutonium	americium	curium —	berkelium	californium	einsteinium	fermium	mendelevium	nobelium	lawrencium
			_	232	231	230	_	-	_	-	-	-	-	-	-	-	_

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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YUYING SECONDARY SCHOOL PRELIMINARY EXAMINATION

Secondary 4 Express

NAME

CLASS

CHEMISTRY

Paper 1

Candidates answer on the Question Paper. Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on this question booklet. Write in dark blue or black pen on both sides of the paper. You may use a pencil for any diagrams, graphs, tables or rough working. Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all questions.

For each question there are four possible answers A, B, C and D.

Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet. Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

The use of an approved calculator is expected, where appropriate. A copy of the Periodic Table is printed on page 17.

For Examiner's Use		
Total	40	

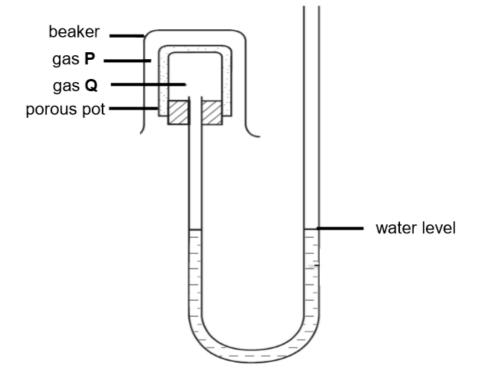
This document consists of 17 printed pages.

6092/1

25 August 2022 1 hour Setter: Mr Danny Louis

REG. NO

1 A beaker of gas **P** is inverted over a porous pot containing gas **Q** as shown.

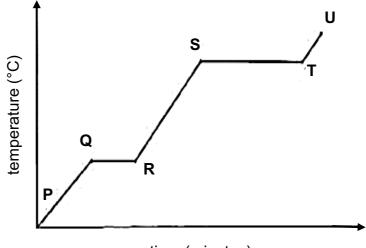


Which pair of gases will result in the water level remaining unchanged?

	Р	Q
Α	CH ₄	N ₂
В	C_2H_4	СО
С	C_2H_6	CO ₂
D	C_3H_8	O ₂

- 2 Which of the following occurs when iodine sublimes?
 - A distance between iodine particles increases
 - **B** forces of attraction between iodine particles become stronger
 - **C** iodine particles become lighter
 - **D** iodine particles begin to be arranged in a more orderly manner

3 The following shows the heating curve of ice.



time (minutes)

Which description in the table below **best** explains the respective section of the graph?

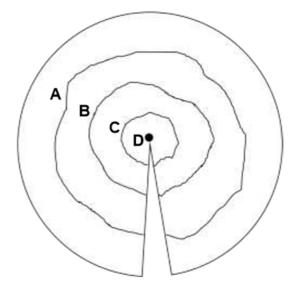
	section	ction description	
Α	AP to Qall ice molecules are in fixed positions		
В	Q to R	the average kinetic energy of the particles remains constant	
С	R to S	the volume of steam is increasing	
D	T to U	water is boiling	

4 Propyl ethanoate and water are two liquids, which are immiscible. Which method is **best** to separate a mixture of propyl ethanoate and water?

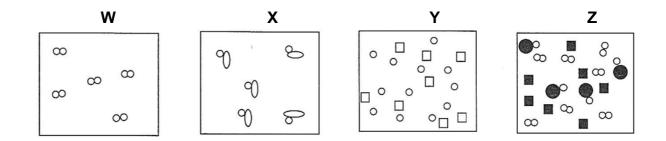
- **A** filtration
- B fractional distillation
- **C** use a separating funnel
- **D** evaporation to dryness
- 5 Which piece of apparatus is **not** required to obtain water from a can of green tea?
 - A white tile
 - **B** condenser
 - **C** distillation flask
 - **D** fractionating column

6 Paper chromatography was used to separate an ink which is comprised of several dyes. In the experiment, a few drops of solvent was added to the centre of the filter paper and allowed to spread out.

The diagram below shows the chromatogram obtained from the experiment. Which dye has the greatest solubility in the solvent used?



- 7 The diagrams below can be used to illustrate the following.
 - I pure element
 - II mixture of elements
 - III pure compound
 - IV mixture of elements and a compound



Which row in the table below is correct?

	Ι	II	III	IV
Α	W	Х	Y	Z
В	Z	W	X	Y
С	W	Y	X	Z
D	Х	Z	W	Y

8 The table shows details of the particles present in the ions of potassium and sulfur.

formula	proton number	nucleon number	number of neutrons	number of electrons
K+	19	39	Х	Y
S ²⁻	Z	32	16	18

What are the values of X, Y and Z?

	X	Y	Z
Α	20	19	20
В	21	19	16
С	21	18	20
D	20	18	16

- 9 Which element would be expected to form an ion with the largest ionic radius?
 - A chlorine
 - **B** fluorine
 - **C** magnesium
 - D oxygen
- 10 Element **J** is found in Group II of the Periodic Table. It has an atomic number b, and a nucleon number a.

Which entry shows the correct information on the ion formed by isotope atom J?

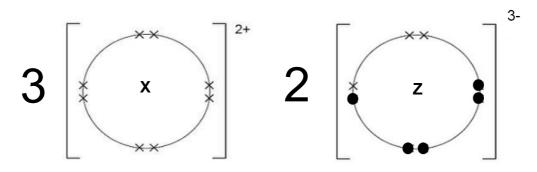
	number of protons	number of neutrons	number of electrons
Α	а	a – b + 1	b + 2
В	а	b	b – 2
С	b	a – b	b – 2
D	b	b – a	b – 2

11 An element **S** has 2 isotopes of mass numbers 16 and 18. Its average relative atomic mass is 16.4.

What is the proportion of each isotopes in element $\boldsymbol{S}?$

- A 50% of S-16 and 50% of S-18
- **B** 60% of S-16 and 40% of S-18
- **C** 70% of S-16 and 30% of S-18
- **D** 80% of S-16 and 20% of S-18

12 The dot-and-cross diagram (with only the outer electrons) of the compound formed between element **X** and **Z** is shown below.

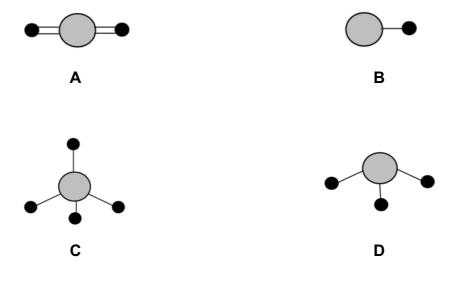


Which of the following is the correct set of formula of the chloride of X and Z?

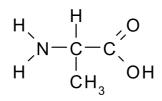
- **A X**Cl , **Z**₃Cl
- **B X**Cl , **Z**C l_3
- **C** $\mathbf{X}\mathbf{C}l_2$, $\mathbf{Z}_3\mathbf{C}l$
- **D X**C*l*₂ , **Z**C*l*₃
- 13 The models shown below represent two molecules.



Which model **correctly** represents the molecule formed between **X** and **Z**?



14 An amino acid, alanine, has the following structure.



How many pairs of valence electrons are **not** involved in bonding in the alanine molecule?

- **A** 4
- **B** 5
- **C** 9
- **D** 10
- 15 The relative molecular mass of a compound with the formula $K_3Co(CN)_x$ is 332. What is the value of x?
 - **A** 3
 - **B** 4
 - **C** 5
 - **D** 6
- 16 The formula of an oxide of element R is R₂O.
 6.2 g of R₂O contains 4.6 g of R.
 How many moles of R ions does 6.2 g of R₂O contain?

A
$$\frac{1.6}{16} \div 2$$

B $\frac{1.6}{16} \times 2$
C $\frac{6.2}{16 \times 2}$
D $\frac{6.2}{16} \times 2$

17 When the metal bismuth (Bi) is added to copper(II) nitrate, bismuth(III) nitrate and copper are formed.

What is the ionic equation of this reaction?

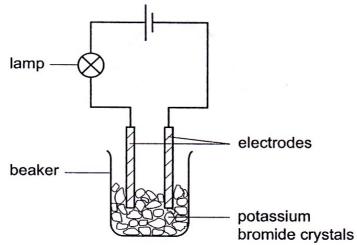
- A $Bi(s) + Cu^{2+} (aq) \rightarrow Bi^{3+}(aq) + Cu(s)$
- **B** $2Bi(s) + 3Cu^{2+}(aq) \rightarrow 2Bi^{3+}(aq) + 3Cu(s)$
- **C** $Bi(s) + Cu(NO_3)_2 (aq) \rightarrow Bi(NO_3)_3 (aq) + Cu(s)$
- **D** $\operatorname{Bi}^{3+}(\operatorname{aq}) + 3\operatorname{NO}_{3^{-}}(\operatorname{aq}) \rightarrow \operatorname{Bi}(\operatorname{NO}_{3})_{3}(\operatorname{aq})$

18 68 g of impure hydrogen peroxide, H_2O_2 (M_r = 34) decomposes in the presence of manganese(IV) oxide, to produce 2.4 dm³ of oxygen gas at room temperature and pressure as shown in the equation below.

$$2 H_2O_2 \rightarrow O_2 + 2 H_2O$$

What is the purity of the hydrogen peroxide?

- **A** 2.5 %
- **B** 5.0 %
- **C** 10.0 %
- **D** 15.0 %
- 19 In the set-up shown below, the lamp does not light. Distilled water is then added to the beaker and the lamp lights up.



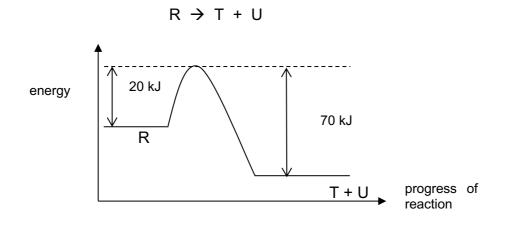
Which statement explains these results?

- A Electrons are free to move in the solution when potassium bromide dissolves.
- **B** Metal ions are free to move when potassium bromide melts.
- **C** Metal ions are free to move when potassium reacts with water.
- **D** Oppositely charged ions are free to move in the solution when potassium bromide dissolves.
- 20 A concentrated aqueous solution containing each of the following ions : Cl^{-} , SO_4^{2-} , Na^+ , Cu^{2+} , is electrolysed using platinum electrodes.

Which row shows the ions that are discharged first at the two electrodes?

	at anode	at cathode
Α	C <i>l</i> -	Cu ²⁺
В	C <i>l</i> ⁻	Na⁺
С	SO4 ²⁻	Cu ²⁺
D	SO4 ²⁻	Na⁺

- 21 Which statement describes what happens in a hydrogen-oxygen fuel cell?
 - A Electricity is generated.
 - **B** Electricity is used to produce water.
 - **C** Hydrogen is burned to produce steam.
 - **D** Hydrogen reacts to form fuel.
- 22 The diagram below represents the energy profile diagram for the following reaction:

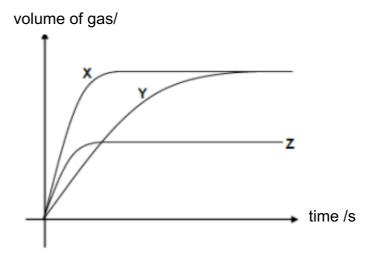


What is the enthalpy change for this reaction?

- A + 50 kJ
 B 50 kJ
 C 70 kJ
 D + 90 kJ
- 23 In which reaction is pressure least likely to affect the rate of reaction?

A C (s) + CO₂ (g) → 2CO (g) B N₂ (g) + 3H₂ (g) → 2NH₃ (g) C NaOH (aq) + HC/ (aq) → NaC/ (aq) + H₂O (/) D 2SO₂ (g) + O₂ (g) → 2SO₃ (g) 24 A student performed three experiments to produce carbon dioxide gas using excess magnesium carbonate and dilute nitric acid at 30°C.

ovporiment	magnesium carbonate	dilute ni	tric acid
experiment	particle size	volume (cm ³)	concentration (mol/dm ³)
1	powdered	20	1.00
2	lumps	10	1.00
3	lumps	40	0.50

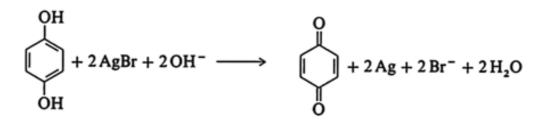


Which graph **best** represents each of the three experiments?

	experiment 1	experiment 2	experiment 3
Α	Х	Y	Z
В	Y	Х	Z
С	Х	Z	Y
D	Z	Х	Y

- 25 Colour changes are often observed when redox reactions occur. Which colour change is due to the reduction of the named agent?
 - A Black solid copper(II) oxide changes to blue aqueous copper(II) sulfate.
 - **B** Colourless aqueous potassium iodide changes to become a brown solution.
 - **C** Green aqueous iron(II) chloride changes to yellow/brown aqueous iron(III) chloride.
 - **D** Purple acidified potassium manganate(VII) changes to become colourless.

26 When exposed film from a camera is developed, one step involves reacting the lightactivated silver bromide crystals with aqueous alkaline hydroquinone.



Which of the following **best** describes the role of hydroquinone?

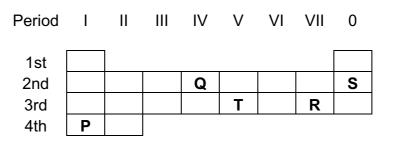
- A an acid
- **B** an oxidizing agent
- **C** an acid and reducing agent
- D a base and oxidizing agent
- 27 The table below gives some statements about acids and alkalis and explanations for these statements.

Which row shows both a correct statement and a correct explanation for the statement?

	statement	explanation
Α	ammonia can be made by heating ammonium sulfate with calcium hydroxide	the hydroxide ion acts as a base and removes H⁺ from the ammonium ion
В	the pH of a weak acid is higher than the pH of a strong acid of the same concentration	pH shows the extent of ionisation– the more ionised the acid is, the higher the pH
С	calcium hydroxide can be used to control pH in soils	metal hydroxides are acidic and can reduce excess alkalinity
D	when an acid reacts with a metal, the metal is reduced	reduction is gain of electrons

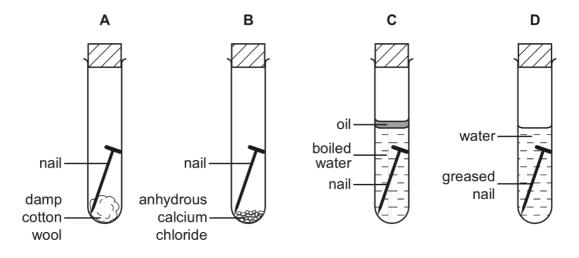
- 28 Given a supply of lead(II) carbonate, copper(II) carbonate, dilute nitric acid and aqueous sodium hydroxide, how many different salts could be prepared?
 - **A** 1
 - **B** 2
 - **C** 3
 - **D** 4

- 29 An aqueous solution containing a mixture of copper(II), lead(II) and zinc ions was treated with an excess of aqueous ammonia. What was the precipitate left behind at the end of the reaction?
 - A copper(II) hydroxide and lead(II) hydroxide
 - **B** copper(II) hydroxide and zinc hydroxide
 - **C** lead(II) hydroxide only
 - **D** zinc hydroxide only
- 30 The positions of five elements **P**, **Q**, **R**, **S** and **T** are shown in the part of the Periodic Table.



Which statement about the elements shown is not correct?

- A Element **S** exists as a monoatomic gas.
- **B** Element **P** is the most reactive metal shown in the table above.
- C Element T has 5 valence electrons in its outermost shell.
- D Elements Q and R form an ionic compound which has the formulae of QR₄.
- 31 Which alloy of iron is used in surgical instruments?
 - A high carbon steel
 - **B** low carbon steel
 - **C** mild steel
 - D stainless steel
- 32 In which test-tube is the iron nail **most** likely to rust?



