ANSWER KEY

CRESCENT GIRLS' SCHOOL
SECONDARY FOUR
PRELIMINARY EXAMINATION 2024

CHEMISTRY

6092/01
28 August 024
1 hour

Paper 1 Multiple Choice

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluids.
Write your name, index number and class on the Answer Sheet in the spaces provided.
DO **NOT** WRITE ON ANY BARCODES.

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 OTAS 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 19.**
The use of an approved scientific calculator is expected, where appropriate.

This booklet consists of **19** printed pages, including the cover page.

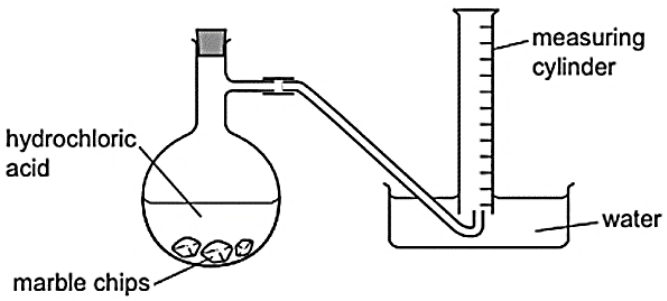
1	2	3	4	5	6	7	8	9	10
B	**C**	**D**	**C**	**A**	**C**	**B**	**A**	**D**	**B**
11	12	13	14	15	16	17	18	19	20
C	**A**	**D**	**A**	**C**	**D**	**C**	**C**	**A**	**B**
21	22	23	24	25	26	27	28	29	30
C	**A**	**D**	**C**	**B**	**B**	**A**	**D**	**A**	**B**
31	32	33	34	35	36	37	38	39	40
C	**D**	**A**	**A**	**B**	**C**	**C**	**B**	**B**	**C**

1 A student measures the rate of the reaction between marble chips, $CaCO_3$, and dilute hydrochloric acid.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

Which diagrams show apparatus that are suitable for this experiment?

1



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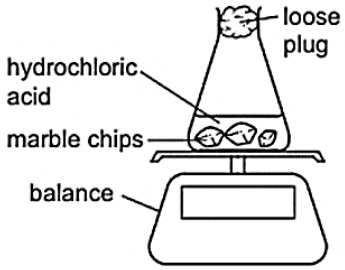

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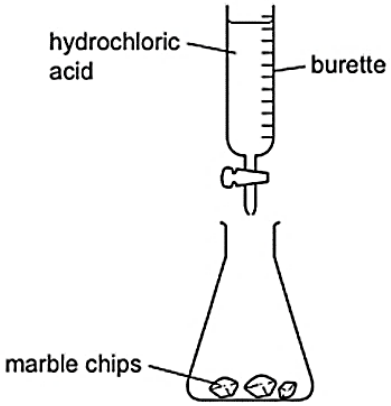

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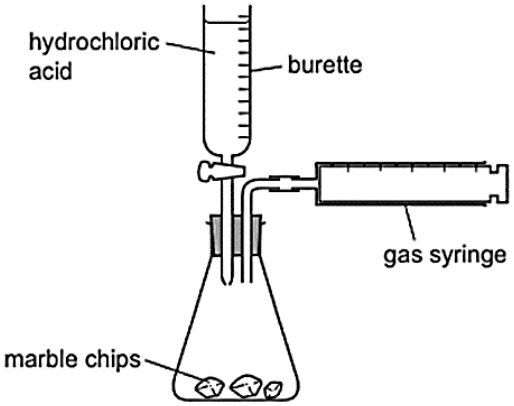


