Paya Lebar Methodist Girls' School (Secondary)
Preliminary Examination 2024
Secondary 4 Express / G3

CANDIDATE NAME		CLASS		CLASS INDEX NO	

CENTRE NUMBER	S					INDEX NUMBER				

CHEMISTRY 6092/01

Paper 1 Multiple Choice **26 August 2024**

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.

The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											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	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl 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 zinc 65	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 tin 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 lanthanoids	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 platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl 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 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

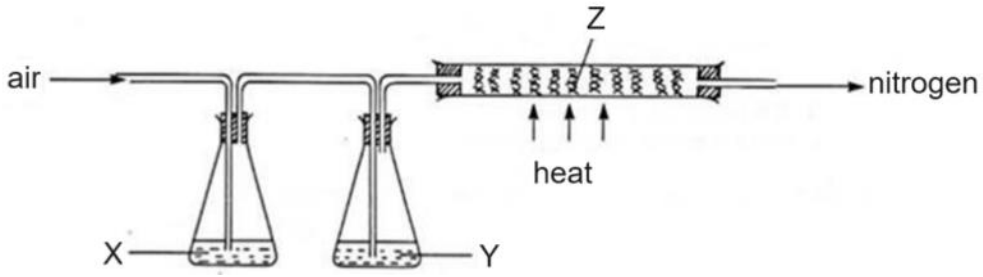
Multiple Choice Questions (40 marks)

1 A student wants to investigate the strength of an unknown monobasic acid, as compared with a sample of hydrochloric acid which has the same concentration.

Which of the following correctly shows the method and apparatus needed to investigate strength of the unknown acid?

	method	apparatus
A	measure pH	voltmeter
B	measure volume of sodium hydroxide needed for neutralisation	burette and pipette
C	measure temperature change when acid reacts with metal	thermometer
D	measure final volume of gas produced when acid reacts with metal	gas syringe

2 The diagram below shows an experimental set-up that can be used to obtain a stream of nitrogen from air.

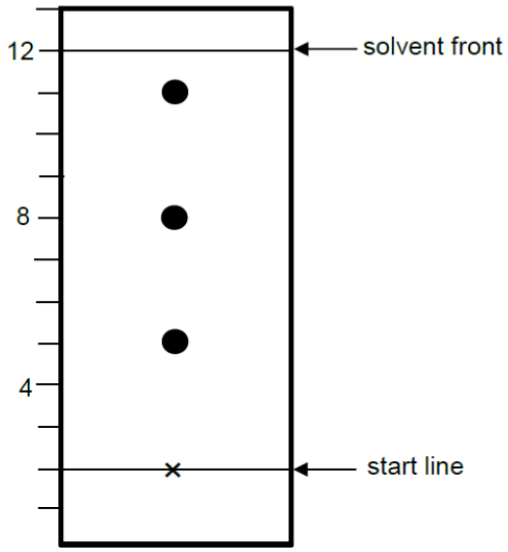


Using this set-up, which set of substances labelled X, Y and Z gives the purest sample of nitrogen?

	X	Y	Z
A	aqueous calcium hydroxide	calcium chloride solution	sulfur
B	calcium chloride solution	aqueous calcium hydroxide	copper
C	concentrated sulfuric acid	sodium hydroxide solution	carbon
D	sodium hydroxide solution	concentrated sulfuric acid	copper

[Turn Over

3 A scientist tested a skincare product to investigate if it contains harmful ingredients. The chromatogram of the skincare product is obtained as shown below, along with a reference table of R_f values of some harmful ingredients.



ingredient	R_f value
diethanolamine	0.3
hydroquinone	0.5
butylated hydroxyanisole	0.8
oxybenzone	0.9

What are the harmful ingredients present in the skincare product?