33 Some facts about three metals are as follows.

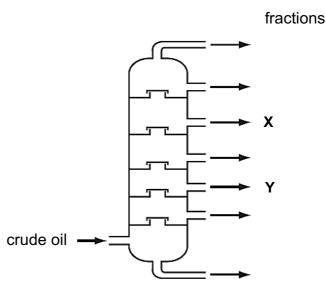
metal	fact
rhodium	found naturally as an alloy with other metals
thallium	extracted by electrolysis of its molten chloride
cobalt	extracted by heating its oxide with coke

What is the likely order of reactivity of the metals?

	least reactive		most reactive
Α	rhodium	thallium	cobalt
В	thallium	cobalt	rhodium
С	rhodium	cobalt	thallium
D	cobalt	rhodium	thallium

- 34 Which pair of pollutants cause damage to buildings?
 - A CFCs and carbon monoxide
 - **B** methane and carbon dioxide
 - C unburnt hydrocarbon and nitrogen monoxide
 - D nitrogen dioxide and sulfur dioxide
- 35 Nitrogen and hydrogen gases react to form ammonia gas in the Haber process. A higher yield of ammonia is favoured by a lower temperature but in industry, a high temperature of 450°C is used. Why is this so?
 - A At high temperatures, gases expand and less volumes are needed.
 - **B** At high temperatures, the catalyst is more effective.
 - **C** At low temperatures, liquid ammonia is collected instead.
 - **D** At low temperatures, the rate of reaction is too slow.

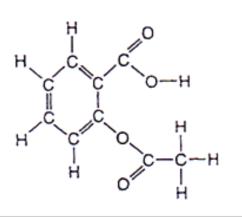
36 The diagram below shows the different fractions after crude oil has undergone fractional distillation.



Which statement is correct?

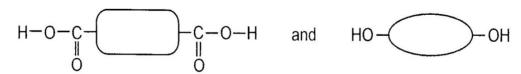
- **A** X and Y are both used as fuels.
- **B** X has a higher boiling point than Y.
- **C** X has a lower relative molecular mass than Y.
- **D** X has more carbon atoms than Y.
- One mole of a hydrocarbon Q reacted completely with 1 mole of hydrogen gas in the presence of a heated catalyst.
 What could be the formula of Q?
 - $\boldsymbol{A} \quad C_2 H_6$
 - **B** C₃H₈
 - **C** C₅H₁₀
 - **D** C₇H₁₆
- A food chemist wants to create a flavor from pineapples for a product. An ester with this flavor has the formula C₃H₇CO₂C₂H₅.
 Which pair of organic compounds will react to form this ester?
 - **A** $C_2H_5CO_2H$ and C_2H_5OH
 - $\textbf{B} \quad C_2H_5CO_2H \ \text{and} \ C_3H_7OH$
 - $\textbf{C} \quad C_3H_7CO_2H \text{ and } C_2H_5OH$
 - $\textbf{D} \quad C_3H_7CO_2H \ and \ C_3H_7OH$

39 Aspirin is a drug which is used as a general painkiller. The structural formula of aspirin is shown below.



Which of the following statements about aspirin is incorrect?

- **A** It decolourises aqueous bromine.
- **B** It turns acidified potassium manganate(VII) colourless.
- **C** It is formed from an alcohol and a carboxylic acid.
- **D** Its aqueous solution reacts with solid sodium carbonate.
- 40 A synthetic polymer is made by the condensation polymerisation of the two monomers shown below.



Which of the following shows the correct changes in the properties of the polymer formed?

	melting point	percentage composition of carbon by mass
Α	increases	increases
В	increases	no change
С	decreases	decreases
D	no change	no change

END OF PAPER

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	0	2	He	helium 4	10	Ne	neon	20	18	Ar	argon 40	36	Кr	krypton	84	54	Xe	xenon	131	86	Rn	radon	ı					71	Lu	lutetium	C/L	103	Ļ	lawrencium -
	VII				6	ш	fluorine	19	17	Cl	chlorine 35.5	35	Br	bromine	80	53	Ι	iodine	171	85	At	astatine	ı					70	Υb	ytterbium	1/3	102	No	nobelium –
	٨I				8	0	oxygen	16	16	თ	sulfur 32	34	Se	selenium	79	52	Te	tellurium	971	84	Ро	polonium	1	116	2	ivermorium	1	69	Tm	thulium	ROL	101	pM	mendelevium -
	^				7	z	nitrogen	14	15	٩.	ohosphorus 31	33	As	arsenic	75	51	Sb	antimony	771	83	Ξ	bismuth	2US											fermium r
	N				9	U	carbon	12	14	Si	silicon 28	32	Ge	germanium	73	50	Sn	tin 440	8LL	82	Pb	lead	201	114	Εl	flerovium	I	67	Но	holmium	COL	66	Es	einsteinium -
	=				5	В	boron	11	13	Al	aluminium 27	31	Ga	gallium	70	49	In	indium	CLL	81	Τl	thallium	204								_			californium
												30	Zn	zinc	65	48	рo	cadmium	711	80	Hg	mercury	701	112	G	opernicium	1				-			berkelium 6
												⊢			-	_			-+			gold	+			-	_	64	Gd	gadolinium	/cl	96	CB	curium I
dr												28	ĪZ	nickel	59	46	Pd	palladium	QUL	78	Ъ	platinum	CRI	110	Ds	armstadtium	1	63	Eu	europium	ZCL	95	Am	americium -
Group												<u>⊢</u>			-				-+			iridium	+		-	0	_	62	Sm	samarium	ncı.	94	Pu	plutonium -
		-	Ξ.	hydrogen 1								26	Fe	iron	56	44	Ru	ruthenium	LOL	76	So	osmium	180	108	Hs	hassium	1	61	Pm	romethium	ı	93	Np	neptunium -
					1							25	Mn	manganese	55	43	ЦС	technetium		75	Re	rhenium 100	100	107	B	bohrium	1	60	Pr Nd	neodymium p	144	92	⊃	uranium 238
					Imber	o		lass				24	ŭ	Ę	52	42	Mo	molybdenum technetium	90	74	8	tungsten	104	106	Sg	seaborgium	1	59	Pr	raseodymium r	141	91	Ра	protactinium 231
				Key	proton (atomic) number	atomic symbol	name	relative atomic mass				23	>	vanadium	51	41		niobium n				tantalum	101	105		dubnium	1	58		-	140	06		thorium 1 232
					proton (ator		relativ				22	F	titanium	48	40	Zr	zirconium	1	72	Ŧ	hafnium 470	0/1	104	ጅ	Rutherfordium	1	57	La	lanthanum	139	89	Ac	actinium I
												21	Sc	scandium	45	39	≻	yttrium	89	57 - 71	anthanoids			89 - 103										
	=				4	Be	beryllium	6	12	Mg	magnesium 24	20	Ca	calcium	40	38	S	strontium	QQ		_	barium	1			radium	'	lanthanoids				actinoids		
	_				3	:-	lithium	7			sodium r 23		¥	potassium	39	37	Rb	rubidium	cα	55	S	caesium	133	87	ŗ	francium	1							

The volume of one mole of any gas is $24 \, \text{dm}^3$ at room temperature and pressure (r.t.p.).

17

Name

6092/01 CHEMISTRY

PAPER 1

Monday

VICTORIA SCHOOL VICTORIA SCHOO

12 September 2022



Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil. Write your name, class and index number on all the work you hand in. Do not use staples, paper clips, glue or correction fluid.

There are forty questions on this paper. Answer all questions. For each question, there are four possible answers A, B, C and D.

Choose the one that you consider correct and record your choice in soft pencil on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

A copy of Periodic Table is printed on **page 16**.



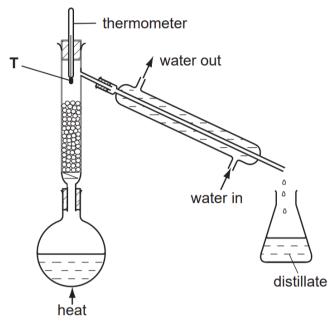


PRELIMINARY EXAMINATION SECONDARY FOUR

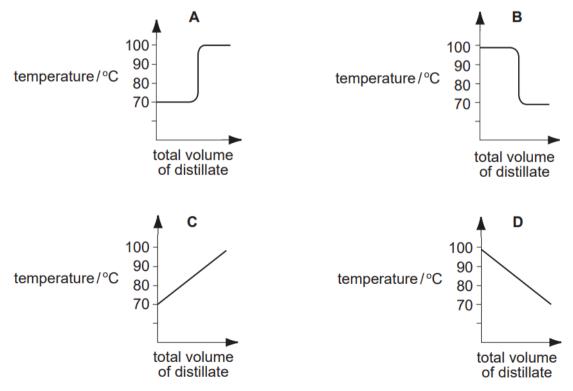
22/4P/6092/1

1 hour

- 1 Which statement about states of matter is correct?
 - **A** When a liquid reaches its boiling point, it becomes a gas. This process is called evaporation.
 - **B** When a gas condenses, it becomes a liquid and energy is lost to the surroundings.
 - **C** When a solid changes directly to a gas, the process is called deposition.
 - **D** When a solid melts, the particles get further apart and have less energy.
- 2 The diagram shows apparatus used to separate hexane (boiling point, 70 °C) and heptane (boiling point, 98 °C)?

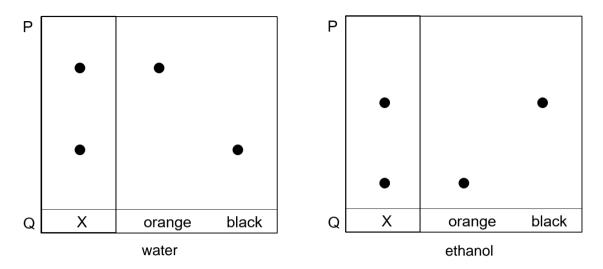


Which graph would be obtained if the temperature at point T was plotted against the total volume of distillate collected?

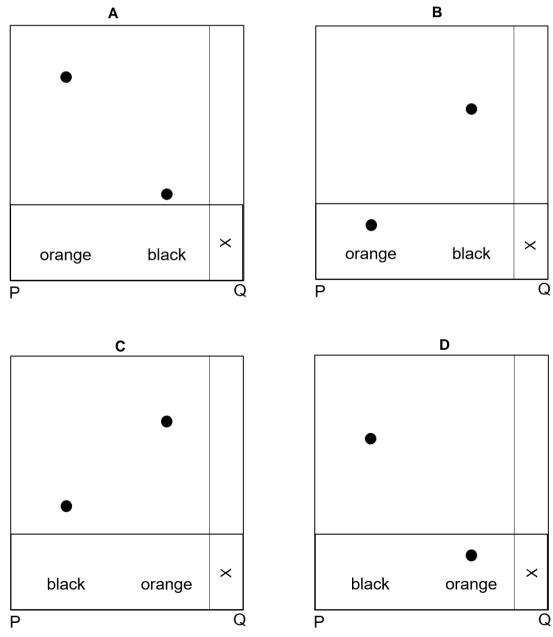


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3 The colours in a soft drink, X, was analysed by chromatography. The experiment was performed using two different solvents, water and ethanol. The results are shown below.



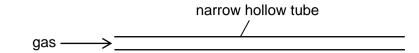
How would the final chromatogram appear if only mixture X was first developed in water, then turned through 90° anticlockwise and edge PQ was placed in ethanol?



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4 A gas is allowed to diffuse across a narrow hollow tube as shown below.



Which of the following changes will not affect the rate of diffusion of the gas through the tube?

- A place the tube vertically
- **B** lower the temperature of the gas from 25 °C to 20 °C
- **C** lowering the pressure from 1 atm to 0.5 atm
- **D** replacing the nitrogen gas with carbon monoxide gas
- 5 Which of the following is an element and forms crystals containing polyatomic molecules?
 - A copper
 - B graphite
 - **C** iodine
 - D oxygen
- 6 The metals Cr, Co, Fe and Mn are transition elements.

Which particles have the same number of electrons?

- A Co²⁺ and Cr
- B Co²⁺ and Fe³⁺
- C Cr and Mn²⁺
- D Fe³⁺ and Mn²⁺
- 7 Naturally-occurring bromine has a relative atomic mass of 80 and consists entirely of two isotopes of relative atomic masses 79 and 81.

What can be deduced about naturally-occurring bromine from this information only?

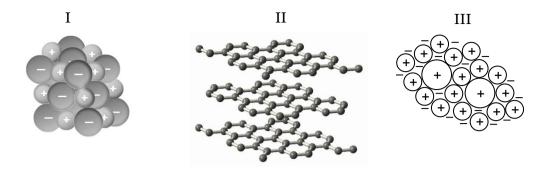
- **A** Bromine contains the two isotopes in equal proportions.
- **B** Bromine has different oxidation states.
- **C** Bromine isotopes have different numbers of protons.
- **D** Bromine is radioactive.
- 8 When a covalent liquid boils, its molecules become more widely spaced.

Which property of the molecules has the most influence on the energy required to boil a covalent liquid?

- **A** forces of attraction between the molecules
- **B** reactivity of the molecules
- **C** size of the molecules
- **D** strength of the covalent bonds in the molecules

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9 The diagram below shows three substances which can conduct electricity.



What are the particles that enable them to conduct electricity?

	Ι	II	III
Α	electrons	electrons	electrons
В	ions	atoms	electrons and ions
С	ions	electrons	electrons
D	electrons and ions	atoms and electrons	electrons and ions

- 10 Which statement is typical of a solid non-metal element?
 - A It conducts electricity.
 - **B** It forms an acidic oxide.
 - **C** It has more than one oxidation state.
 - **D** It reacts vigorously with chlorine.
- **11** The statements below describe elements X and Y.

An atom of X has more protons than an atom of Y.

An atom of Y has more valence electrons than an atom of X.

Particles of X and Y combine to form an ionic structure.

Which of the following statements can be deduced based on the statements above?

- A An atom of X has more electron shells than an atom of Y.
- **B** X forms negatively charged ions.
- **C** X and Y are in the same period of the Periodic Table.
- **D** X and Y are in the same group of the Periodic Table.

- **12** Part of the procedure to obtain crystals of a soluble salt is shown below.
 - 1 25.0 cm³ of a dilute acid was accurately measured into a conical flask.
 - 2 A known, accurate volume of alkali was gradually added to the conical flask until the solution was neutral.
 - 3 The solution was then heated in an evaporating dish, cooled and washed with approximately 10 cm³ of cold distilled water.

Which of the following shows the correct apparatus used in steps 1 to 3?

	1	2	3
Α	burette	pipette	measuring cylinder
в	measuring cylinder	burette	pipette
С	pipette	burette	measuring cylinder
D	pipette	measuring cylinder	burette

13 An alloy of copper and zinc is added to an excess of dilute hydrochloric acid. The resulting mixture is then filtered.

Which observations are correct?

	filtrate	residue	
Α	colourless solution	none	
В	colourless solution	red-brown	
С	blue solution	grey	
D	blue solution	none	

14 Solid X is insoluble in water. It gives off a gas when heated and also when reacted with dilute sulfuric acid.

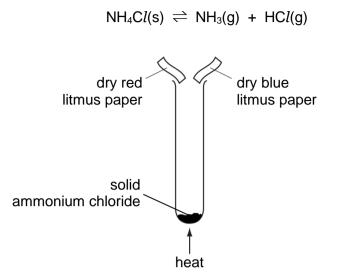
What is X?

- **A** aluminium oxide
- **B** sodium carbonate
- **C** sodium nitrate
- D zinc carbonate
- **15** Hydrazine (N_2H_4) is a powerful reducing agent. When reacted with aqueous solution containing silver ions, nitrogen is one of the products formed.

Which one of the following equations is the ionic equation of this reaction?

- $A \qquad N_2H_4 + 2Ag^+ \rightarrow N_2 + 2AgH_2$
- $\mathbf{B} \qquad \mathsf{N}_2\mathsf{H}_4 + \mathsf{A}\mathsf{g}^+ \rightarrow \mathsf{N}_2 + 2\mathsf{H}_2 + \mathsf{A}\mathsf{g}$
- $\mathbf{C} \qquad \mathsf{N}_2\mathsf{H}_4 + \mathsf{A}\mathsf{g}^+ \rightarrow \mathsf{N}_2 + 4\mathsf{H}^+ + \mathsf{A}\mathsf{g}$
- $\mathbf{D} \qquad \mathbf{N}_2\mathbf{H}_4 + 4\mathbf{A}\mathbf{g}^+ \rightarrow \mathbf{N}_2 + 4\mathbf{H}^+ + 4\mathbf{A}\mathbf{g}$

16 Ammonium chloride decomposes to form ammonia and hydrogen chloride when heated as shown in the diagram below.



What will be observed after some time?