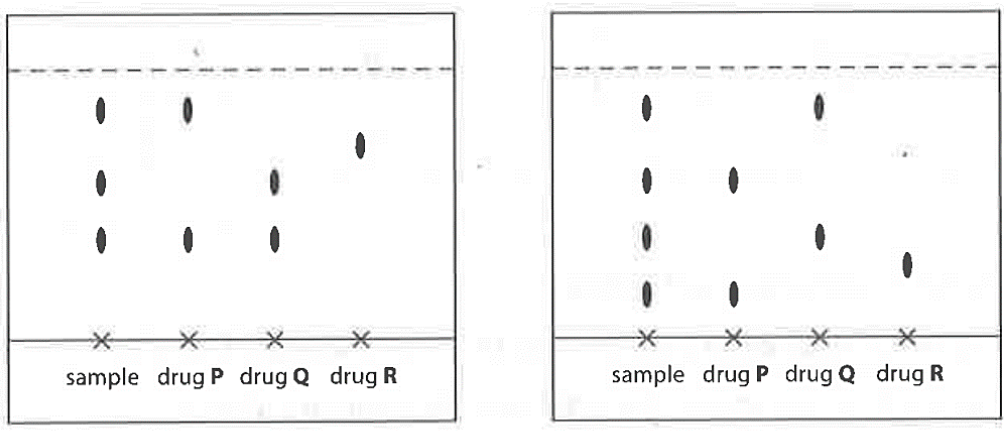
A 1 and 2

B 1, 2 and 4

C 2 and 3

D 2, 3 and 4

2 Chromatograms of a urine sample using two different solvents are shown below.



Based on the two chromatograms, which drug(s) is/are present in the urine sample?

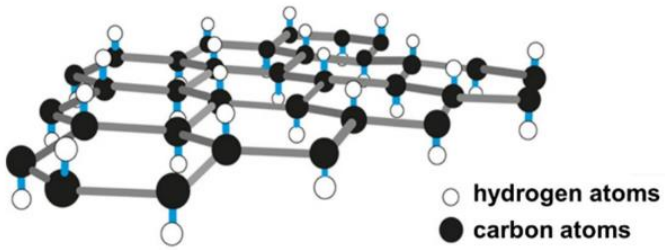
A drug **P** only

B drug **Q** only

C drugs **P** and **Q** only

D drugs **P**, **Q** and **R**

3 Since the discovery of graphite, scientists have been able to extract a single layer of carbon atoms (known as graphene) and convert it to another material known as graphane by attaching one hydrogen atom to each carbon atom as shown below.



Graphane has the same hexagonal-ring structure as graphene and retains most of its properties too. Which properties of graphene is not likely to be shared by graphane?

A It is insoluble in water.

B It is very strong.

C It has a high melting point.

D It is an electrical conductor.

4 An isotope of element **Z** has 20 neutrons and 17 protons. Which is the correct symbol for an ion of the isotope of element **Z**?

A $^{18}_{17}Z^{+}$ **B** $^{18}_{17}Z^{-}$

C $^{37}_{17}Z^{-}$ **D** $^{37}_{18}Z^{-}$

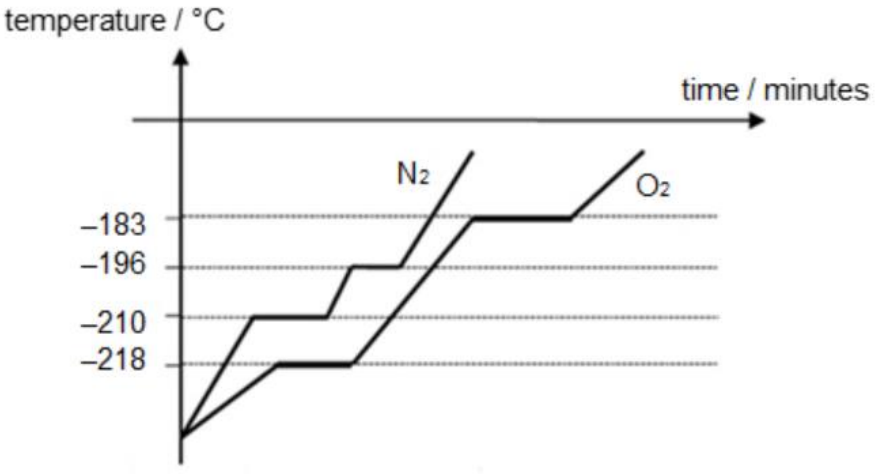
5 Hydrogen is able to form compounds with metals and non-metals. The formulae of some of these compounds are shown below.

CH_4 HCl MgH_2 KH

What is the order of melting point of these compounds?

	lowest melting point ⟶			highest melting point
A	CH_4	HCl	KH	MgH_2
B	CH_4	HCl	MgH_2	KH
C	HCl	CH_4	MgH_2	KH
D	KH	MgH_2	HCl	CH_4

6 The heating curves (not drawn to scale) of nitrogen and oxygen over a period of time are shown in the graph.



At which temperature will there be two **different** states of matter co-existing at the same time, in a mixture of nitrogen and oxygen under similar conditions?