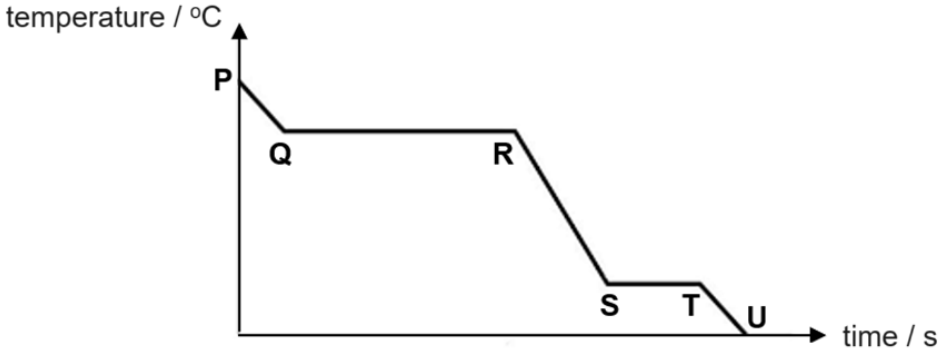
A diethanolamine only
B diethanolamine and oxybenzone only
C hydroquinone and butylated hydroxyanisole only
D hydroquinone and oxybenzone only

4 Two gases, CH_3Cl and SO_2, were separately released from one end of a laboratory on a hot day. The experiment was repeated on a cold day. The time taken for the gases to reach the opposite end of the laboratory was recorded for each experiment.

Which gas on which day would take the shortest time to reach the end of the laboratory?

	gas	day
A	CH_3Cl	hot
B	CH_3Cl	cold
C	SO_2	hot
D	SO_2	cold

5 The graph below shows the change in temperature as a sample of X_2 is cooled.



Which stage (**P** to **U**) reflects a change in the movement of particles from moving around each other to vibrating about in fixed positions?

A **P** to **Q**
B **Q** to **R**
C **R** to **S**
D **S** to **T**

6 In which particle are the number of protons, neutrons and electrons all different?

A O^{2-} **B** Mg^{2+} **C** Ne **D** P^{3-}

7 Element M exists as 3 stable isotopes and has a relative atomic mass of 65.1.

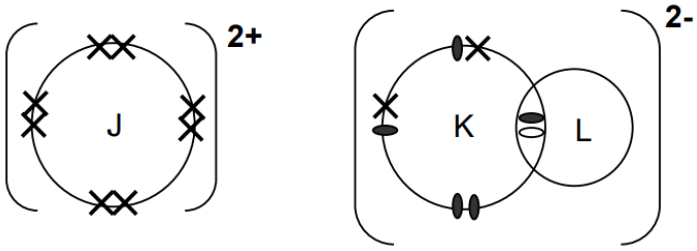
Which row shows the correct compositions of isotopes?

	^{64}M	^{66}M	^{67}M
A	32.1%	56.4%	11.5%
B	54.6%	6.6%	38.8%
C	56.3%	31.3%	12.6%
D	53.5%	25.5%	21.2%

[Turn Over

8 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.

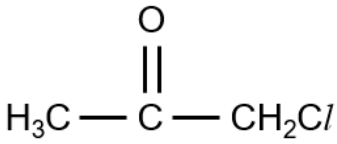


Which statements are correct?

I. Element J could be magnesium.
II. Element K belongs to Group 14 of the Periodic Table.
III. Element L belongs to Group 1 of the Periodic Table.
IV. Element K and element L are bonded together by a covalent bond.

A I and II
B I and IV
C II and III
D I, III and IV

9 Chloroacetone is used to make dye couplers for colour photography.



Which statements about chloroacetone are correct?

I. Chloroacetone cannot conduct electricity in any state.
II. Chloroacetone has high boiling point.
III. The total number of electrons that are involved in bonding in one chloroacetone molecule is 10.
IV. The chlorine atom has 6 valence electrons which are not involved in bonding.

A I and II
B I and IV
C II and III
D I, III and IV

10 In the lattice structure of ionic compounds, the coordination number of each ion is the number of neighbouring ions of opposite charge.