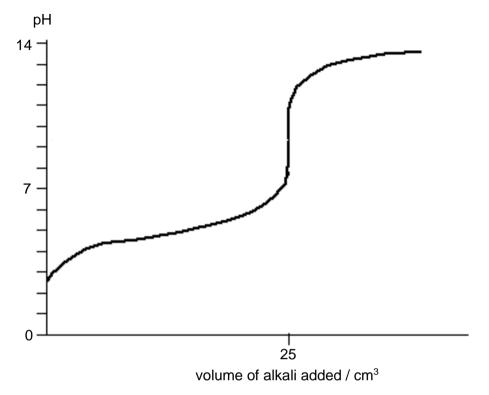
	red litmus paper	blue litmus paper		
Α	turns blue	turns red then blue		
В	turns blue then red	turns red		
С	turns blue then red	turns red then blue		
D	no change	no change		

17 The addition of dilute acid to a solution containing anion Q and the subsequent addition of barium nitrate can be used to identify the anion Q.

What is Q?

- A carbonate
- B chloride
- **C** iodide
- D sulfate
- **18** Which of the following is the best method to prepare a pure and dry sample of magnesium carbonate from a solid mixture of magnesium carbonate and lead(II) oxide?
 - A Add excess dilute acid, filter, crystallise filtrate, filter and dry.
 - **B** Add excess dilute acid, filter, rinse residue with distilled water and dry.
 - **C** Add excess aqueous sodium hydroxide, filter, rinse residue with distilled water and dry.
 - **D** Add excess aqueous sodium hydroxide, filter and heat filtrate to dryness.

19 Joe titrated dilute ethanoic acid with aqueous sodium hydroxide. The pH changes were recorded with a pH meter and represented in the graph below.



The diagram below shows the pH ranges of three indicators.

рН	1 2	3	4	5 	6	7	8	9
methyl orange	red				У	ellow		
phenolphthalein	colourless			pink				
bromothymol blue	yellow blue			;				

Which indicator(s) can Joe use to determine the end-point of the titration?

- A methyl orange only
- **B** phenolphthalein only
- **C** bromothymol blue and phenolphthalein only
- **D** bromothylmol blue, methyl orange and phenolphthalein
- **20** The Haber process is used to make ammonia at a temperature of 450 °C and a pressure of 200 atm. The temperature is changed to 700 °C but the pressure is kept the same.

What will be the effects of this change on the production of ammonia?

- A It is made at an increased rate and the yield increases.
- **B** It is made at an increased rate and the yield decreases.
- **C** It is made at a decreased rate and the yield increases.
- **D** It is made at a decreased rate and the yield decreases.

21 Aqueous acidified potassium manganate(VII) was added to a 2.30 g sample of ethanol. The mixture was then boiled under reflux for some time.

The percentage yield of the organic product collected by distillation was 60.0%.

What is the mass of the product collected?

- **A** 1.32 g **B** 1.80 g **C** 3.00 g **D** 5.00 g
- 22 Ammonia is used to make nitric acid, HNO₃ by the Ostwald Process.

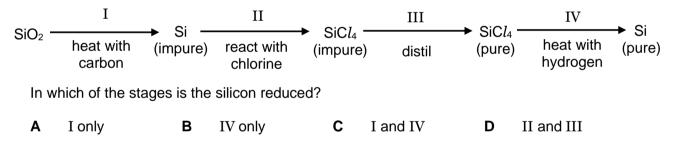
Three reactions occur in the following stages.

- 1 $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$
- 2 $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$
- 3 $3NO_2(g) + H_2O(l) \rightarrow 2HNO_3(aq) + NO(g)$

What is the number of moles of nitric acid produced from the reaction between 50.0 dm³ of oxygen gas and excess ammonia gas in stage 1?

A 1.11 **B** 1.25 **C** 1.39 **D** 1.74

23 The reaction scheme represents the process for obtaining pure silicon.



24 Three chemical reactions are represented as shown in the equations below.

 $Cl_2 + 2H_2O + SO_2 \rightarrow 2HCl + H_2SO_4$

$$Cl_2 + H_2S \rightarrow 2HCl + S$$

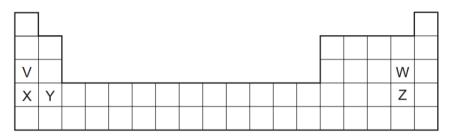
$$SO_2 + 2H_2S \rightarrow 2H_2O + 3S$$

Which of the following shows the reducing power of the reducing agents in a decreasing order?

- A chlorine, hydrogen sulfide, sulfur dioxide
- **B** chlorine, sulfur dioxide, hydrogen sulfide
- **C** hydrogen sulfide, sulfur dioxide, chlorine
- D sulfur dioxide, hydrogen sulfide, chlorine

- 25 Which is a property of aqueous potassium iodide?
 - A It does not conduct electricity.
 - **B** It is a purple solution.
 - **C** It is decolourised by chlorine.
 - **D** It reacts with aqueous bromine to form iodine.
- 26 Part of the Periodic Table is shown.

The letters are not the symbols of the elements.



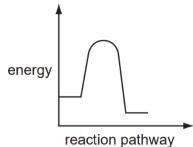
Which statement about the elements is not correct?

- **A** V is less reactive than X.
- **B** W is more reactive than Z.
- **C** Y forms an ion with same electronic configuration as X.
- **D** Z has a higher melting point than W.
- 27 The exhaust gas of a car fitted with a catalytic converter contains oxides of nitrogen.

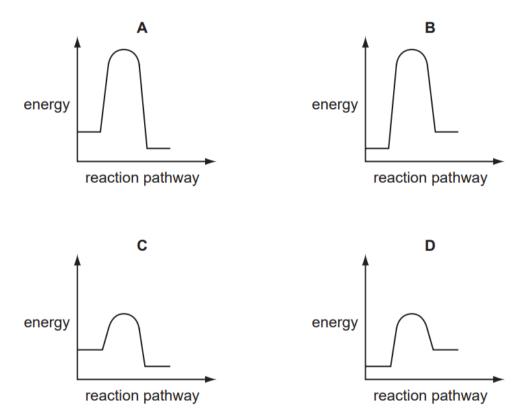
Which of the following modifications should be made to lower the concentration of oxides of nitrogen present in the exhaust gas?

- 1 decrease the size of the catalyst in the converter
- 2 increase the temperature of combustion in the engine
- 3 increase the rate of exhaust gas flowing through the converter
- **A** 1 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

28 The diagram shows the reaction pathway for the forward reaction of a reversible reaction without a catalyst.



Which diagram shows the addition of a catalyst that speeds up the backward reaction?



- 29 The scheme shows four stages, 1 to 4, in the conversion of solid candlewax, $C_{30}H_{62}$, into carbon dioxide and water.
 - 1 $C_{30}H_{62}(s) \rightarrow C_{30}H_{62}(l)$
 - 2 $C_{30}H_{62}(l) \rightarrow C_{30}H_{62}(g)$
 - 3 $C_{30}H_{62}(g) + 45.5O_2(g) \rightarrow 30CO_2(g) + 31H_2O(g)$
 - 4 $30CO_2(g) + 31H_2O(g) \rightarrow 30CO_2(g) + 31H_2O(l)$

Which stages are exothermic?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

- **30** The properties of the compound of metals X Z are shown below.
 - Carbonate of X does not decompose upon heating.
 - Metal Y displaces iron but not zinc from their sulfate salts.
 - Oxide of Z decomposes slowly to its metal at room temperature.

Which metal(s) is/are suitable to be used as a sacrificial metal to protect iron?

Α	X only	В	Y only	С	Z only	D	X and Y
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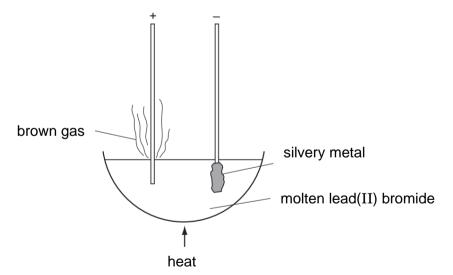
31 The products from the thermal decomposition of carbonates and hydroxides of three metals X, Y and Z are shown below.

metal	carbonate	hydroxide		
Х	carbon dioxide and metal oxide	metal oxide and water		
Y	no reaction	metal oxide and water		
Z	carbon dioxide and metal oxide	metal, oxygen and water		

What is the order of reactivity of the metals, starting with the least reactive?

Α	X, Y, Z	В	X, Z, Y	С	Z, Y, X	D	Z, X, Y
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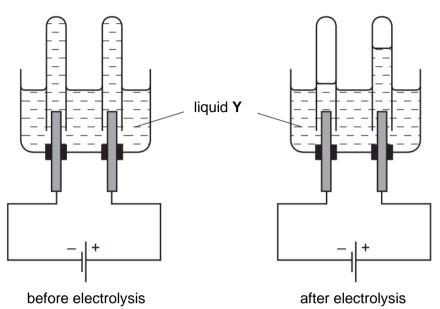
32 The diagram shows the electrolysis of molten lead(II) bromide using inert electrodes.



What happens during this electrolysis?

- A Atoms change to ions.
- **B** Covalent bonds are broken.
- **C** lons change to atoms.
- **D** New compounds are formed.

33 The diagrams show an electrolysis experiment using inert electrodes.



Which could be the possible identity of liquid Y?

- A aqueous copper(II) sulfate
- B concentrated aqueous sodium chloride
- **C** dilute sulfuric acid
- D ethanol

34 These statements refer to hydrogen and its use as a fuel.

- 1 Both water and hydrocarbons can be used as a source of hydrogen.
- 2 In a fuel cell, hydrogen reacts with oxygen to generate electricity.
- 3 The reaction taking place in a fuel cell is a redox reaction.

Which statements are correct?

- **A** 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3
- **35** Hydrazine, N_2H_4 is widely used as a rocket fuel as it burns in oxygen to produce harmless gases as shown in the equation below.

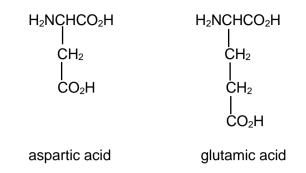
$$\mathsf{N}_2\mathsf{H}_4 + \mathsf{O}_2 \twoheadrightarrow \mathsf{N}_2 + 2\mathsf{H}_2\mathsf{O}$$

However, hydrazine does not burn spontaneously in oxygen.

Which of the following explains why hydrazine does not burn spontaneously?

- 1 Hydrazine is a liquid.
- 2 The N \equiv N bond is very strong.
- 3 The activation energy is very high.
- **A** 1 only **B** 3 only **C** 2 and 3 only **D** 1, 2 and 3

36 The diagram below shows the structural formula of aspartic acid and glutamic acid.

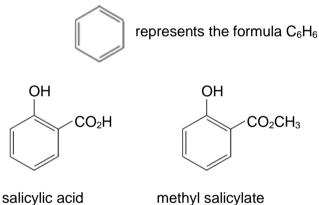


Aspartic acid and glutamic acid can react with each other to form amide linkages.

What is the maximum number of different organic compounds that can be formed when one molecule of aspartic acid reacts with one molecule of glutamic acid?

- **A** 1 **B** 2 **C** 3 **D** 4
- **37** Methyl salicylate, the main ingredient used in the treatment of muscular pain and joint can be prepared from salicylic acid.

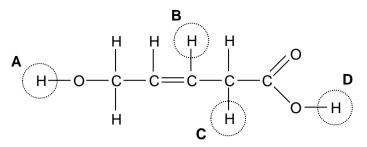
The diagram below shows the structural formula of methyl salicylic acid and methyl salicylate.



What is the best method to prepare methyl salicylate from salicylic acid?

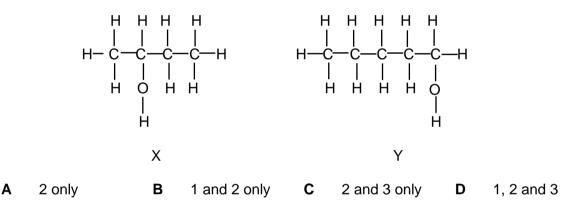
- **A** heating with ethanol
- **B** heating with methanol
- **C** heating with ethanol and concentrated sulfuric acid
- **D** heating with methanol and concentrated sulfuric acid

38 The full structural formula of compound **X** is shown below.

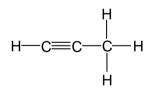


Which of the hydrogen will react with sodium carbonate?

- 39 Which of the following statements about alcohols is/are correct ?
 - 1 Alcohols contain hydroxide ions, OH⁻.
 - 2 Methanol is oxidised to methanoic acid using acidified potassium manganate(VII).
 - 3 Alcohols X and Y shown below are isomers.



40 The structure of propyne is shown below.



Propyne undergoes polymerisation to form polypropyne. 100 kg of propyne is used during polymerisation.

Which of the following statements is correct?

- A The mass of polypropyne is larger than 100 kg.
- **B** Polypropyne burns with a smokier flame than propyne.
- **C** Polypropyne has a higher percentage by mass of carbon.
- **D** Propyne burns in air to produce a larger volume of carbon dioxide than polypropyne.

End of Paper

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Elements
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The

4 He U O	10 Neon 20 Ar 40 40	X Krypton 84 54 Xenon Xenon Xenon	Rn Radon I adon	71 Lu lutetium 175 103 Lr lawrencium
M	9 F fluorine 19 17 C1 C1 S.55	35 Br bromine 80 53 53 1 1	At At astatine -	70 Yb 173 102 No nobelium
>	8 O Xygen 16 16 332 32 sulfur	34 Selenium 79 52 52 tellurium	Po 84 84 84 Po 900nium - 116 LV Iivermorium	69 Tm thulium 169 101 mendelevium
>	nitrogen 14 15 Phosphorus 31	33 As arsenic 75 51 Sb antimony	Bi Bi bismuth 209	68 Er erbium 167 100 Fm fermium
≥	6 Carbon 12 12 S S S S S	32 Ge germanium 73 50 50 Sn tin	82 82 82 82 10 113 114 7 <i>I</i> 114 7 <i>I</i> 114 5 <i>I</i>	67 Ho holmium 165 99 Es einsteinium
=	5 B boron 11 13 Al aluminium 27	31 Ga gallium 70 19 In indium	81 81 thallium 204	66 Dy dysprosium 163 98 Cf Cf californium
		30 Zn 2inc 65 Cd cadmium	80 80 Hg mercury 201 112 Cn Cn copernicium	65 Tb terbium 159 97 BK berkelium
		29 Cu 64 47 Ag Silver	79 79 80ld 197 111 Rg roentgenium	64 64 gadolinium 157 96 96 cm
Group		28 Ni 59 76 Pd Pd Pd	78 78 Platinum 195 110 Ds darmstadtium	63 Eu europium 152 95 Am americium
	_	27 CO 59 45 Rh rhodium	I 103 Ir iridium 192 109 Mt meitnerium	62 Sm samarium 150 94 Pu Plutonium
hydrogen		1 1	76 76 Os asmium 190 190 Hs hassium	61 Promethium 93 Np neptunium
		¥ 3	- 75 76 Re thenium 186 107 Bh bohrium -	60 Nd 144 92 92 92 92
	umber bol mass	24 Cr chromium 52 A0 Mo molybdenum	V V tungsten 184 106 Sg seaborgium	59 Praseodymium 141 91 91 Protactinium
Kev	proton (atomic) number atomic symbol _{name} relative atomic mass		73 73 tantalum 181 105 Db dubnium -	Ce Ce 140 90 90 90
	proton atc relati	22 Tittanium 48 21 Zr Zr 21 Conium	Hf Hf hafnium 178 104 Rutherfordium	57 La lanthanum 139 89 Ac actinium
		21 Sc 45 39 39 39 21	57 – 71 lanthanoids 89 – 103 actinoids	
	4 Beryllium 9 Mg magnesium 24	20 20 Calcium 40 38 Sr strontium	56 56 Ba barium 137 88 Ra radium	lanthanoids actinoids
	23 23 23 23 23	19 Potassium 39 37 Rb rubidium	55 55 Cs Cs caesium 133 87 Fr francium	<u></u>

The volume of one mole of any gas is 24 \mbox{dm}^3 at room temperature and pressure (r.t.p.).

californium I

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uranium 238

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141 91 Pa protactinium 231

140 90 232 232

22/4P/6092/1



West Spring Secondary School Preliminary Examination 2022

CHEMISTRY Paper 1			6092/01
SECONDARY 4 EXPRESS			
Name (Date	31 August 2022
Class		Duration	1 hour
Additional materials: Laminated Periodic Table, Answer Sheet			
READ THESE INSTRUCTIONS FIRST			
Write your index number, class and name on the Answer Shee Write in dark blue or black pen. You may use an HB pencil for any diagrams or graphs. Do not use staples, paper clips, glue or correction fluid.	t.		
There are forty questions on this paper. Answer all questions. possible answers A , B , C and D . Choose the one you consider correct and record your choice in Sheet.			
Read the instructions on the Answer Sheet very carefully.			
Each correct answer will score one mark. A mark will not be de Any rough working should be done in this booklet. A copy of the laminated Periodic Table is provided separately. The use of an approved scientific calculator is expected, where		-	swer.
This document consists of 16 printed pages i	nclu	iding the cover pag	ge.