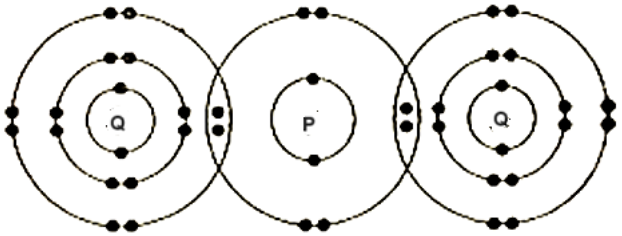
A – 180 °C

B – 200 °C

C – 215 °C

D – 220 °C

7 The diagram below shows the bonding between **P** and **Q** in the covalent molecule, **PQ_2.**



What are the electronic structures of atoms **P** and **Q** before combining together to form the above molecule?

	P	**Q**
A	2.8	2.8.8
B	2.6	2.8.7
C	2.6	2.8.6
D	2.4	2.8.7

8 0.1 mole of a chloride XCl_2 combines with 10.8 g of water to form the hydrated salt, $XCl_2.\mathbf{n}H_2O$. What is the value of **n**?

A 6 **B** 8

C 10 **D** 12

9 Ammonia reacts with chlorine according to the equation shown below:

$$2NH_3\ (g) + 3Cl_2\ (g) \rightarrow N_2\ (g) + 6HCl\ (g)$$

If 90 cm^3 of ammonia is mixed with 60 cm^3 of Cl_2 and all the volumes were measured at room temperature and pressure, what is the total volume of gases at the end of the reaction?

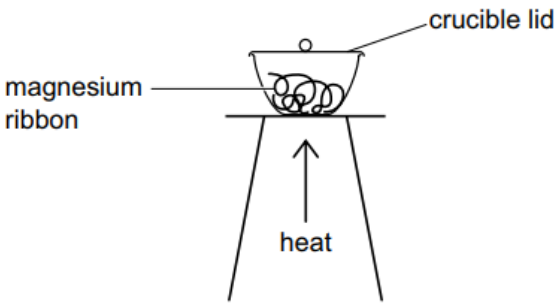
A 20 cm^3

B 120 cm^3

C 140 cm^3

D 190 cm^3

10 When 4.8g of magnesium is heated in a crucible, 5.9g of magnesium oxide is formed.



What is the percentage yield of magnesium oxide?

A 53% **B** 74% **C** 80% **D** 81%

11 A student is given two samples, one of which is aluminium oxide and the other is magnesium carbonate. He needs to find a method to identify the two samples.

Which of the following show(s) the correct method(s) and observation(s)?

	method	observation(s)
1	add nitric acid	only aluminium oxide dissolves
2	add nitric acid	both samples dissolve. Effervescence is observed in the reaction with magnesium carbonate
3	add sodium hydroxide	only aluminium oxide dissolves
4	add sodium hydroxide	both samples dissolve. Effervescence is observed in both the reactions

A 1 and 4 only

B 2 only

C 2 and 3 only

D 3 only

12 Butterfly pea flower extract is commonly used in drinks nowadays and it changes colour according to different pH values. The table below shows the colours of butterfly pea flower extract at different pH values.

pH range	colour
0 – 3	violet
4 – 8	blue
9 – 11	green
12 – 14	yellow

Which pair of substances can be distinguished by adding butterfly pea flower extract to each substance separately?

A acid rain and aqueous sodium chloride

B aqueous ammonia and limewater

C aqueous sodium sulfate and aqueous sodium chloride

D dilute hydrochloric acid and dilute sulfuric acid

13 Which of the following reactions will produce the least amount of carbon dioxide?

A sodium carbonate and hydrochloric acid

B copper(II) carbonate and hydrochloric acid

C magnesium carbonate and sulfuric acid

D lead(II) carbonate and sulfuric acid

14 The table below shows the results of some tests carried out on separate portions of a solution **M**.

test	observation
aqueous sodium hydroxide added	test-tube feels warm and no precipitate forms
acidified aqueous silver nitrate added	white precipitate forms

What could be the identity of solution **M**?

A hydrochloric acid

B potassium sulfate

C sodium chloride

D zinc sulfate

15 A student stated that since low temperatures produce a greater yield of ammonia, the reaction should be carried out at 50°C instead of 450°C.

Which of the following statements best explains why the reaction is **not** carried out at 50°C?