The table below shows the ions present and the coordination number of ions in some ionic compounds. Taking sodium chloride for instance, each sodium ion is surrounded by 6 chloride ions, while each chloride ion is surrounded by 6 sodium ions. Hence, the coordination number for both the sodium ions and chloride ions is 6.

ionic compound	ions present		coordination number of		Formula
	cation	anion	cation	anion	
sodium chloride	Na^+	Cl^-	6	6	NaCl
titanium(IV) oxide	Ti^{4+}	O^{2-}	6	3	TiO_2
compound **X**	Y	Z	6	4	?

Using the information from the table, determine the formula of compound **X**.

A Y_2Z **B** YZ_4

C Y_3Z_2 **D** Y_2Z_3

11 Solution X and solid Y are mixed in a beaker. After mixing, the final mass of the substances and the beaker is less than the initial mass.

What can solution X and solid Y be?

	solution X	solid Y
A	sulfuric acid	potassium hydroxide
B	nitric acid	copper metal
C	hydrochloric acid	aqueous ammonia
D	calcium hydroxide	ammonium carbonate

12 Which element will react with oxygen to form a product that will not react with both sodium hydroxide and nitric acid?

A hydrogen
B aluminum
C magnesium
D sulfur

13 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 calcium carbonate

How many soluble salts can be prepared by mixing any two of the five reagents?

A 3
B 4
C 5
D 6

14 Which of the following does **not** show the appropriate reagents used for preparation of the named salts?

	salt	Reagent
A	silver chloride	silver nitrate + hydrochloric acid
B	ammonium chloride	ammonium carbonate + hydrochloric acid
C	zinc sulfate	zinc oxide + sulfuric acid
D	potassium sulfate	potassium metal + sulfuric acid

15 The following substances are used in the laboratory to test for various ions.

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

Which reaction(s) could produce a gas that turns moist red litmus paper blue?

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

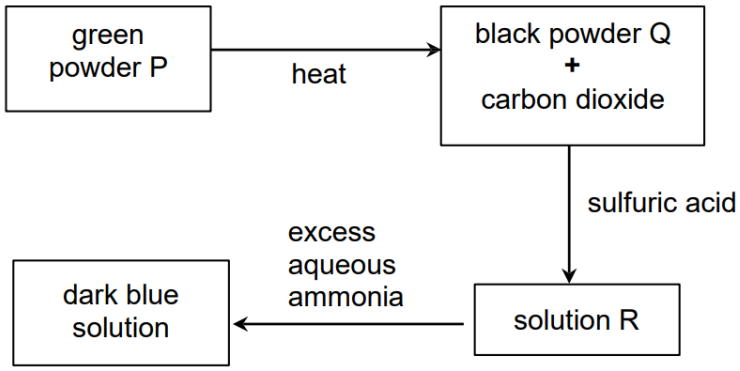
16 A salt, P, dissolved in water to give a colourless solution. A series of tests were conducted with the solution, and the results are seen below.

- On adding chlorine, the colourless solution turned brown.
- On adding aqueous silver nitrate, a yellow precipitate was seen.
- On adding aqueous ammonia, no precipitate was seen.
- On adding sodium hydroxide solution, no precipitate was seen.

What is the chemical formula of P?

A KI **B** CaF_2 **C** $ZnSO_4$ **D** $NaNO_3$

17 The diagram below shows a series of tests starting with substance P.



Which statement is true?

A P consists of a metal that has only one oxidation state.
B Q reacts with acids to liberate hydrogen gas.
C Solution R can also be formed by reacting P with sulfuric acid.
D Solution R also reacts with excess aqueous sodium hydroxide to give a dark blue solution.

18 The nitrate salt of element Y undergoes thermal decomposition.

$$2YNO_3\,(s) \rightarrow 2Y\,(s) + 2NO_2\,(g) + O_2\,(g)$$

8.5 g of YNO_3 is heated and 1.8 dm^3 of gases, measured at room temperature and pressure, are produced.