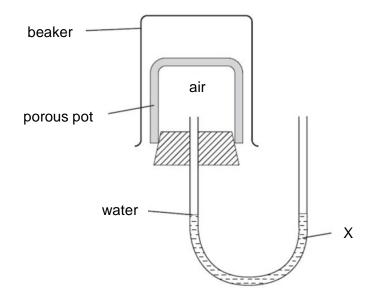
Setter: Mdm Sharena

[Turn over

1 A student follows the rate of the reaction when 0.19 g of calcium carbonate reacts with excess acid at room temperature and pressure.

What is most suitable for measuring volume of gas produced at different times during this experiment?

- **A** a 50 cm³ gas syringe
- **B** an inverted 250 cm³ measuring cylinder filled with water
- **C** an inverted 50 cm³ burette filled with water
- **D** place the apparatus on a balance and measure the loss in mass
- 2 The apparatus shown in the diagram was set up.



Which gas, when present inside the beaker, will cause the water level at X to fall?

A ammonia, NH₃

C hydrogen, H₂

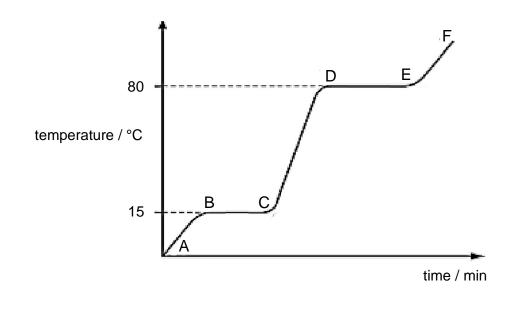
B carbon dioxide, CO₂

D nitrogen, N₂

- Some students are asked to describe the difference between the particles in gases and liquids.
 Three of their suggestions are:
 - 1 Particles in gases are further apart than particles in liquids.
 - 2 Particles in gases are bigger than particles in liquids.
 - 3 Particles in gases are smaller than particles in liquids.

Which suggestion or suggestions are correct?

- A
 1 only
 B
 2 only
 C
 3 only
 D
 1, 2 and 3
- 4 The graph shows a change of temperature when substance Y is heated.

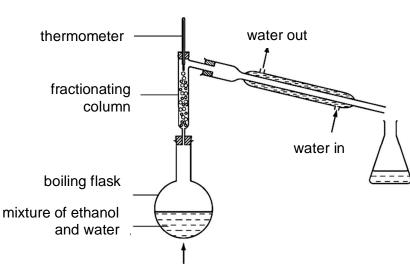


Which stage shows that substance Y is melting?

 A
 A to B
 B
 B to C
 C
 D to E
 D
 E to F

5 At which temperature does a concentrated aqueous solution of sodium chloride begin to boil?

A 93 °C **B** 99 °C **C** 100 °C **D** 104 °C

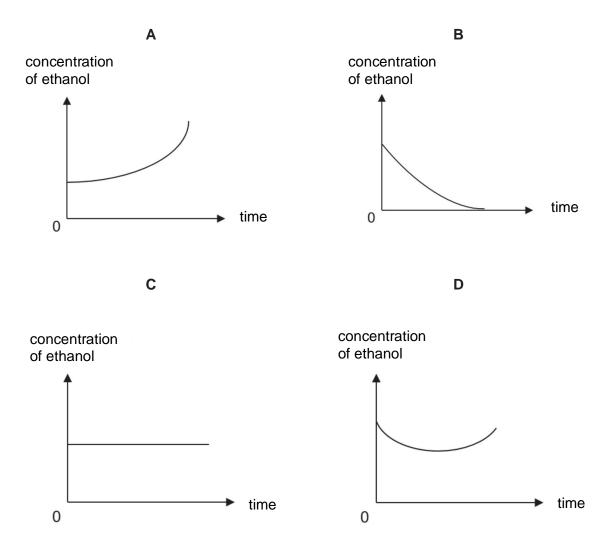


Fractional distillation is used to distil ethanol (boiling point 78°C) from a dilute ethanol solution.

6

Which graph best shows the change in concentration of ethanol in the boiling flask as distillation proceeds?

heat



- electrical conductivity percentage substance effect of heat composition by mass when solid solid burns in air to form an Ρ constant yes oxide liquid burns to form carbon Q varies no dioxide and water solid decomposes to form R constant no two products S solid melts varies yes
- Some properties of four substances P, Q, R and S are given in the table below.

Which classification of the substances as an element, a mixture or a compound is correct?

	element	compound	mixture
Α	Р	Q, R	S
В	Р	R	Q, S
С	R	Q, P	S
D	S	Р	Q, R

8 An ion Q³⁻ has 18 electrons.

7

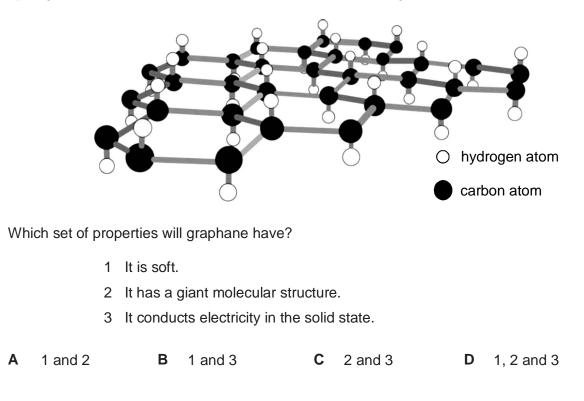
If its nucleon number is 31, what is the composition of its nucleus?

- A 15 protons and 15 neutrons
- **B** 15 protons and 16 neutrons
- **C** 18 protons and 13 neutrons
- D 21 protons and 10 neutrons

9 Which statement about atoms is correct?

- A The mass of an atom is almost entirely due to its nucleus.
- **B** The nucleus and the electrons repel each other.
- **C** The protons and neutrons have opposite charges.
- **D** The shell nearest to the nucleus always contains the most electrons.

10 Graphane, an allotrope of carbon has a similar structure to graphite, except that, it has one hydrogen atom attached to each carbon as shown in the diagram.



11 Carbon disulfide is a simple covalent compound used in manufacturing polymers.

Which statement about carbon disulfide would you predict to be true?

- A It has a low boiling point and conducts electricity when molten.
- **B** It has a low boiling point and is soluble in organic solvents.
- **C** It is a crystalline solid at room temperature and conducts electricity when molten.
- **D** It is a crystalline solid at room temperature and is soluble in organic solvents.
- 12 The formula of thallium carbonate is Tl₂CO₃ and that of sodium chlorite is NaClO₂.

What is the formula of thallium chlorite?

A $T_lC_lO_2$ **B** $T_l_2C_lO_2$ **C** $T_l(C_lO_2)_2$ **D** $T_l_2(C_lO_2)_3$

7

13 Two of the reactions used in the manufacture of nitric acid, HNO₃, are shown.

$$2NO + O_2 \rightarrow 2NO_2$$
$$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$$

What is the maximum number of moles of nitric acid which could be formed from one mole of nitrogen monoxide, NO?

A 0.5 mol **B** 1.0 mol **C** 2.0 mol **D** 4.0 mol

14 Basic copper carbonate, $Cu_2CO_3(OH)_2$, is used as a pigment in paint.

What is the percentage by mass of copper in basic copper carbonate?

A 28.8 % **B** 31.2 % **C** 57.7 % **D** 62.4 %

15 20 cm³ of hydrogen is reacted with 20 cm³ of oxygen as shown in the equation.

 $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

What are the volumes of gases remaining at the end of the reaction?

[All volumes are measured at room temperature and pressure.]

	volume of hydrogen / cm ³	volume of oxygen / cm ³	volume of product / cm ³
Α	0	0	20
В	0	0	40
С	0	10	0
D	10	10	0

16 Which statement best explains why farmers should not lime the soil and add ammonium nitrate fertiliser at the same time?

- A It is too costly to add both substances together at the same time.
- **B** The lime makes the soil too alkaline for plant growth.
- **C** The lime will react with ammonium nitrate and result in the loss of nitrogen.
- **D** The lime will react with ammonium nitrate to produce acidic substances that inhibit plant growth.

17 The table gives information about three indicators.

indicator	colour change low pH ───→ high pH	pH at which colour change takes place
methyl orange	red → yellow	4.0
bromothymol blue	yellow —— blue	6.5
phenolphthalein	colourless> pink	9.0

If equal volumes of these three indicators were mixed, which colour would be observed at pH 5?

Α	blue	В	green	С	orange	D	yellow
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- **18** How many different sulfates in total could be prepared by the reaction of dilute sulfuric acid with the following substances?
 - copper
 - magnesium
 - silver
 - zinc carbonate
 - **A** 1 **B** 2 **C** 3 **D** 4
- **19** An aqueous solution of a chloride is made by the reaction of hydrochloric acid with the hydroxide of metal M:

 $M(OH)_2$ (s) + 2HCl (aq) $\rightarrow MCl_2$ (aq) + 2H₂O (l)

Which metal cannot be M?

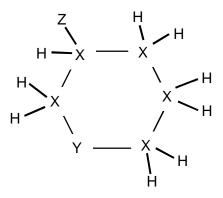
- A copper
- B iron
- C lead
- D magnesium

- 20 In addition to sodium ions and chloride ions, sea water contains magnesium ions and sulfate ions. Which method could be used to measure the amount of sulfate ions present in a sample of sea water?
 - A Add excess aqueous lead(II) nitrate, dry and weigh the precipitate formed.
 - **B** Add excess aqueous barium nitrate, dry and weigh the precipitate formed.
 - **C** Evaporate off all the water and weigh the remaining solid.
 - **D** Measure the electrical conductivity of the sample.
- 21 A pale green solution Z, gives a green precipitate with excess aqueous sodium hydroxide.

An alkaline gas is only given off when the mixture is warmed with powdered aluminium.

Which ions does Z contain?

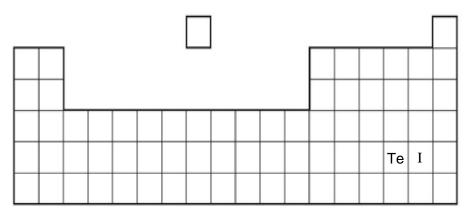
- A ammonium and copper(II) ions
- **B** ammonium and iron(II) ions
- C copper(II) and nitrate ions
- D iron(II) and nitrate ions
- 22 The compound below is made up of hydrogen and the elements X, Y and Z.



Which statement is incorrect?

- A Element Z is most likely from Group I.
- B Element X is most likely from Group IV
- **C** The compound has a simple molecular structure.
- **D** The compound has the molecular formula X_5YH_9Z .

23 Iodine, I, has a lower relative atomic mass than tellurium, Te, but is placed after it in the Periodic Table.



Which statement explains why iodine (I) is placed after tellurium (Te) in the Periodic Table?

- A lodine has fewer neutrons than tellurium.
- **B** lodine has fewer protons than tellurium.
- **C** lodine has more neutrons than tellurium.
- **D** lodine has more protons than tellurium.
- 24 Lithium reacts with water to form solution P and gas Q.

When solution P reacts with hydrochloric acid, salt R is formed.

What are the formulae of P, Q and R?

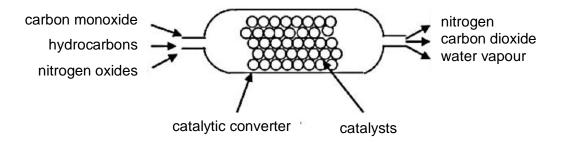
	Р	Q	R
Α	Li ₂ O	H ₂	LiCl
в	Li ₂ O	O ₂	Li ₂ Cl
С	LiOH	H ₂	LiCl
D	LiOH	O ₂	Li ₂ Cl

25 Ammonia is produced by the Haber process.

Which statement is correct?

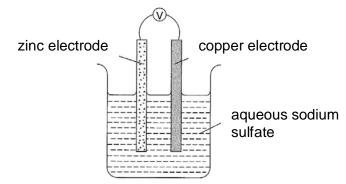
- A high pressure of 500 atm and temperature of 450 °C are used in the process.
- **B** Hydrogen is obtained from fractional distillation of crude oil.
- **C** Iron is used as a catalyst to increase the activation energy in the process.
- **D** Nitrogen obtained from liquid air is used as one of the raw materials.

26 The diagram shows the cross section of a catalytic converter in the exhaust system of a car.



Which process(es) take(s) place in the converter?

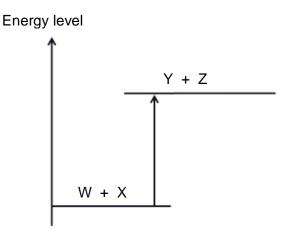
- 1 Hydrocarbons oxidise to form carbon dioxide and water vapour.
- 2 Carbon monoxide reacts with nitrogen oxides to form carbon dioxide and nitrogen.
- 3 Nitrogen oxides react with hydrocarbons to form water vapour and nitrogen.
- A 1 only
- **B** 2 only
- **C** 1 and 2
- **D** 1 and 3
- 27 The diagram shows a simple cell.



Which option describes what happens in the cell?

- A Copper ionizes and becomes smaller.
- **B** Zinc ionizes and becomes smaller.
- **C** Effervescence of hydrogen gas is observed at the zinc electrode.
- **D** Effervescence of oxygen gas is observed at the copper electrode.

28 The energy level diagram for a reaction is as shown.



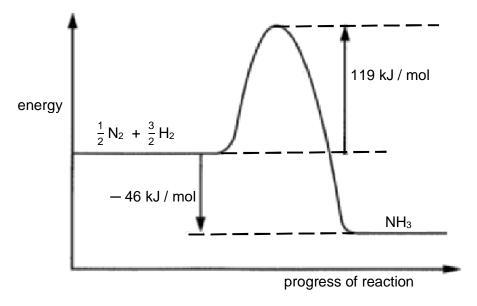
The initial temperature measured was 28.0 °C.

As the reaction progressed, the reaction temperature changed by 5.5 °C.

What would be the final temperature recorded?

A 2	22.5 °C	В	28.0 °C	С	33.5 °C	D	39.0 °C
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29 The energy profile diagram shows the formation of ammonia.



What is the activation energy for the decomposition of ammonia into its elements?

 A
 46 kJ / mol
 B
 73 kJ / mol
 C
 119 kJ / mol
 D
 165 kJ / mol

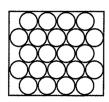
- **30** Which is the overall equation for the reactions that take place in a hydrogen fuel cell?
 - $\label{eq:alpha} \textbf{A} \quad 2H_2 \ \textbf{+} \ O_2 \ \rightarrow \ 2H_2O$
 - $\label{eq:bound} \textbf{B} \quad 2H_2O \ \rightarrow \ 2H_2 \ \textbf{+} \ O_2$

 - $\label{eq:bar} \textbf{D} \quad H_2 \ \rightarrow \ 2H^{\scriptscriptstyle +} \ + \ 2e^{\scriptscriptstyle -}$
- 31 Iron rusts easily, hence steel structures should be treated to slow down the rusting process.

Which option describes incorrectly how each method protects iron from rusting and its main disadvantage?

	method	how it protects	disadvantage	
A	alloying steel with chromium to make stainless steel	chromium reacts with oxygen in the air to form a barrier of chromium oxide which prevents iron from rusting	production of stainless steel is costly	
В	coating steel plates with zinc	zinc is less reactive than iron, and provides a barrier between iron and the atmosphere	when the coating of zinc is scratched, iron will corrode in place of zinc, making it rust more quickly	
С	painting steel	provides a barrier between the iron and the atmosphere	paint scrapes off easily to expose iron to the atmosphere	
D	storing steel objects in a dry place	absence of water prevents iron from rusting quickly	difficult to keep storage place dry at all times	

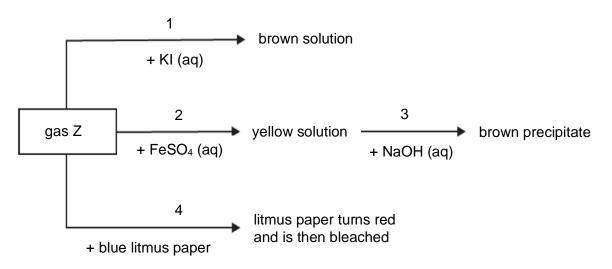
32 The arrangement of atoms in pure iron is shown.