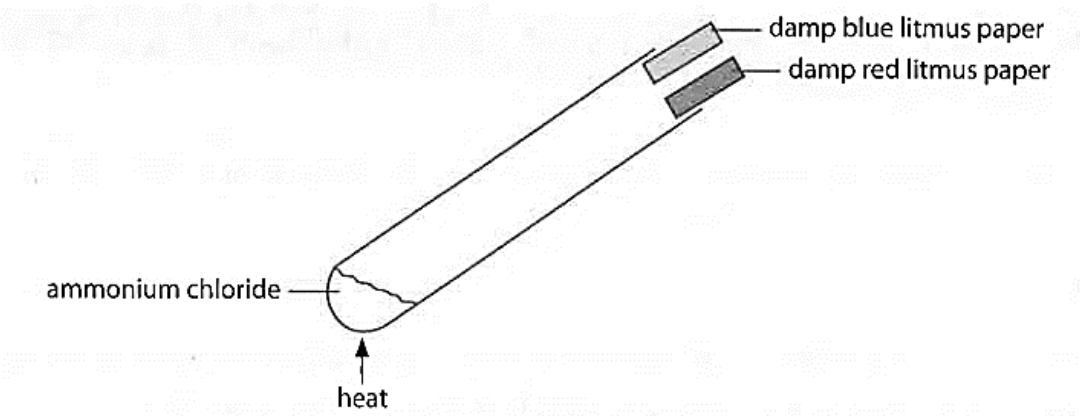
A Ammonia is unstable at 50°C.

B The reactants are unstable at 50°C.

C The reaction is too slow at 50°C.

D The reaction mixture is easily separated at higher temperatures.

16 Ammonium chloride is heated strongly in a boiling tube. Damp blue and red litmus papers were placed at the mouth of the boiling tube for the gases produced.



Which of the following is the correct sequence of observations that would be made?

	first observed colour change	final colour of both litmus papers
A	The damp blue litmus paper turns red.	red
B	The damp blue litmus paper turns red then bleaches.	white
C	The damp red litmus paper turns blue.	blue
D	The damp red litmus paper turns blue.	red

17 Which are redox reactions?

1 $HCl + NaOH \rightarrow NaCl + H_2O$

2 $Zn + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2$

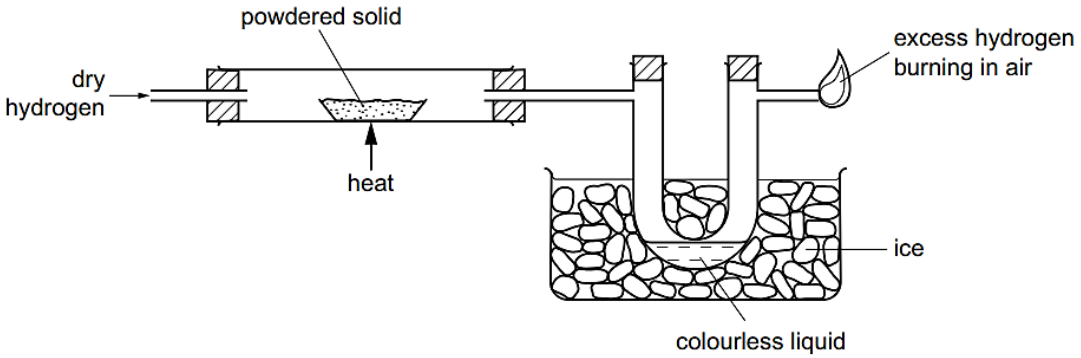
3 $Ag_2SO_4 + 2NaCl \rightarrow 2AgCl + Na_2SO_4$

4 $2Fe^{2+} + Cl_2 \rightarrow 2Fe^{3+} + 2Cl^-$

A 1, 2 and 3 **B** 1 and 3

C 2 and 4 **D** 3 and 4

18 Dry hydrogen gas is passed over a heated powdered solid and then through a cooled U-tube before the excess of hydrogen is burned in air.



A colourless liquid collects in the U-tube. What could the powdered solid be?