What is the relative atomic mass of Y?

A 57
B 108
C 113
D 227

[Turn Over

19 Ammonium nitrate, NH_4NO_3, can be manufactured from ammonia, NH_3, in a two-step process.

Step 1: $NH_3 + 2O_2 \rightarrow HNO_3 + H_2O$

Step 2: $HNO_3 + NH_3 \rightarrow NH_4NO_3$

What is the maximum mass of NH_4NO_3 that can be made from 17 tonnes of ammonia?
(1 tonne = 1 000 000 g)

A 34 tonnes **B** 40 tonnes
C 80 tonnes **D** 97 tonnes

20 A sample of solid magnesium hydroxide is prepared by adding an excess of aqueous sodium hydroxide to an aqueous solution containing 1.20 g magnesium sulfate.
The mass of magnesium hydroxide collected is 0.32 g.

What is the percentage yield for this reaction?

A 26.7% **B** 34.2% **C** 55.2% **D** 73.3%

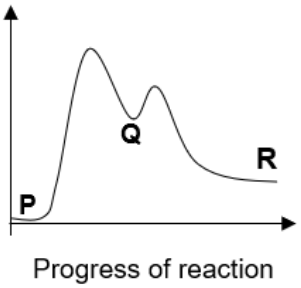
21 Pentene can be converted into carbon dioxide and water in the following stages:

$$\underset{\textbf{1}}{C_5H_{12}\,(l)} \rightarrow \underset{\textbf{2}}{C_5H_{12}\,(g)} \rightarrow 5CO_2\,(g) + 6H_2O\,(g) \rightarrow \underset{\textbf{3}}{5CO_2\,(g) + 6H_2O\,(l)}$$

Which stage(s) is/are exothermic?

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

22 In the conversion of compound P into compound R, it was found that the reaction occurred in a two-step reaction, with Q as the intermediate. The energy profile diagram for the reactions is shown below.



step **1**: **P** → **Q**
step **2**: **Q** →**R**

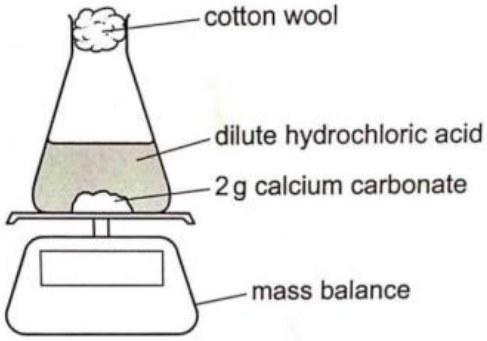
What can be deduced from the diagram?

A Both steps are endothermic.
B The backward reaction to form P from R is exothermic.
C Step 1 has a higher activation energy than step 2 because more bonds have to be broken.
D Step 2 involves breaking stronger bonds than step 1 because Q is at a higher energy level.

23 Which statement about ammonia is correct?

A It dissolves in rain to form acid rain.
B It is formed when ammonium salts are heated with sulfuric acid.
C Both of its raw materials can be obtained from the fractional distillation of air.
D It decomposes when heated to a high temperature to form nitrogen and hydrogen.

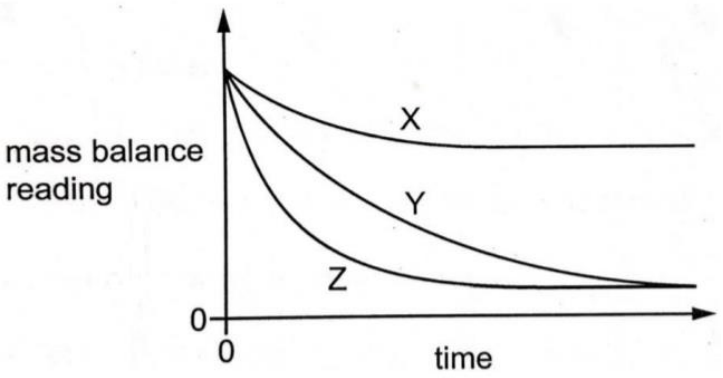
24 The rate of reaction between calcium carbonate and hydrochloric acid is measured in three separate experiments.