Steel can be made by adding carbon to pure iron.

Which description of the arrangement of atoms in steel is correct?

- A A regular pattern of carbon atoms with iron atoms fitting into the gaps between them.
- **B** A regular pattern of iron atoms with carbon atoms fitting into the gaps between them.
- **C** An irregular pattern of iron atoms with carbon atoms randomly spread throughout the structure.
- **D** Rows of iron atoms alternating with rows of carbon atoms.
- 33 The scheme below shows reactions of a gas Z.



Which statement is incorrect?

- A Gas Z is chlorine.
- **B** In stage 1, potassium iodide is reduced to form iodine.
- **C** In stage 2, iron(II) sulfate is oxidized to form iron(III) sulfate.
- **D** The brown precipitate formed in stage 3 is iron(III) hydroxide.

34 Hydrogen peroxide (H₂O₂) acts as an oxidising agent in some reactions, but in others, as a reducing agent.

reaction 1: $H_2O_2 + 2KI + H_2SO_4 \rightarrow I_2 + K_2SO_4 + 2H_2O$ reaction 2: $5H_2O_2 + 2KMnO_4 + 3H_2SO_4 \rightarrow 2MnSO_4 + K_2SO_4 + 5O_2 + 8H_2O$ reaction 3: $H_2O_2 + Ag_2O \rightarrow 2Ag + O_2 + 2H_2O$

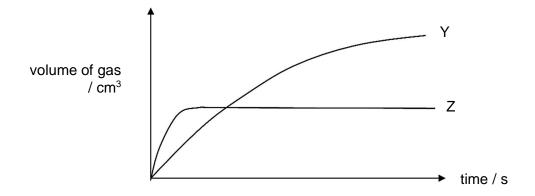
Which row identifies correctly the role of hydrogen peroxide in each reaction?

	reaction 1	reaction 2	reaction 3
Α	oxidising agent	reducing agent	reducing agent
в	oxidising agent	reducing agent	oxidising agent
С	reducing agent	oxidising agent	oxidising agent
D	reducing agent	oxidising agent	reducing agent

35 Manganese(IV) oxide catalyses the decomposition of aqueous hydrogen peroxide to water and oxygen.

In order to follow the rates of this reaction for two different solutions of hydrogen peroxide the total volumes of oxygen evolved were recorded at regular time intervals and the results were plotted.

In each experiment, the same mass of catalyst was used and the temperature was the same.



If graph Y corresponds to 20 cm³ of 4.0 mol / dm³ hydrogen peroxide solution, what is the volume and concentration of graph Z?

- A 5 cm³ of a 8.0 mol / dm³ solution
- **B** 10 cm^3 of a 2.0 mol / dm³ solution
- C 20 cm³ of a 4.0 mol / dm³ solution
- **D** 20 cm³ of a 8.0 mol / dm³ solution

- **36** When crude oil is fractionally distilled, which compounds leave from the top of the fractionating column?
 - A The compounds that are the least flammable.
 - **B** The compounds that are the most viscous.
 - **C** The compounds with the highest relative molecular mass.
 - **D** The compounds with the lowest boiling points.
- **37** What is the structure of the product of the reaction between butene, CH₃–CH₂–CH=CH₂, and bromine, Br₂?
 - A CH₃–CH₂–CHBr–CH₂Br
 - B CH₃-CHBr-CH₂-CH₂Br
 - $\textbf{C} \qquad CH_2Br\text{---}CH_2\text{---}CH_2Br$
 - D CH₂Br–CH₂–CHBr–CH₃
- **38** X reacts with steam to form Y.

Y is oxidized to Z.

 $X \xrightarrow{+ \text{ steam}} Y \xrightarrow{- \text{ oxidation}} Z$

If X is propene, what is the formula of Z?

A C_3H_6 **B** C_3H_7OH **C** C_2H_5COOH **D** C_3H_7COOH

39 Which carboxylic acid would combine with ethanol to give the ester $C_2H_5COOC_2H_5$?

- A butanoic acid C methanoic acid
- B ethanoic acid D propanoic acid
- 40 The table refers to the polymers nylon and poly(ethene).

Which row is correct?

	polymer	type	use
Α	nylon	addition	cling film
в	nylon	condensation	parachutes
С	poly(ethene)	addition	parachutes
D	poly(ethene)	condensation	cling film

END OF PAPER

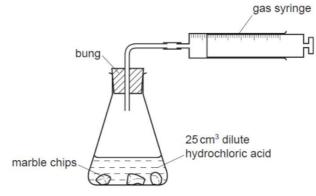


An unknown white solid, M, melts between 171 °C and 174 °C. When chromatography is performed with water as the solvent, M produces only one spot on the chromatogram.

Which statement must be true about M?

1

- A M can sublime.
- **B** M is an ionic compound.
- **C** M is impure as it melts over a range of temperatures.
- **D** M is pure as it produced only 1 spot on the chromatogram.
- 2 The apparatus shown in the diagram below was set up by a student to measure the volume of carbon dioxide gas produced when different masses of marble chips were added to 25 cm³ of dilute hydrochloric acid.



Which other apparatus did the student use for his experiment?

- A Filter funnel and mass balance
- B Filter funnel and stopwatch
- **C** Measuring cylinder and mass balance
- **D** Measuring cylinder and stopwatch
- **3** Two isotopes of carbon, C-12 and C-13 are found combined in a giant molecule. The average relative atomic mass of carbon in the giant molecule is 12.4.

What is the proportion of C-12 atoms in the giant molecule?

- **A** 50%
- **B** 60%
- **C** 70%
- **D** 80%
- **4** Three elements X, Y and Z belong to the same period in the Periodic Table. The properties of the oxide formed by the three elements are shown below.

oxide of X:	Insoluble in water and aqueous sodium hydroxide but dissolves readily in dilute hydrochloric acid
oxide of Y:	Has low boiling point and does not react with both aqueous sodium hydroxide and dilute hydrochloric acid
oxide of Z:	Insoluble in water but dissolves in both aqueous sodium hydroxide and dilute hydrochloric acid

Based on the statements above, arrange X, Y and Z in order of increasing atomic number in the Periodic Table.

- **A** X, Y, Z
- **B** Y, X, Z
- **C** X, Z, Y
- **D** Y, Z, X
- 5 Elements X and Y are in Group VII of the Periodic Table.X is a liquid while Y is a solid at room temperature and pressure.

Which statement is correct?

- **A** Atoms of X has more protons than atoms of Y.
- **B** X displaces Y from an aqueous solution of Y.
- **C** Y is a stronger oxidising agent than X.
- **D** Molecules of Y have more atoms than molecules of X.
- 6 What can be deduced about two gases that have the same relative molecular mass?
 - **A** They have the same rate of diffusion at room temperature and pressure.
 - **B** They have the same solubility in water at room temperature.

- **C** They have the same number of atoms in one molecule.
- **D** They have the same boiling point.

- 7 Which substance will react with dilute sulfuric acid to produce a colourless solution only?
 - **A** zinc hydroxide
 - B copper(II) oxide
 - C sodium carbonate
 - **D** barium chloride
- 8 An ion has 23 electrons and a mass number of 56. What is the charge on the ion if it has 30 neutrons?

A –2 B +2	C –3	D +3
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9 The table below shows the physical properties of substances P, Q, R and S.

Substance	Malting point / 90	Electrical conductivity		
Substance	Melting point / °C	in solid state	in molten state	
Р	High	Poor	Good	
Q	High	Good	Good	
R	High	Poor	Poor	
S	Low	Poor	Poor	

Using the information from the table, which statement is true about substances P, Q, R and S?

- A Substance R consists of weak bonds between the atoms.
- **B** Substance S exists in a simple molecular structure.
- **C** Substance P contains mobile electrons to conduct electricity when in molten state.
- **D** Substance Q consists of strong electrostatic attractions between oppositely charged ions.
- **10** In 1986, an accident in Chernobyl Nuclear Power Plant resulted in the melting of its nuclear reactor core, and the release of radioactive isotopes into the atmosphere.

One of these radioactive isotopes is $^{131}_{53}$, which has been linked to an increased risk of thyroid cancer.

Which statement about ${}^{131}_{53}$ is correct?

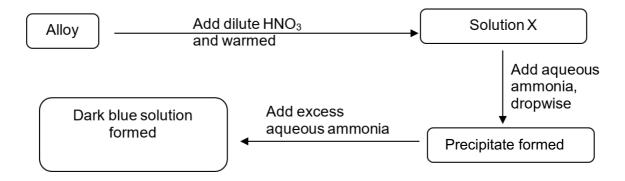
- **A** An atom of ${}^{127}_{53}X$ is an isotope of ${}^{131}_{53}I$.
- **B** An atom of ${}^{131}_{53}$ I has 78 nucleons.
- **C** An ion of ${}^{131}_{53}$ has 131 neutrons.
- **D** A molecule of ${}^{131}_{53}$ has a relative molecular mass of 184.
- **11** A sample of potassium oxide, K₂O, is dissolved in 250 cm³ of distilled water. 25.0 cm³ of the solution is neutralised by 15.0 cm³ of 1 mol/dm³ dilute sulfuric acid.

What is the mass of potassium oxide dissolved in 250 cm³ of distilled water?

- **A** 6.9 g
- **B** 8.1 g
- **C** 14.1 g
- **D** 28.2 g
- **12** A piece of seashell has a mass of 23.0 g. Seashell contains impure calcium carbonate. When analysed, the seashell is found to contain 0.226 moles of pure calcium carbonate.

What is the percentage purity of calcium carbonate in the piece of seashell?

- **A** 0.4 %
- **B** 0.983 %
- **C** 1.70 %
- **D** 98.3 %
- **13** A student conducted the following tests on a sample of alloy containing two metals.



What are the two possible metals present in the alloy?

- A iron and zinc
- **B** aluminium and copper

- C zinc and copper
- D lead and iron

14 Aqueous copper(II) sulfate is electrolysed using copper electrodes.

Which statement is true?

- **A** A colourless gas is liberated at the anode.
- **B** The electrolyte turns from blue to colourless.
- **C** A reddish-brown solid is deposited at the cathode.
- **D** The electrolyte becomes acidic.
- 15 In electroplating a chromium bracelet with silver, which combination is correct?

	anode	cathode	electrolyte
Α	bracelet	silver	silver nitrate
в	silver	bracelet	silver nitrate
С	bracelet	silver	chromium nitrate
D	silver	bracelet	silver chloride

16 Four different metals, zinc, silver, magnesium and iron were added separately in excess, to blue copper(II) sulfate solution in four beakers.

How many beaker(s) of solution will be colourless after a week?

- A 1 B 2 C 3 D 4
- **17** Hydrogen peroxide, H_2O_2 , reacts with an oxide, M_2O , as shown below.

 $M_2O(s) + H_2O_2(l) \rightarrow 2M(s) + H_2O(l) + O_2(g)$

What is the function of the oxide M_2O , in this reaction?

- A an oxidising agent
- **B** a reducing agent
- **C** a catalyst
- D a base

18 In the electrolysis of molten aluminium oxide, 4 moles of aluminium ions (Al³⁺) were discharged at the cathode.

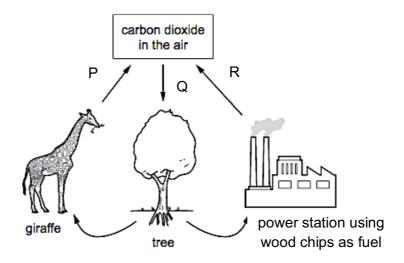
Which one of the following would be discharged by the same amount of electricity?

- **A** 4 mole of Cu²⁺ in the electrolysis of aqueous copper(II) sulfate
- **B** 6 moles of Pb²⁺ in the electrolysis of molten lead(II) bromide
- **C** 6 moles of Ag⁺ in the electrolysis of aqueous silver nitrate
- **D** 12 moles of Zn^{2+} in the electrolysis of molten zinc sulfate
- **19** The following waste gases from a coal burning power station are passed through wet powdered calcium carbonate to reduce gaseous pollutants from escaping into the atmosphere.

sulfur dioxide	carbon monoxide	sulfur trioxide
nitrogen monoxide	nitrogen dioxide	carbon dioxide

How many waste gases will be removed by the wet powdered calcium carbonate?

20 The diagram shows part of the carbon cycle. P, Q and R refer to specific processes of the carbon cycle.

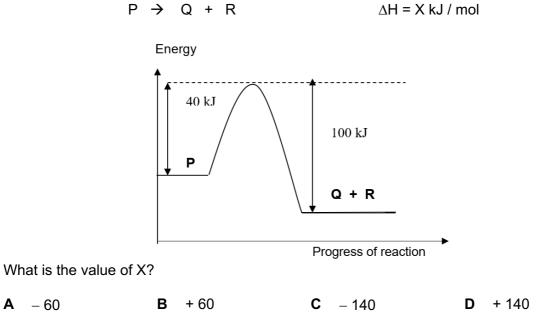


Which row correctly describe the energy changes of these processes?

P Q R

Α	endothermic	exothermic	endothermic
в	endothermic	endothermic	exothermic
С	exothermic	exothermic	endothermic
D	exothermic	endothermic	exothermic

21 The diagram below represents the energy profile diagram for the reaction,



- 22 Which property shows an increasing trend in the elements, from Group I to Group VII, across a period of the Periodic Table?
 - Α metallic character

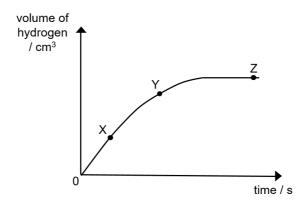
A - 60

- В non-metallic character
- С number of electron shells
- D reactivity with water
- 23 Aerials in portable radios are made of a mixture of the oxides of calcium and iron known as 'ferrite'. It contains 18.5% calcium and 51.9% iron by mass.

Which is the empirical formula of 'ferrite'?

- Α CaFe₂O
- В CaFe₂O₄
- С Ca₂FeO₂
- Ca₄Fe₂O D

24 The graph shows how the volume of hydrogen gas produced by the reaction between 50 cm³ of 2.0 mol/dm³ hydrochloric acid and an excess of magnesium varied with time.



Which statement is correct?

- **A** The reaction is faster at point Y than point X.
- **B** All the magnesium has reacted at point Z.
- **C** The volume of gas produced is doubled if 100 cm³ of 2.0 mol/dm³ hydrochloric acid is used.
- **D** The time taken to reach completion decreases if 100 cm³ of 2.0 mol/dm³ hydrochloric acid is used.
- 25 Which is the overall equation for the reactions that take place in a hydrogen fuel cell?

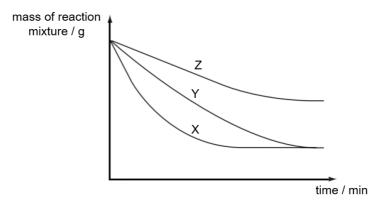
At the positive electrode: $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$ At the negative electrode: $2H_2(g) + 4OH^-(aq) \rightarrow 4H_2O(l) + 4e^-$

- $\textbf{A} \qquad 2H_2\left(g\right) \ + \ O_2\left(g\right) \ \rightarrow \ 2H_2O\left(l\right)$
- $\textbf{B} \qquad 2H_2O~(l)~\rightarrow~2H_2~(g)~+~O_2~(g)$
- $\label{eq:constraint} \boldsymbol{\mathsf{C}} \qquad 2\mathsf{H}^{\scriptscriptstyle +}\left(\mathsf{aq}\right) \ + \ 2\mathsf{e}^{\scriptscriptstyle -} \ \rightarrow \ \mathsf{H}_2\left(\mathsf{g}\right)$
- **D** $4OH^{-}(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e^{-}$

- 26 Which of the statements are true of the Haber process?
 - 1 Ammonia formed is condensed and obtained as a liquid.
 - 2 Hydrogen gas is obtained from cracking of crude oil.
 - 3 Nickel catalyst is used to increase the yield of ammonia.
 - 4 Nitrogen gas is oxidised to form ammonia.
 - A 1 and 2 only
 - B 1 and 3 only
 - C 2 and 3 only
 - **D** 3 and 4 only
- **27** A student carried out two experiments under the same room temperature and pressure to investigate the speed of reaction of marble with 0.2 mol/dm³ hydrochloric acid.

experiment 1: excess powdered marble is added to 20 cm³ of dilute hydrochloric acid experiment 2: excess marble chips is added to 20 cm³ of dilute hydrochloric acid

The mass of the reaction mixture was measured at regular time intervals and plotted against time.