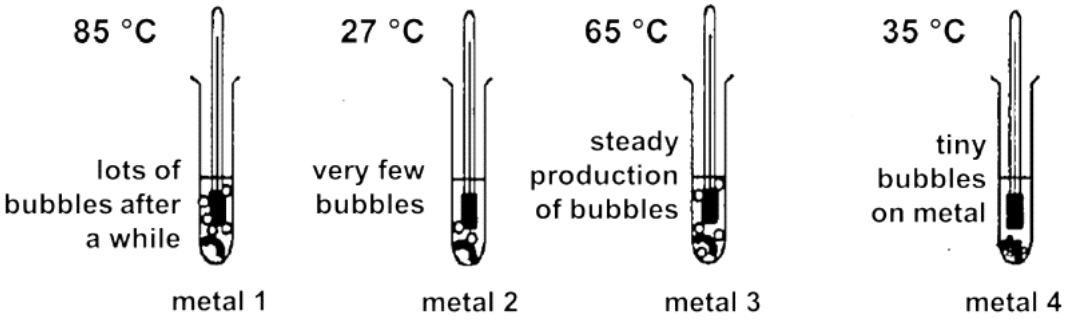
A aluminium oxide

B copper(II) oxide

C iron(III) oxide

D magnesium oxide

19 Equal masses of different metals 1 to 4 are placed in the test tubes containing an equal volume of hydrochloric acid of equal concentration. The thermometers show the maximum temperature recorded for the reaction. (The room temperature is 25 °C.)



Which of the following statements is/are most likely to be true?

I Metal 3 will displace metals 2 and 4 from their aqueous salt solutions.
II Metal 2 can likely be extracted by chemical reduction of its oxide by carbon.
III Metal 1 is likely to be obtained by electrolysing its molten chloride.

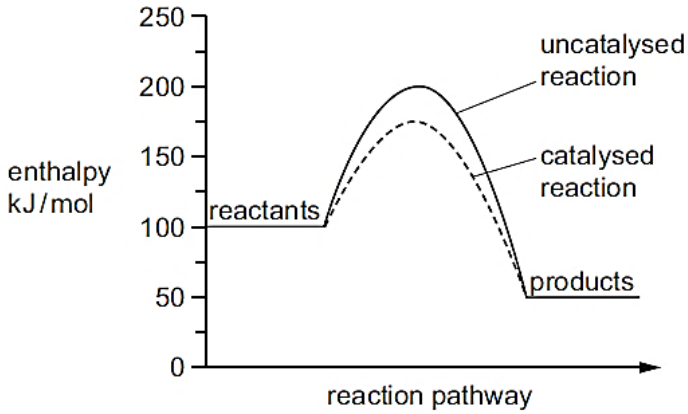
A I, and II only

B I and III only

C I, II and III

D II and III only

20 The energy diagram represents a chemical reaction carried out both with a catalyst and without a catalyst.



What is the enthalpy change for the catalysed reaction?

A - 125 kJ/mol

B - 50 kJ/mol

C + 75 kJ/mol

D + 100 kJ/mol

21 Hydrogen peroxide reacts with potassium iodide in the presence of dilute acid to produce iodine molecules as shown in the equation below.

$$H_2O_2\ (aq) + 2I^-\ (aq) + 2H^+\ (aq) \rightarrow I_2\ (aq) + 2H_2O\ (l)$$

Which factor would **not** affect the rate of this reaction?

A Concentration of hydrogen peroxide

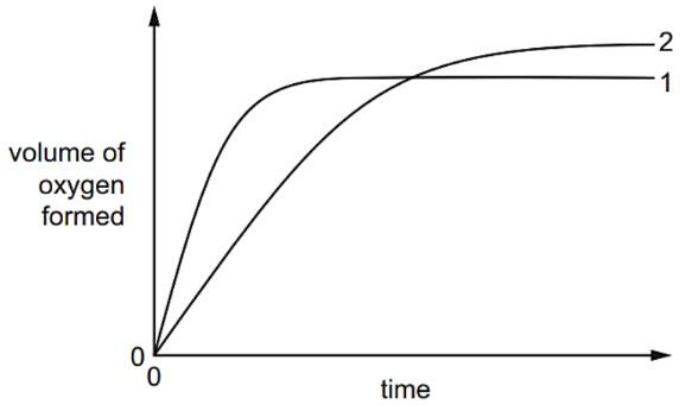
B Concentration of potassium iodide

C Pressure of the reacting vessel

D Temperature of the reacting vessel and its surroundings

22 In the graph shown, curve 1 was obtained by the decomposition of 100 cm^3 of 1.0 mol/dm^3 hydrogen peroxide solution with manganese(IV) oxide as the catalyst.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$



Which change to the original experimental conditions would produce curve 2?