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.

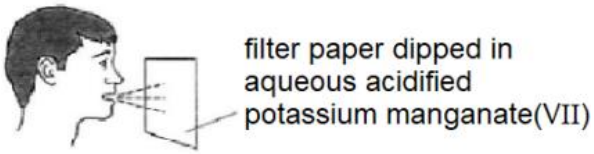
25 Concentrated sulfuric acid is able to react with potassium halide solids, according to the following equations:

reaction 1: $H_2SO_4 + 2KCl \rightarrow 2HCl + K_2SO_4$
reaction 2: $2H_2SO_4 + 2KBr \rightarrow 2H_2O + Br_2 + K_2SO_4 + SO_2$
reaction 3: $5H_2SO_4 + 8KI \rightarrow 4H_2O + 4I_2 + 4K_2SO_4 + H_2S$

What is the change in the oxidation state of sulfur in the above reactions?

	reaction 1	reaction 2	reaction 3
A	0	0	4
B	0	2	4
C	0	2	8
D	2	4	8

26 Acidified potassium manganate (VII) can be used to detect the presence of ethanol vapour in the breath of a person who has consumed alcohol.

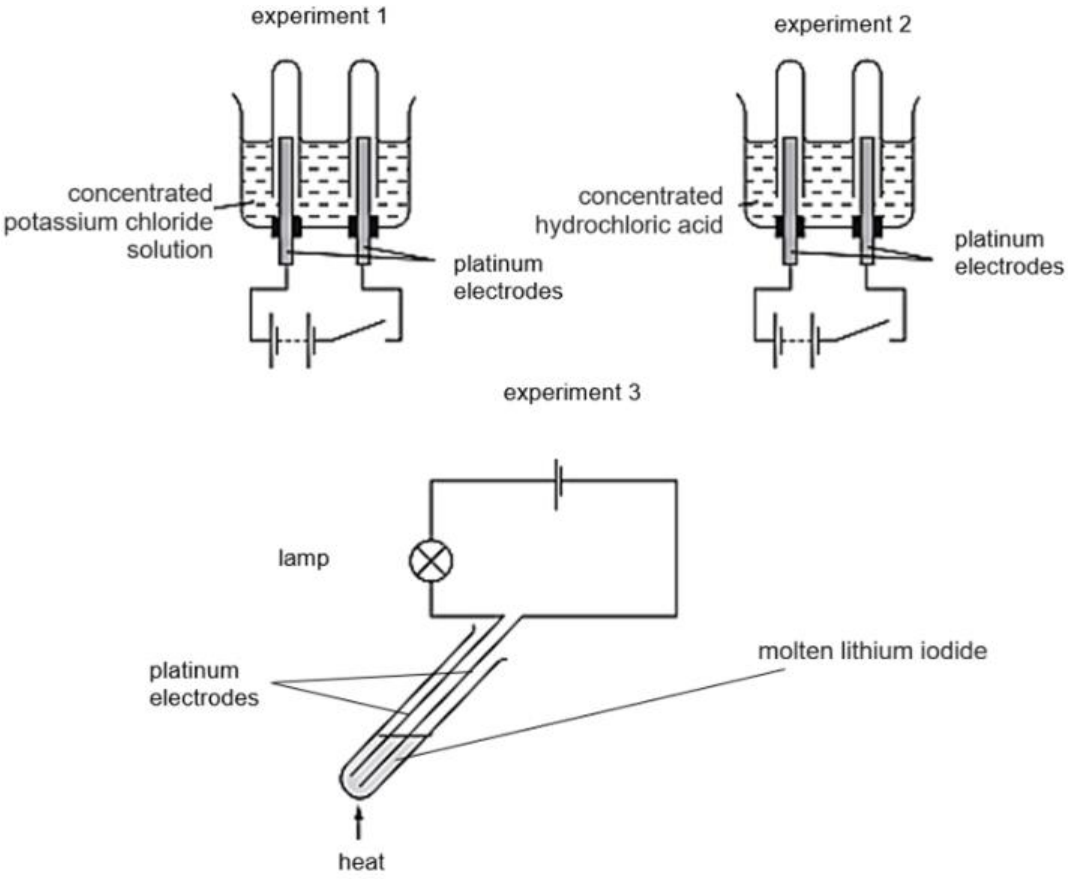


It was observed that the acidified potassium manganate (VII) turned from purple to colourless in the presence of ethanol vapour.

Which explanation is correct?

A Ethanol has been oxidised.
B Ethanol is an oxidising agent.
C Acidified potassium manganate (VII) has been oxidised.
D Acidified potassium manganate (VII) is a reducing agent.

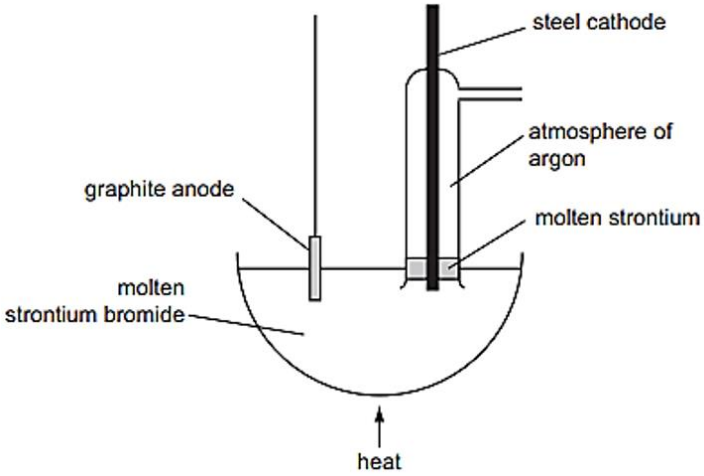
27 In three separate experiments, various types of electrolytes were used.



Which statement is correct?

A Effervescence was observed at the cathode in experiments 1 and 2 only.
B Effervescence was observed at the anode in experiments 2 and 3 only.
C Silvery-grey deposits were formed at the cathode in experiments 1 and 3 only.
D Silvery-grey deposits were formed at the anode in experiments 1 and 3 only.

28 In the experimental set-up shown below, strontium metal can be obtained by electrolysis of molten strontium bromide, $SrBr_2$.