Which pair of curves is obtained in the two experiments?

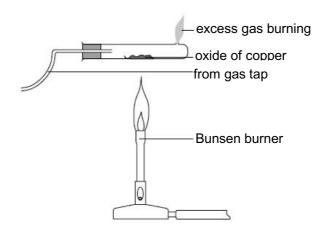
	experiment 1	experiment 2
Α	Х	Y
В	Y	Z
С	Х	Z
D	Y	Х
В	Y	z z

28 Tin is a metal between iron and lead in the reactivity series.

Which method is used for the extraction of tin from its ores?

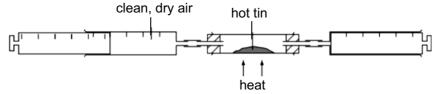
- A heat with limestone
- B heat with carbon
- **C** electrolysis of the molten ore
- **D** heat with copper powder
- **29** The following set-up is used to study the reduction of an oxide of copper by heating it with a gas.

The oxide of copper is Cu_2O , which is a red solid. What would be observed when the reaction has stopped, and what is the purpose of burning the excess gas?



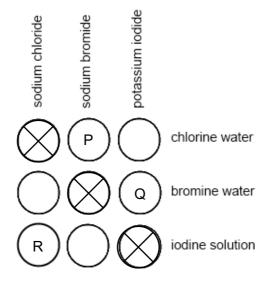
	observation	purpose of burning excess gas
Α	red solid turns pink	carbon dioxide is a pollutant
в	red solid remains unchanged	carbon monoxide used to reduce oxide is poisonous
С	red solid turns pink	hydrogen gas used to reduce oxide is highly flammable
D	red solid turns black	nitrogen dioxide gas used to reduce oxide is a pollutant

30 A sample of clean, dry air is passed over hot tin until all the oxygen in the air has reacted with tin.



The volume of air decreases by 30 cm³. What was the estimated original volume of the sample of air?

- **A** 6 cm³
- **B** 40 cm³
- **C** 120 cm³
- **D** 145 cm³
- **31** Drops of chlorine, bromine and iodine water are added to petri-dishes containing salt solutions of other halides, shown below.

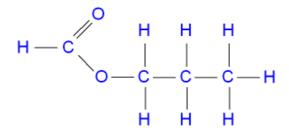


Which option correctly identifies what will be observed in dishes P, Q and R?

	Р	Q	R
Α	colourless solution turns orange	colourless solution turns brown	no visible reaction
в	orange solution turns colourless	brown solution turns orange	pale yellow solution turns brown
С	colourless solution turns orange	no visible reaction	colourless solution turns brown
D	orange solution turns colourless	no visible reaction	no visible reaction

- **32** The compound C_6H_{10} is a member of a hydrocarbon homologous series. Which one of the following is the first member of this series?
 - **A** C₂H₂
 - **B** C₂H₃
 - $\boldsymbol{C} \qquad C_2H_4$
 - $\boldsymbol{D} \qquad C_2 H_6$

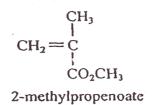
33 A compound associated with the smell or flavour of raspberries has the structure:



Which alcohol and carboxylic acid can be used to make this compound in the laboratory?

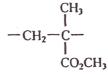
- A butanol and ethanoic acid
- **B** methanol and propanoic acid
- **C** propanol and methanoic acid
- **D** ethanol and ethanoic acid
- **34** Which comparison of the properties of pentane, C_5H_{12} and propane is true?
 - A Propane has a higher boiling point.
 - **B** Propane has a lower melting point.
 - **C** Propane is less flammable.
 - **D** Propane is more viscous.

35 In an artificial hip joint, bone cement is used to attach the polyethene cup for the joint to the pelvic girdle. Bone cement is formed by the polymerisation of 2-methylpropenoate and the process is highly exothermic.



Which one of the following is/are correct statements about this polymerisation?

1. The repeat unit of the polymer is

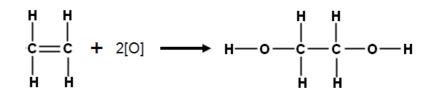


- 2. The formation of cement occurs by addition polymerisation.
- **3.** Less energy is released in making two C-C bonds than absorbed in breaking a C=C bond.
- **A** 1 and 2
- **B** 2 and 3
- **C** 1 and 3
- **D** 1, 2 and 3
- **36** A gaseous hydrocarbon Q, on heating with a catalyst, forms a solid compound R. Both Q and R have the same empirical formula.

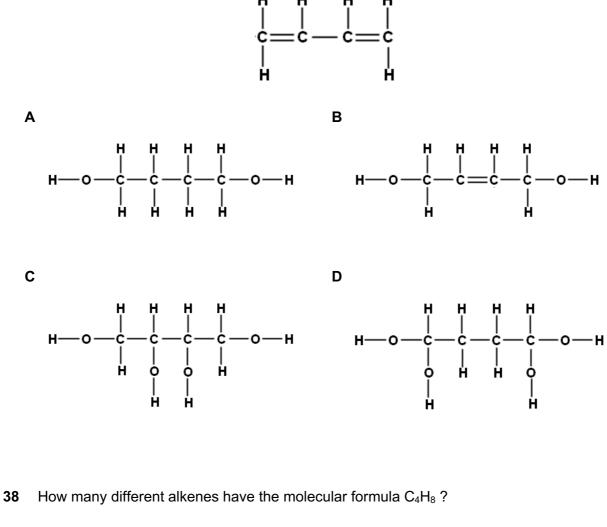
What type of reaction is this?

- A addition polymerisation
- **B** condensation polymerisation
- C hydrogenation
- **D** substitution

37 Cold, dilute potassium manganate(VII) can be used to oxidise alkenes to diols. An example is shown below with ethene. The [O] represents an oxygen atom from the oxidising agent.



What is the product when the compound below is reacted with cold, dilute potassium manganate(VII)?



A 2 **B** 3 **C** 4 **D** 5

 $\label{eq:action} \textbf{39} \quad A \text{ carboxylic acid has the formula } C_2 H_4 O_2 \ .$

What type of formula is this?

- **A** empirical formula
- **B** general formula
- **C** molecular formula
- **D** structural formula
- **40** An alcohol, X, was fully oxidised to a carboxylic acid. Neutralisation of the acid with calcium carbonate gave a salt of formula (CH₃CO₂)₂Ca.

What was alcohol X?

- A CH₃OH
- B C₂H₅OH
- C C₃H₇OH
- D C₄H₉OH

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YUHUA SECONDARY SCHOOL PRELIMINARY EXAMINATION 2022 SECONDARY FOUR EXPRESS

	CANDIDATE NAME		
4E	CLASS	INDEX NUMBER	

CHEMISTRY

Paper 1 Multiple Choice

29 August 2022 1 hour

6092/01

Additional Materials : Multiple Choice Answer Sheet

Setter: Ms Cerenna Ng

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid. Write your *Name*, *Class* and *Class Index Number* on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

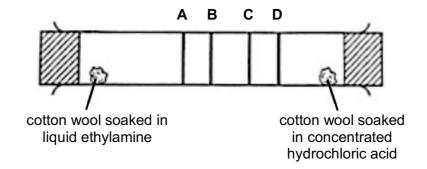
Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet. A copy of the Periodic Table is printed on page 16.

The use of an approved scientific calculator is expected, where appropriate.

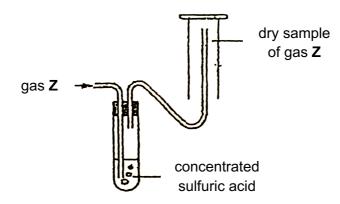
1 Liquid ethylamine and hydrochloric acid are volatile substances.

Ethylamine gas, C₂H₅NH₂, and hydrogen chloride gas, HC*I*, react to form a white solid, ethylamine hydrochloride.

At which position in the tube would a ring of white solid ethylamine hydrochloride form?



2 The diagram shows a method to collect a dry sample of gas Z.



Which information can be deduced about gas Z?

- 1 **Z** is an alkaline gas.
- 2 Z is less dense than air.
- 3 Z is very soluble in water.
- A 2 only
- **B** 1 and 2 only
- **C** 2 and 3 only
- **D** 1, 2 and 3

3 A series of experiments was conducted on a newly discovered substance.

Which observation suggests that the substance **cannot** be an element?

- A Electrolysis of the molten substance produces two products.
- **B** The substance dissolves in water to give a colourless solution.
- **C** The substance has a fixed melting point.
- **D** When the substance is heated in air, a white solid is formed.
- 4 In an experiment, a solid **P** is found to melt at 121 °C, the same temperature as the melting point of benzoic acid.

In another experiment, some solid P is mixed with pure solid benzoic acid. The melting point of the mixture is found to be 116 °C.

What can be concluded from the two experiments?

- **A P** is a mixture.
- **B P** is not benzoic acid.
- **C P** is a pure compound.
- **D P** is impure benzoic acid.
- 5 Compound **A** consists of a lattice of positive ions of **Y** and negative ions of **Z**. Each positive ion is surrounded by eight negative ions and each negative ion is surrounded by four positive ions.

Which option correctly shows the chemical formula of compound **A** and ions present in compound **A**?

	chemical formula	ions present
Α	YZ ₂	Y ²⁺ , Z ⁻
в	Y ₂ Z	Υ ⁺ , Ζ ²⁻
С	ZY ₂	Y ²⁺ , Z ⁻
D	Z ₂ Y	Y ⁺ , Z ²⁻

6 An atom of one isotope of uranium is represented by the symbol $^{235}_{92}$ U.

Which row is correct for an atom of a different isotope of uranium?

	nucleon number	number of protons	number of neutrons
Α	147	92	147
в	239	92	147
С	235	92	143
D	239	147	239

7 Dilute sulfuric acid is added to a mixture of excess copper, excess magnesium, and excess lead in a beaker. The beaker is left for about 10 minutes and its contents are then filtered.

What does the filtrate contain?

- A copper(II) sulfate, magnesium sulfate, and lead(II) sulfate
- **B** copper(II) sulfate and magnesium sulfate
- **C** lead(II) sulfate and magnesium sulfate
- D magnesium sulfate
- 8 Silicon and carbon are in the same group of the Periodic Table.

Which chemical formula containing silicon is incorrect?

- A CaSiO₂
- B SiCl₄
- C SiH₄
- D SiHCl₃
- 9 Element **Z** forms an ion with 2+ charge.

An ion of **Z** has a nucleon number of 226 and 86 electrons.

Which statement about an ion of Z Is correct?

- A It has 140 neutrons.
- **B** It has 2 electrons in its valence shell.
- **C** It has 86 protons.
- $\label{eq:D} \textbf{D} \qquad \text{It has the same number of nucleons as an atom of } \textbf{Z}.$

10 A student wants to prepare calcium sulfate.

Which pair of reagents are the most suitable for making calcium sulfate?

- A calcium and sulfuric acid
- **B** calcium carbonate and sulfuric acid
- **C** calcium nitrate and sulfuric acid
- **D** calcium oxide and sulfuric acid
- 11 Which gas contains the same number of atoms as 9 g of water?
 - A 1 g of hydrogen
 - **B** 15 g of neon
 - **C** 24 g of ozone
 - **D** 44 g of carbon dioxide
- **12** The combustion reaction of ammonia gas and carbon are shown below.

Reaction 1: $4NH_3(g) + 3O_2(g) \rightarrow 2N_2(g) + 6H_2O(l)$

Reaction 2: $C(s) + O_2(g) \rightarrow CO_2(g)$

 80 cm^3 of ammonia burns in 80 cm^3 of oxygen and the resulting gas mixture is reacted with an excess of carbon.

What is the total volume of gases that would be collected at the end of the second reaction?

- **A** 20 cm³
- **B** 40 cm³
- **C** 60 cm³
- **D** 160 cm³
- 13 Zinc oxide has antibacterial properties and is commonly used in the treatment of skin conditions.

Zinc oxide reacts with hydrochloric acid according to the equation shown below.

$$ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$$

When 19 g of impure zinc oxide was reacted with excess hydrochloric acid, 23 g of zinc chloride was formed.

What is the percentage purity of the zinc oxide used?

- A 42.9 %B 59.5 %
- **B** 59.5 % **C** 72.1 %
- **D** 82.6 %

14 Each of the following solutions has a concentration of 0.5 mol/dm³.

Which solution contains the greatest number of ions in 1 dm³ of solution?

- A calcium hydroxide
- B ethanoic acid
- **C** ethanol
- **D** nitric acid
- **15** Chromium(III) sulfate reacts with sodium carbonate to produce a precipitate of chromium(III) carbonate.

Which row shows the solubility of chromium(III) sulfate, sodium carbonate and chromium(III) carbonate?

	chromium(III) sulfate	sodium carbonate	chromium(III) carbonate
Α	insoluble	soluble	insoluble
в	soluble	soluble	insoluble
С	insoluble	insoluble	soluble
D	soluble	soluble	soluble

- 16 What does the term *strong acid* mean in relation to hydrochloric acid, HCl?
 - **A** Each molecule can produce two hydrogen ions.
 - **B** It is fully ionised in aqueous solution.
 - **C** Its aqueous solution has a pH greater than 7.
 - **D** Its salt, lead(II) chloride, is insoluble in water.
- 17 Imidazole dissolves in water to give a weak alkaline solution.

A few drops of Universal Indicator are added to an aqueous solution of imidazole.

Which row shows the pH of the solution and the colour of the solution after the indicator has been added?

	рН	colour of solution
Α	greater than 7	blue
в	greater than 7	purple
С	less than 7	blue
D	less than 7	purple

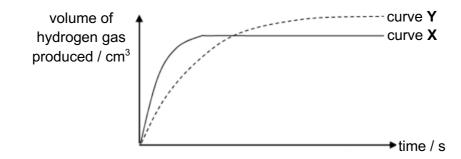
18 The reaction represented by the following equation occurs by collisions between X_2 and Y_2 molecules.

$$\mathbf{X}_{2}(g) + \mathbf{Y}_{2}(g) \rightarrow 2\mathbf{X}\mathbf{Y}(g)$$

Which statement(s) is/are correct?

1	All collisions between X_2 and Y_2 molecules produce XY molecules.
2	The frequency of collisions is increased by raising the concentration of X_2 and Y_2 molecules in the reaction mixture.
3	The frequency of collisions is unaffected by raising the pressure exerted on the reaction mixture.
4	The frequency of collisions is increased by a rise in the temperature of the reaction mixture.

- A 1 and 3
- **B** 1, 2 and 3
- **C** 2 and 4
- **D** 4 only
- **19** In the graph below, curve X was obtained by the reaction between 100 cm³ of 1 mol/dm³ hydrochloric acid and 5 g of zinc granules.



Which change could produce curve Y?

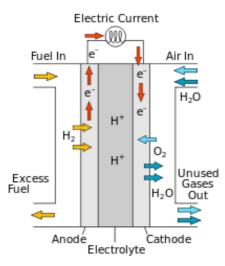
- A 200 cm³ of 0.8 mol/dm³ hydrochloric acid
- **B** 50 cm³ of 1.5 mol/dm³ hydrochloric acid
- **C** same mass of zinc powder
- **D** increasing the temperature by 15 °C

 $K_2Cr_2O_7 + 2KOH \rightarrow 2K_2CrO_4 + H_2O$

Which option correctly shows the changes to the oxidation state of chromium and the pH of the reaction mixture?

	oxidation state of chromium	pH of mixture
Α	decreases	decreases
в	decreases	increases
С	remains the same	decreases
D	remains the same	increases

21 The following diagram shows an acidic fuel cell.



The half equations are given below.

Anode: $H_2 \rightarrow 2H^+ + 2e^-$

Cathode:
$$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$$

Which option shows the overall equation for the acidic fuel cell?