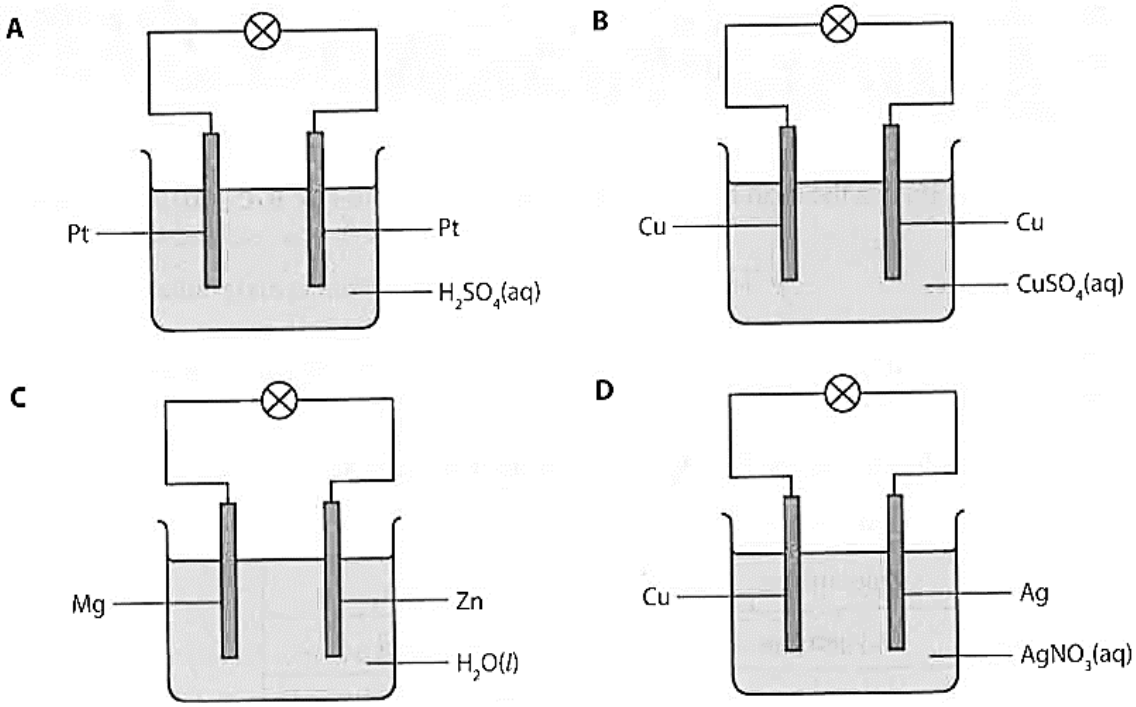
A adding some 0.1 mol/dm^3 hydrogen peroxide solution

B lowering the temperature

C using a different catalyst

D using less manganese(IV) oxide

23 In which of the following set-up will the bulb light up?



24 An electrolysis was carried out on an electrolyte containing X^+ and Y^- ions.

The two equations below show the reactions at the electrodes:

Cathode : $2X^+ + 2e^- \rightarrow X_2$

Anode : $2Y^- \rightarrow Y_2 + 2e^-$

What can the electrolyte be?

A aqueous magnesium chloride

B aqueous sodium sulfate

C concentrated magnesium chloride

D molten potassium chloride

25 In which electrolysis experiment would there be no change in the concentration of the solution?

	electrodes	electrolyte
A	carbon	aqueous copper(II) sulfate
B	copper	aqueous copper(II) sulfate
C	carbon	concentrated potassium chloride
D	platinum	dilute sulfuric acid

26 Methane reacts very slowly with air at room temperature. But if a transition metal T is added to the methane-air mixture, the methane ignites quickly.

A student made some statements about the observation.

I Addition of T reduces the activation energy.
II Addition of T increases the enthalpy change.
III Addition of T increases the rate of reaction.
IV Addition of T reduces the energy of the reactants.

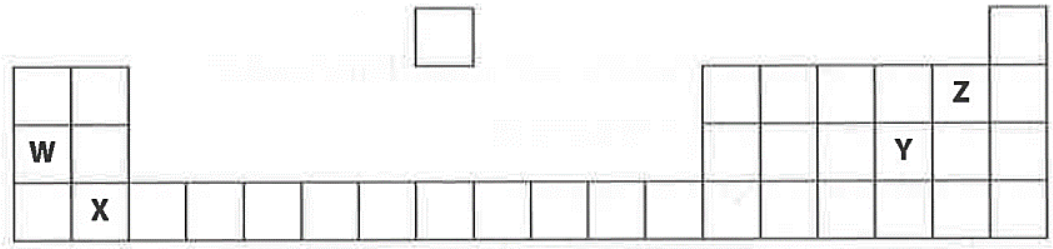
A I and II only

B I and III only

C II and III only

D All of the above

27 The positions of the elements W, X, Y and Z are shown in part of the periodic table.



Which statement is **not** correct?