Which of the following explains why argon and strontium bromide are used?

	argon	molten strontium bromide
A	helps lower the melting point of strontium bromide, requiring less heat	ions are free to move around and act as mobile charge carries
B	prevents the strontium from overflowing	low melting point, requiring less heat
C	reacts with strontium to form a compound that protects the metal from oxidation	low melting point, requiring less heat
D	prevents the formation of strontium oxide	ions are free to move around and act as mobile charge carries

29 In an electrolysis experiment, the same amount of charge deposited 2.17 g of chromium and 4 g of copper. The charge on the copper ion was 2+.

What is the charge on the chromium ion?

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

30 In electroplating a chromium bracelet with silver, which combination is correct?

	anode	cathode	electrolyte
A	bracelet	silver	aqueous silver nitrate
B	silver	bracelet	aqueous silver nitrate
C	bracelet	silver	chromium nitrate
D	silver	bracelet	molten sodium chloride

31 Which row correctly shows air pollutants and their sources?

	pollutant	source	pollutant	source
A	carbon dioxide	photosynthesis	sulfur dioxide	decomposition
B	carbon monoxide	incomplete combustion of petrol	methane	volcanic activity
C	sulfur dioxide	incomplete combustion of petrol	carbon dioxide	burning of fossil fuels
D	nitrogen dioxide	lightning flashes	carbon monoxide	incomplete combustion of petrol

32 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 from the table above will be removed by the wet powdered calcium carbonate?