A $2H_2 + O_2 \rightarrow 2H_2O$

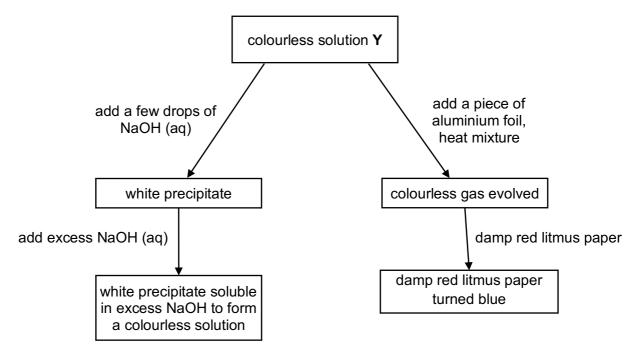
$$\mathbf{B} \qquad \mathbf{H}_2 + \mathbf{O}_2 \rightarrow \mathbf{2}\mathbf{H}_2\mathbf{O}$$

- **C** $H_2 + 2H^+ + O_2 \rightarrow 2H_2O$
- **D** $2H_2 + 4H^+ + O_2 \rightarrow 2H_2O + 4H^+$

22 What is the effect of a catalyst on the activation energy and enthalpy change of an exothermic reaction?

	activation energy	enthalpy change
Α	decreases	decreases
в	increases	no change
с	decreases	no change
D	increases	decreases

- 23 Which substance is unlikely to react with aqueous sodium hydroxide?
 - A ammonium sulfate
 - **B** carbon dioxide
 - **C** copper(II) carbonate
 - **D** nitric acid
- 24 The flow chart outlines the results of a series of tests on solution Y.



What is the possible identity of solution Y?

- **A** aluminium sulfate
- **B** ammonium chloride
- **C** calcium nitrate
- **D** zinc nitrate

25 Astatine is an element in Group VII of the Periodic Table.

What deduction can be made about the element astatine?

- **A** It is more reactive than iodine.
- **B** It forms a covalent compound with sodium.
- **C** It is a gas at room temperature and pressure.
- **D** It can be displaced from aqueous potassium astatide by chlorine.
- 26 X, Y and Z are elements in the same period of the Periodic Table.

The oxides of **X** and **Z** react readily with hydrochloric acid while the oxides of **Y** and **Z** react readily with sodium hydroxide.

- If X, Y and Z are placed in increasing proton number, which order is correct?
- A X, Z, Y
- B X, Y, Z
- C Y, Z, X
- D Y, X, Z
- 27 When metal **M** was placed in aqueous copper(II) nitrate, a brown deposit was obtained and the colour of the blue solution faded.

The temperature of the reaction mixture increased.

Which conclusion cannot be deduced from this information?

- **A** The reaction is exothermic.
- **B** Metal **M** is a stronger reducing agent than copper.
- **C** Metal **M** is more reactive than copper.
- **D M** has the same valency as copper.
- 28 Which equation does **not** represent a redox reaction?
 - A $Ca^{2+}(aq) + SO_4^{2-}(aq) \rightarrow CaSO_4(s)$
 - **B** $Cu^{2+}(aq) + Zn(aq) \rightarrow Cu(s) + Zn^{2+}(aq)$
 - **C** $Cl_2(g) + S^{2-}(aq) \rightarrow S(s) + 2Cl^{-}(aq)$
 - **D** $Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$
- 29 Which Group VII element acts as the strongest oxidising agent in redox reactions?
 - **A** bromine
 - B chlorine
 - **C** fluorine
 - D iodine

30 All ammonium salts on heating with sodium hydroxide produce ammonia gas.

From which ammonium salt can the greatest mass of ammonia be obtained?

- A 0.25 mol (NH₄)₃PO₄
- B 0.25 mol (NH₄)₂CO₃
- **C** 0.5 mol NH₄C*l*
- **D** 0.5 mol NH₄NO₃

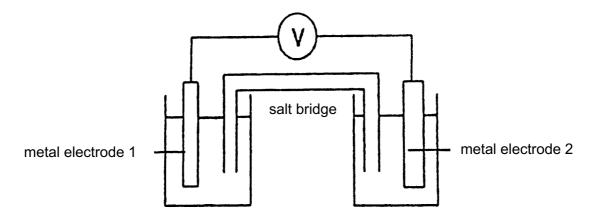
31 Ammonia is manufactured by the Haber process.

 $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta H = -92.4 \text{ kJ / mol}$

Which statement about the Haber process is **incorrect**?

- **A** A high temperature will increase the yield of ammonia.
- **B** Increasing pressure would increase the yield of ammonia.
- **C** It is not possible to obtain a 100 % yield of ammonia in an industrial setting.
- **D** Nitrogen is reduced by hydrogen.
- 32 Which electrolyte will increase in pH when electrolysed using platinum electrodes?
 - A concentrated copper(II) chloride solution
 - **B** concentrated sodium chloride solution
 - **C** dilute calcium nitrate solution
 - **D** dilute nitric acid

33 Four metals, tin, **X**, **Y** and **Z** were connected in pairs as shown in the experimental set-up below, and the voltages were recorded.



The results obtained are shown in the table below.

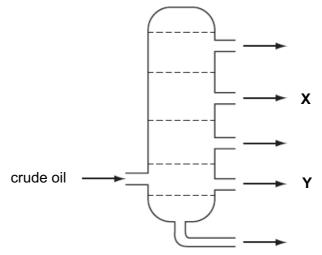
metal electrode 1	metal electrode 2	voltage (V)	
tin	Y	1.1	
tin	X	- 0.9	
Z	tin	2.5	
Z	X	- 1.6	

When metal electrode 1 was magnesium and metal electrode 2 was copper, a reading of 2.7 V was recorded.

Which option shows the order of the metals in increasing reactivity?

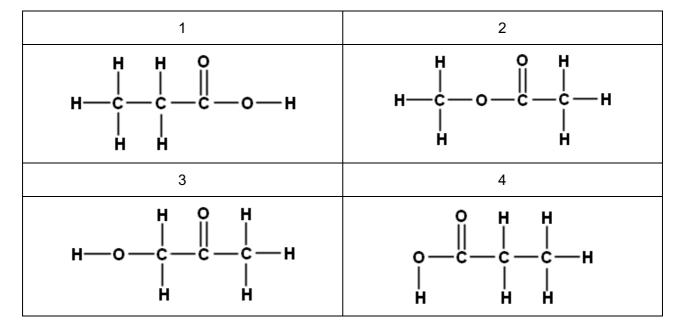
- A X, tin, Y, Z B Y. tin, X, Z
- B Y, tin, X, Z C Y, tin, Z, X
- \mathbf{D} $\mathbf{Z}, \mathbf{Y}, \operatorname{tin}, \mathbf{X}$
- _____, ___, ___, ___
- 34 Which atmospheric pollutants can be removed by fitting catalytic converters to motor cars?
 - I sulfur dioxide
 - II carbon monoxide
 - III nitrogen oxides
 - IV unburnt hydrocarbons
 - A I, II and III only
 - B I, III and IV only
 - C II, III, IV only
 - D I, II, III and IV

35 The diagram shows the separation of crude oil into fractions.



Which statement is correct?

- **A** X and Y are pure substances.
- **B** X condenses at a lower temperature than **Y**.
- **C X** has a higher boiling point than **Y**.
- **D** The temperature increases up the column.
- 36 Which of the following are isomers?



- **A** 1 and 4
- **B** 1, 2 and 3
- **C** 1, 2 and 4
- **D** 1, 2, 3 and 4

37 A polyunsaturated fatty acid molecule has a molecular mass of 278.

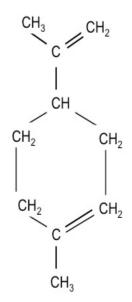
139 g of this fatty acid molecule reacts completely with 240 g of bromine gas.

How many double bonds are there in one molecule of the fatty acid?

- **A** 2
- **B** 3
- **C** 6
- **D** 10
- 38 Ethanol is a very useful substance.

Which of the following is **not** a use for ethanol?

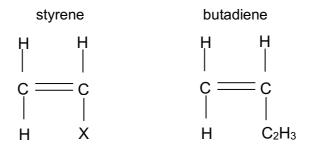
- A as a fragrance
- B as a fuel
- **C** as a solvent
- **D** making alcoholic beverages
- **39** Liquid limonene is the major component found in the oil of citrus fruit peels. It has the molecular structure shown below.



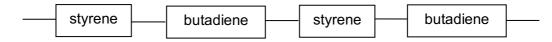
What type of compound is limonene?

- A ester
- B polymer
- C salt
- **D** unsaturated hydrocarbon

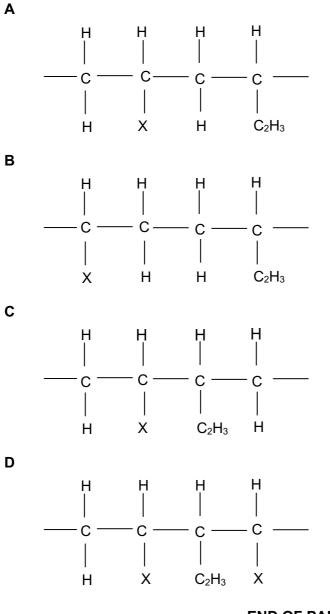
40 Styrene – butadiene is a synthetic rubber. It is made by polymerising several units of the monomers shown below.



One of the possible structures for the polymer is shown below.



Which structure is not a possible repeating unit in this polymer?



END OF PAPER

						<u>г г</u>] []
	0	4 He	10 Ne 180 Ar 40	36 Krypton 84	54 Xe xenon 131	86 Rn I adon	71 LU 1175 103 Lr Iawrencium
	VII		9 F fluorine 19 C1 C1 C1 S5.5	35 Br bromine 80	53 I iodine 127	85 At astatine -	70 Ytberbium 173 102 No nobelium
	١٨		8 O 16 16 S S 32 32	34 Se selenium 79	52 Te 128	84 PO - 116 LV Iivermorium	69 Trm 169 101 Md Md Fort
	\ \		7 N 14 15 15 P Phosphorus 31	33 AS arsenic 75	51 Sb antimony 122	83 Bismuth 209	68 68 68 68 68 68 167 100 100 100 100 100 100
	N		6 C 12 12 Silicon 28	32 Ge germanium 73	50 Sn 119	82 Pb lead 207 114 F <i>Î</i> ferovium	67 67 HO 165 165 165 185 89 99 99 99 165 165 165 165 165 165 165 165 165 165
			5 B boron 11 13 A1 aluminium 27	31 Ga gallium 70	49 IN indium 115	81 T <i>l</i> thallium 204	66 Dy dysprosium 163 98 98 Cf californium
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dn	-			28 Dickel 59	46 Pd palladium 106	78 Platinum 195 135 135 135 131 135	63 Eu 152 95 Am americium
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			umber ool nass	24 Cr 52	42 Mo nolybdenum 96	74 VV tungsten 184 106 Sg seaborgium	59 Praseodymium 141 91 Pratactinium 231
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			proton ato relativ	22 Ti titanium 48	40 Zr zirconium 91	72 Hf 178 178 104 Rutherfordium	57 La Ianthanum 139 89 AC actinium
				21 Sc scandium 45	39 yttrium 89		
	=		4 Be beryllium 9 9 12 Mg magnesium 24	20 Ca calcium 40	38 Sr strontium 88	56 Ba barium 137 88 Ra radium	anthanoids actinoids
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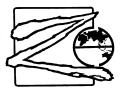
The Periodic Table of Elements

The volume of one mole of any gas is $24\,\text{dm}^3$ at room temperature and pressure (r.t.p.).

16

Index No: ____

Class: _____



ZHENGHUA SECONDARY SCHOOL PRELIMINARY EXAMINATION 2022 SECONDARY FOUR EXPRESS CHEMISTRY

6092/01

Paper 1 Multiple Choice

13 September 2021

1 hour

Additional Materials: Multiple Choice Answer Sheet

Zhenghua Secondary School Zhenghua Secondary

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid. Write your name, Centre number and index number on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** or **D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 18.

The use of an approved scientific calculator is expected, where appropriate.

Name of Setter: Ms Nur Elfianie Abdul Samad

1 Th rate of diffusion of five gases is measured. The gases are CO, CO₂, NH₃, C_3H_8 and $N_{2,,}$

The list gives five pairs of gases.

- 1 CO and CO₂
- 2 CO and N₂
- 3 CO_2 and C_3H_8
- 4 NH_3 and N_2
- 5 NH_3 and CO

In which pairs would one gas diffuse faster than the other under the same conditions of temperature and pressure?

Α	1 and 4	В	2 and 3
С	2, 3 and 5	D	1, 4 and 5

2 The boiling points of some substances found in air are given in the table.

When the temperature is raised from -350 $^{\circ}$ C to -190 $^{\circ}$ C, which substance(s) will be liquid?

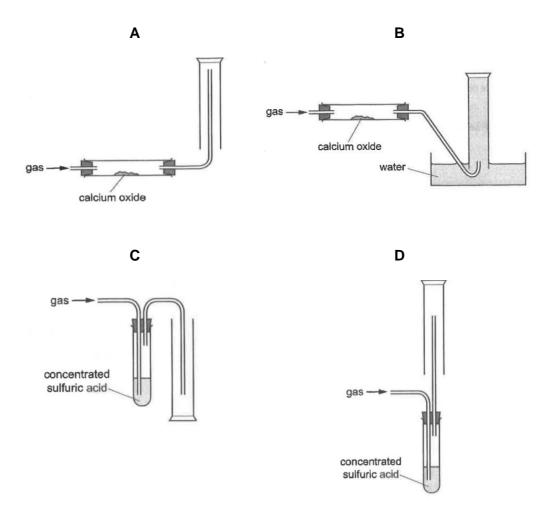
substance	boiling point / °C
argon	-186
neon	-246
oxygen	-196
nitrogen	-183

Α	argon only	В	argon and oxygen
---	------------	---	------------------

C neon and nitrogen D neon and oxygen

3 A gas has no effect on both red and blue litmus papers but is soluble in water and less dense than air.

Which diagram shows the best way of drying and collecting the gas?



4 An aqueous solution of a salt is tested and the following results are obtained.

test	result
addition of a few drops of aqueous sodium hydroxide followed by addition of excess aqueous sodium hydroxide	white precipitate forms, then dissolves
addition of 2 cm ³ of dilute sulfuric acid	effervescences, gas turned blue litmus paper red

What ions are most likely found in the salt?

Α	Al ³⁺ and SO ₄ ²⁻	В	AI^{3+} , Zn^{2+} and CO_3^{2-}
С	Al ³⁺ , Zn^{2+} and SO ₄ ²⁻	D	Zn ²⁺ and CO ₃ ²⁻

5 Element R has p protons and n neutrons in its neuclues.

Which row gives the correct number of sub-atomic particles in a negative ion of an isotope of R?

	proton	neutron	electron
Α	р	n + 1	p + 1
в	р	n - 1	p - 1
С	p + 1	n	p + 1
D	p + 1	n	p - 1

6 Which statement(s) correctly describes the properties of mixtures of iron and sulfur and the compound iron(II) sulfide?

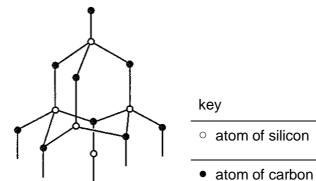
	mixtures of iron and sulfur	compound iron(II) sulfide
1	iron and sulfur mixed without undergoing a chemical reaction	iron and sulfur combined in a chemical reaction
2	the ratio of iron and sulfur varies	the ratio of iron and sulfur is always the same
3	properties of iron and sulfur were lost when the mixture was formed.	iron(II) sulfide has the same properties of iron and sulfur

Α	1 only	В	1 and 2
С	2 and 3	D	3 only

- 7 The following all conduct electricity.
 - 1 aqueous copper(II) sulfate
 - 2 copper metal
 - 3 molten sodium chloride
 - 4 solid graphite

Which substance(s) conduct/s electricity using free-moving electrons?

- Α 1 and 2 В 2 and 3
- С 2 and 4 D 3 and 4
- 8 The diagram shows a structure of a compound made of carbon and silicon atoms, (SiC)_{n.}



Which statement is true for (SiC)_n?

- Α It acts as a lubricant.
- В It conducts electricity.
- С It is a gas at room temperature.
- D It is insoluble in water.
- 22 g of hydrocarbon X has a volume of 12 dm³ at room temperature and 9 pressure.