A All the elements are reactive except for element Z.

B Element W and element Y can form ionic bonds.

C Element X will react with element Z in the ratio 1:2.

D Element Y and element Z will form a compound by sharing electrons.

28 Which of the following is **not** true when chlorine gas is bubbled into potassium iodide solution?

A Chlorine is more reactive than iodine and hence displaces iodine form potassium iodide solution.

B Potassium iodide is the reducing agent.

C The ionic equation for the reaction is $Cl_2(g) + 2I^-(aq) \rightarrow 2Cl^-(aq) + I_2(aq)$

D The solution turns from brown to colourless.

29 Bioethanol can be obtained from the fermentation of the sugar in sugarcane.
Which of the following best explains why burning of bioethanol is considered more environmentally sustainable compared to the use of fossil fuels?

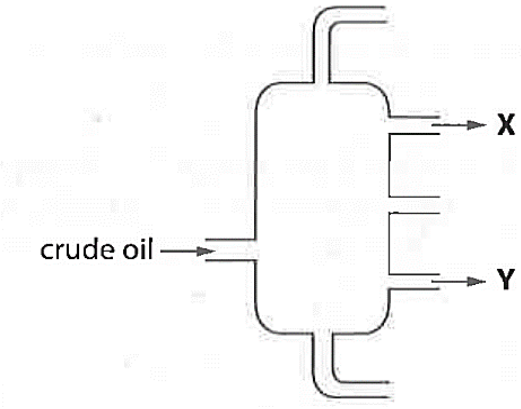
A As sugarcane grows, it absorbs carbon dioxide produced during photosynthesis.

B Cabon dioxide and water are formed during burning of bioethanol.

C Sugarcane plants can be regrown and replaced within a short period of time.

D Sugarcane plants need to be planted and transported for treatment.

30 Figure below shows the fractional distillation of petroleum.



Which of the following statements best describes the fractions at X and Y?

A The molecules in fraction X contain more carbon atoms than the molecules in fraction Y.

B The molecules in fraction X are more flammable than the molecules in fraction Y.

C The molecules in fraction X are larger than the molecules in fraction Y.

D The molecules in fraction X have higher boiling points than the molecules in fraction Y.

31 An unsaturated hydrocarbon, C_4H_6 reacts with 0.10 mole of hydrogen gas to form the corresponding alkane. What is the mass of C_4H_6 that is required to react with the hydrogen gas completely?

A 0.90 g

B 1.80 g

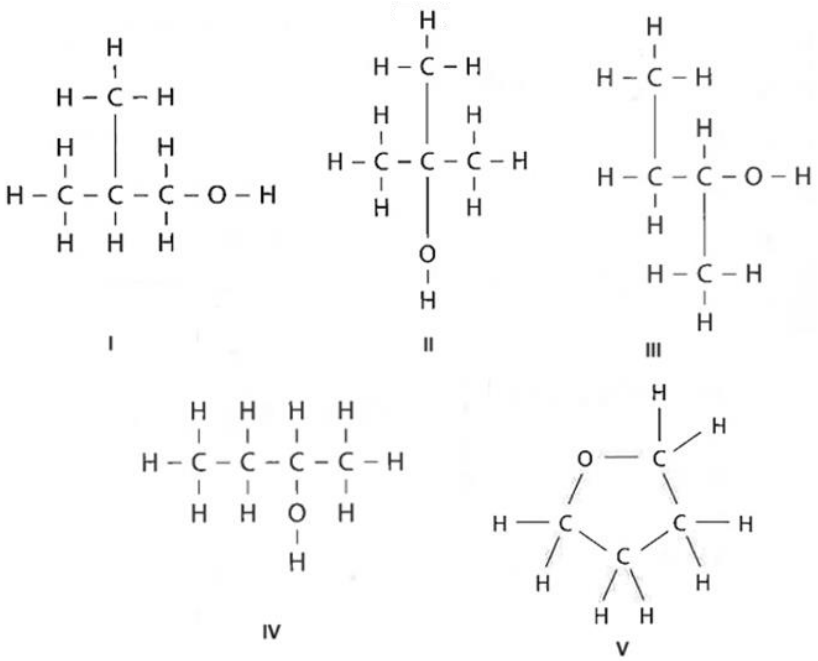
C 2.70 g

D 3.60 g

32 Which one of the following shows the correct structural formula and name of the ester formed when methanoic acid reacts with propanol?