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

33 Which statement correctly shows the general trend of the Period 3 elements from sodium to chlorine?

A The melting point increases.
B The number of protons decreases.
C The ability to conduct electricity increases then decreases.
D The number of electrons involved in bonding decreases then increases.

34 Which of the following statements are true about the elements in Group 1 of the Periodic Table?

I. They are soft and can be cut easily.
II. They are oxidising agents.
III. The melting point decreases down the group.
IV. The reactivity decreases down the group.

A I and II
B I and III
C II and IV
D I, II and III

35 Reactions of three metals and their oxides are shown.

metal	add dilute hydrochloric acid to metal	heat metal oxide with carbon
1	✓	✓
2	✓	✗
3	✗	✓

key
✓ = reacts
✗ = does not react

What is the order of reactivity of these metals, from most reactive to least reactive?

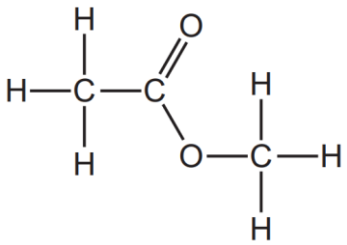
A 1 → 2 → 3 **B** 1 → 3 → 2 **C** 2 → 1 → 3 **D** 2 → 3 → 1

36 Which of the following must be the same for molecules which are isomers?

1 empirical formula
2 structural formula
3 molecular formula
4 functional group

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

37 The structure of ester X is shown.



Which row gives the name and property of ester X, and the number of electrons used in bonding?

	name	property of ester X	number of electrons used in bonding
A	ethyl methanoate	high boiling point	11
B	ethyl methanoate	soluble in water	22
C	methyl ethanoate	cannot conduct electricity	11
D	methyl ethanoate	exist as liquid at room temperature	22

38 Ethanol is manufactured in industries by the fermentation of glucose or by the catalytic addition of steam to ethene.

Which statement describes an advantage of fermentation compared to catalytic addition?

A Products from fermentation are harmless to the environment.
B Fermentation produces many types of alcohol but catalytic addition only produces ethanol.
C Fermentation uses a higher temperature than catalytic addition.
D Fermentation is more environmentally sustainable as it uses a renewable resource.

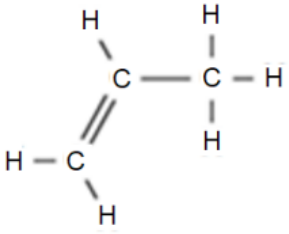
39 A molecule of compound P contains three carbon atoms and has a relative molecular mass of 44.

Which row represents P?

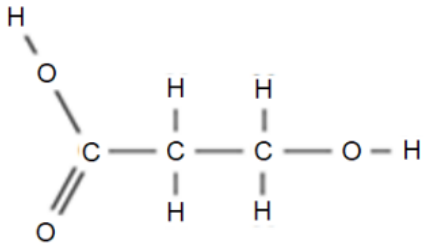
	name of compound	reaction with aqueous bromine
A	propane	no effect
B	propene	decolourises
C	butane	no effect
D	butene	decolourises

40 Which monomers, without the addition of any other reagent, would undergo polymerisation?

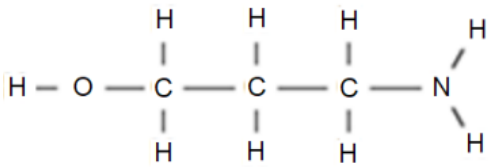
1



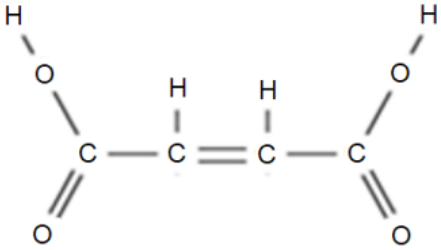
2



3



4



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

End of paper