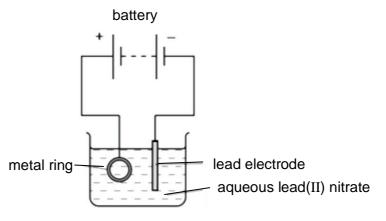
What is the molecular formula of X?

Α В CH₄ C_2H_6

С C_3H_6 D C_3H_8

10 Which statement about electrolysis is correct?

- A Chemical energy is converted to electrical energy.
- **B** Electrons flow through the electrolyte.
- **C** Ionic compounds are broken down.
- **D** Metals are formed at the positive electrode.
- **11** The diagram below shows the apparatus used to electroplate a metal ring with lead.



The electroplating was not successful.

What change must be made for it to work?

- **A** Add solid lead(II) sulfate to the electrolyte.
- **B** Increase the temperature of the electrolyte.
- **C** Replace the lead electrode with carbon electrode.
- **D** Reverse the terminals of the battery.

12 The complete combustion of ethane is an exothermic reaction.

Which statement explains this?

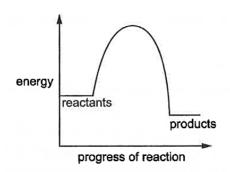
- A More bonds are broken than formed.
- **B** More bonds are formed than broken.
- **C** The total enthalpy of the bonds broken is greater than the total enthalpy of the bonds formed.
- **D** The total enthalpy of the bonds broken is less than the total enthalpy of the bonds formed.
- **13** An equation for respiration is shown.

 $C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2$ $\Delta H = -2830 \text{ kJ/mol}$

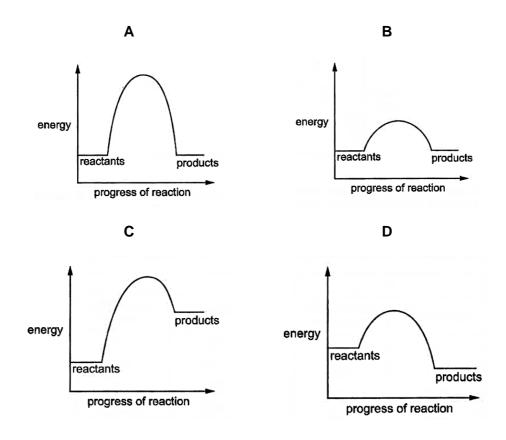
What can be deduced from this equation?

- A Energy form the sun is needed for this reaction.
- **B** Glucose is reduced.
- **C** Larger molecules are made from smaller molecules.
- **D** $\triangle H$ for photosynthesis is +2830 kJ/mol

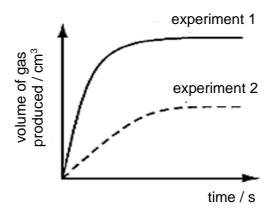
14 The energy profile diagram for a given reaction without the use of catalyst is shown below.



Which energy profile diagram is correct for the same reaction but using a catalyst?



15 Excess calcium carbonate was reacted with 25.0 cm³ of 2 mol/dm³ of dilute hydrochloric acid at 50°C. The gas produced was collected at regular time and the results are shown below as experiment 1.



Similarly, experiment 2 was a reaction between excess calcium carbonate and dilute hydrochloric acid but the volume of gas collected in experiment 1 was twice of that in experiment 2.

What change was made to produce the graph of experiment 2?

- A Add catalyst.
- **B** Reduce the concentration of dilute hydrochloric acid to 1 mol/dm³
- **C** Reduce the temperature of the reaction to 25°C.
- **D** Reduce the volume of dilute hydrochloric acid to 12.5 cm³
- 16 The following reactions take place during a thunderstorm.

$$N_2 + O_2 \rightarrow 2NO$$

$$2NO + O_2 \rightarrow 2NO_2$$

$$NO + O_2 \rightarrow NO_2 + O_2$$

Which row shows the correct processes undergo by the reactants?

	N ₂	NO	O ₃
Α	oxidised	oxidised	oxidised
В	oxidised	oxidised	reduced
С	reduced	reduced	oxidised

D	reduced	reduced	reduced
---	---------	---------	---------

17 The dissociation constant for an acid indicates the extent of dissociation into its ions. The higher the dissociation constant, the stronger the acid.

The dissociation constants of some acid and two statements are given below.

acid	dissociation constant	
methanoic acid, HCO ₂ H	1.80 x 10 ⁻⁴	
ethanoic acid, CH ₃ CO ₂ H	1.75 x 10⁻⁵	
proponoic acid, CH ₃ CH ₂ CO ₂ H	1.34 x 10 ⁻⁵	
chloroethanoic acid, C/CH2CO2H	1.40 x 10 ⁻³	

- statement 1: Increasing the length of the carbon chain makes the acid stronger.
- statement 2: Replacing a hydrogen atom in ethanoic acid makes the acid stronger.

Based on the information above, which statement(s) is / are correct?

- A both statements
- **B** neither statement
- **C** statement 1
- D statement 2

18 Salt P can be prepared by reacting together:

- a dilute acid and a soluble base or
- a soluble base and an ammonium salt

Which salt cannot be P?

- A iron(II) chloride
- B potassium chloride
- **C** potassium nitrate
- D sodium sulfate

19 Beryllium oxide is an amphoteric white solid.

Which substance(s) can be used to distinguish beryllium oxide from sulfur dioxide?

- 1 HCI (aq)
- 2 HNO₃ (aq)
- 3 NaOH (aq)
- 4 KOH (aq)

Α	1 and 2	В	2 and 3
С	2 and 4	D	3 and 4

20 What are the uses of sulfuric acid?

- 1 making fertilisers
- 2 making detergents
- 3 Sterilising water
- 4 used in car batteries

Α	1 and 2	В	1, 2 and 4
С	2 and 3	D	2, 3 and 4

21 Aqueous ethylamine has similar properties as aqueous ammonia.

Which statement is true about ethylamine?

- **A** It forms an alkaline gas when heated strongly.
- **B** It forms a blue precipitate with a solution of copper(II) sulfate.
- **C** It forms a colourless solution with a solution of aluminium nitrate.
- **D** It is insoluble in water.

- 22 Which statement does not correctly describe the Haber Process?
 - A A catalyst of finely divided iron is used.
 - **B** A yield of 100% of ammonia is achieved when temperature of 450°C is used.
 - **C** Nitrogen and hydrogen are fed into the reactor based on the ratio of 1:3.
 - **D** To reduce cost due to high pressure technology, the reaction is carried out at a more economical pressure of 200 atm.
- 23 Some properties of elements in the same group of the Periodic Table are listed.
 - 1 charge on the ion
 - 2 number of electron shell
 - 3 number of protons
 - 4 total number of inner shell electrons

Which property shows an increase as the group is descended?

Α	1 and 2	В	1 and 3
С	2 and 4	D	3 and 4

24 The element Astatine is below lodine in Group VII of the Periodic Table.

Which statement describes astatine correctly?

- A It forms covalent molecules with sodium metal.
- **B** It is a weaker oxidising agent than iodine.
- **C** It has high melting point due to the strong covalent bonds between astatine atoms.
- **D** It has a lower density than iodine.

25 An oxide of metal J increases the rate of decomposition of hydrogen peroxide. At the end of the reaction, oxide of J is chemically unchanged.

	proton number	mass number
Α	18	40
в	20	40
С	25	55
D	53	127

Which row correctly describes metal J?

- 26 Which statements about metals are correct?
 - 1 All metals are good at conducting thermal energy.
 - 2 All metals react with oxygen to form basic oxides.
 - 3 Some metals have more than one oxidation states.

Α	1 and 2 only	В	1 and 3 only
С	2 and 3 only	D	1, 2 and 3

27 Which statement about steel is correct?

- A Steel does not conduct electricity as well as pure metals.
- **B** Steel has a chemical formula.
- **C** Steel is formed by a chemical reaction.
- **D** The structure of steel contain a 'sea of electrons'

28 Pieces of lead, magnesium, iron and a metal X were placed in separate test tubes containing aqueous solutions of their ions.

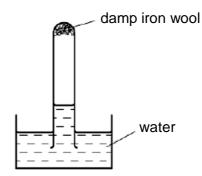
motol		meta	al ion		
metal	Pb ²⁺	Mg ²⁺	Fe ²⁺	X ²⁺	
Pb	×	×	×	×	
Mg	✓	×	~	~	key
Fe	✓	×	×	~	\checkmark = reaction occurs
Х	~	×	×	×	reaction does not occur

The following observations were made.

Which is the correct order of reactivity of the metals, starting from the most reactive to the least?

- A Fe, Mg, Pb, X
- B Fe, X, Pb, Mg
- C Mg, Fe, X, Pb
- D Pb, Fe, X, Mg
- **29** Which reaction is **not** a step in the production of iron from haematite in the blast furnace?
 - A coke burning in the air to produce carbon dioxide
 - **B** carbon reacting with carbon dioxide to produce carbon monoxide
 - **C** iron(III) oxide reacting with carbon monoxide to produce iron
 - D iron reacting with limestone to produce slag

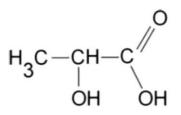
30 A test tube containing some damp iron wool was inverted in water. After three days, the water inside the test tube has risen.



Which statement explains the rise in water?

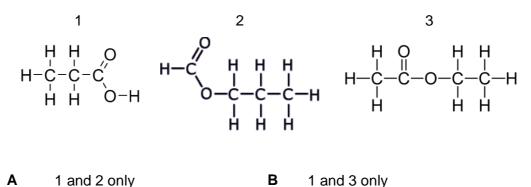
- A Iron(III) oxide was formed.
- **B** Oxygen gas had dissolved in water.
- **C** The iron wool was reduced.
- **D** The temperature of the water had increased.
- 31 Which statement about the fractional distillation of petroleum is true?
 - A At each level in the fractionating column, only one type of hydrocarbon is collected.
 - **B** Temperatures are higher at the top of the fractionating column than at the bottom.
 - **C** The hydrocarbons collected at the top of the fractionating column have high viscosity.
 - **D** The hydrocarbons collected at the top of the fractionating column have the smallest molecular mass.
- **32** Which substance could **not** be produced when methane reacts with cblorine in the presence of ultra violet light?
 - A chloromethane
 - B hydrogen
 - **C** hydrogen chloride
 - D tetrachloromethane

33 The structural formula of 2-hydroxyl propanoic acid is shown below.



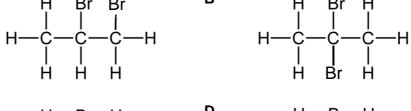
Which reaction can take place with 2-hydroxyl propanoic acid?

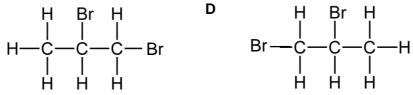
- Α It decolourises aqueous bromine.
- В It dissociates in water to produce hydroxide ions.
- С It produces ammonia gas with ammonium nitrate.
- D It undergoes condensation polymerisation.
- 34 Which of the compounds below are isomers of each other?



С	2 and 3 only	D	1, 2, and 3
•	2 and 5 only		1, Z , and J

35 Which is the product for the reaction between propene and bromine?





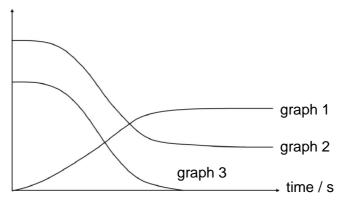
С

Α

- **36** What is the minimum number of moles of oxygen needed for the complete combustion of 1 mole of propanol?
 - A
 3.0
 B
 4.5

 C
 5.0
 D
 8.0
- **37** The graph below shows the amount of substances present in a mixture during the process of fermentation.

amount of substance



Which substance is correctly represented by each graph?

	graph 1	graph 2	graph 3
Α	ethanol	yeast	glucose
В	glucose	yeast	ethanol
С	glucose	ethanol	yeast
D	ethanol	glucose	yeast

- 38 Which pollutant is formed when gases in the air react at very high temperature?
 - A carbon monoxide
 - **B** nitrogen dioxide
 - **C** sulfuric acid
 - **D** unburnt hydrocarbon

39 The air in four cities were collected and analysed. The concentration of three gases in parts per million (ppm) in the air samples are shown below.

city	concentration of carbon monoxide / ppm	concentration of carbon dioxide / ppm	concentration of nitrogen dioxide / ppm
Taxila	48	23	36
Skara Bae	44	35	47
Troy	38	50	22
Sanchi	20	44	59

In which city will the problem of acid rain be reduced if all vehicles are fitted for catalytic converters?

Α	Sanchi	В	Skara Bae
С	Taxila	D	Troy

- 40 Which atmospheric pollutant can be removed by the process of reduction?
 - A Carbon monoxide in catalytic converter
 - **B** Nitrogen dioxide in acid rain by reaction with calcium carbonate
 - **C** Nitrogen oxide in catalytic converter
 - **D** Sulfur dioxide by flue gas by reaction with calcium carbonate

End – Of – Paper

The Periodic Table of Elements

																										_							_						
	0	He 2	helium	4	10	Ne	neon	20	18	Ar	argon 40	36	Кr	krypton	84	54	Xe	xenon 131	86	Rn	radon	1					71	Lu	Iutetium 175	103	٦	lawrencium	1						
11 11 11	ΝI				0 I	L	fluorine	19	17	Cl	chlorine 35.5	35	Ъ	bromine	80	53	Ι	iodine 127	85	At	astatine	ı					20	γb	ytterbium 173	102	No	nobelium	,						
	N				œ	0	oxygen	16	16	თ	sulfur 32	34	Se	selenium	6/	52	Те	tellurium 128	84	Ро	polonium	ı	116	ב י			69	Tm	thulium 169	101	Md	mendelevium	,						
	>				2	z	nitrogen	14	15	٩.	phosphorus 31	33	As	arsenic	ç/	51	Sb	antimony 122	83	ы	bismuth	503					68	ш	erbium 167	100	Еm	fermium	,						
	≥	_		¢	9	ပ	carbon	12	14	<u>S</u>	silicon 28	32	Ge	germanium	/3	20	Sn	11 ^{1 Er}	82	Рр	lead	7N/	114	F/			67	Но	holmium 165	66	Щ	einsteinium	,						
	=				5	മ	boron	11	13	AI	aluminium 27	31	Ga	gallium	0	49	IJ	indium 115	81	Tl	thallium	204							dysprosium 163										
Group												30	Zn	zinc	69	48	8	cadmium 112	80	Hg	mercury	50.I	112	ຽ			65	Tb	terbium 159	67	畄	berkelium	,						
																		silver 108									64	Gd	gadolinium 157	96	Cm	curium	,						
												28	ïZ	nickel	59	46	Ρd	palladium 106	78	Ę	platinum	GR1	110	Ds			63	Eu	europium 152	95	Am	americium	,						
												27	ပိ	cobalt	59	45	RЧ	rhodium 103	77	IL	iridium	192	109	Mt			62	Sm	samarium 150	94	Pu	plutonium	,						
		- I	hydrogen 1									26	Fe	iron	99	44	Ru	ruthenium 101	76	os	osmium	181	108	Hs			61	Ъm	promethium -	93	Np	neptunium	,						
												25	ПМ	manganese	ςς Γ	43	ЦС	technetium	75	Re	rhenium	90	107	Bh			60	PN	neodymium 144	92	⊃	uranium	007						
					umber	loc		nass					ບັ	chromium	52	42		molybdenum 96							-			Pr	praseodymium 141	91		protactinium							
			Kow	Ney	proton (atomic) number	atomic symbol	name		relative atomic mass	ve atomic i	ve atomic i	ve atomic I	/e atomic i	/e atomic i				23	>	vanadium	51	41		niobium 93									58		cerium 140			thorium	
					proton	atc	-								22	Ħ	titanium	48	40	Zr	zirconium 91	72	Η	hafnium	1/8	104	Ţ,	Kumerroraium		57	Га	lanthanum 139	89	Ac	actinium	1			
															45	39	≻	yttrium 89	57 - 71	lanthanoids			89 - 103	actinoids															
	=				4	Be	beryllium	6	12	Mg	magnesium 24	20	Ca	calcium	40	38	പ്	strontium 88	56	Ba	barium	13/	88	Ra	Ladium		anthanoids			actinoids									
	_				ო [lithium		11 Na		sodium 23	19	¥	potassium	<u>6</u> 2	37	ď	rubidium 85	55	S	caesium	133	87	Ŀ.	Irancium														

The volume of one mole of any gas is 24 \mbox{dm}^3 at room temperature and pressure (r.t.p.).