	structural formula	name
A	$CH_3CH_2COOCH_3$	methyl propanoate
B	$CH3CH_2COOCH_3$	propyl methanoate
C	$HCOOCH_2CH_2CH_3$	methyl propanoate
D	$HCOOCH_2CH_2CH_3$	propyl methanoate

33 Which of the following structures are isomers?



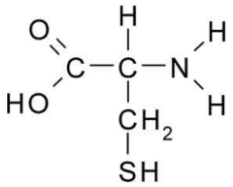
A I, II and IV

B I, II and V

C I, III and IV

D II, III and V

34 Below is a diagram of Cysteine.



Which one of the following statements about Cysteine is true?

A Effervescence is observed when magnesium metal is added to Cysteine.

B It decolourises acidified potassium manganate(VII).

C It forms a polymer with the same linkage as Terylene.

D It forms an addition polymer with other units of Cysteine.

35 An organic compound M undergoes a 2-stage process to form a compound N of chemical formula: $CH_3CH_2CH_2COOH$. The reagents and conditions of the 2 reactions are as follows:

stage number	reagents	conditions
1	steam	300°C 65 atm Phosphoric acid
2	acidified potassium manganate(VII)	heat under reflux

Which of the following can be a possible structural formula of compound M?

A butane

B butene

C propane

D propene

36 Which of the following is true of an addition polymer and a condensation polymer?

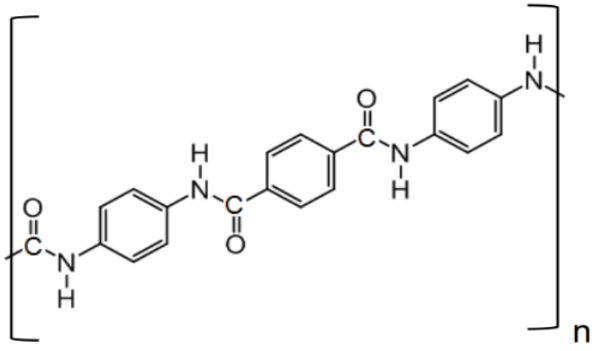
A Addition polymers are formed from alkenes while condensation polymers are formed from alkanes.

B Addition polymers produce water as a by-product whereas condensation polymers do not produce any by-products.

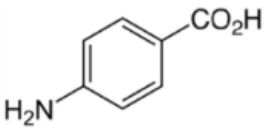
C Condensation polymers could produce water as a by-product whereas addition polymers do not produce any by-product.

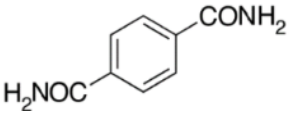
D Nylon is an example of an addition polymer where terylene is an example of a condensation polymer.

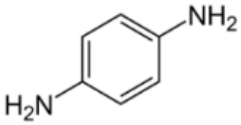
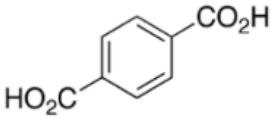
37 Kevlar is a polymer with high tensile strength, which is five times greater than steel. It is a lightweight and strong fibre with many applications ranging from being used in bulletproof vests to tires. It has the structure below.

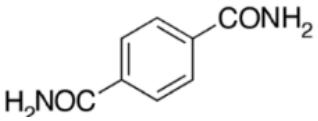
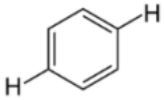


Which could be the monomer(s) for Kevlar?

A 

B 

C  and 

D  and 

38 To reduce atmospheric pollution, the waste gases from a coal-burning power station are passed through powdered calcium carbonate. Which waste gas will not be removed by the calcium carbonate?

A carbon dioxide

B nitrogen monoxide

C phosphorus(V) oxide

D sulfur dioxide

39 Which of the following statements are always true of methane and carbon dioxide?

1 Both gases can be produced by cows.
2 Both gases cause acid rain.
3 Methane burns in limited oxygen to produce carbon dioxide.
4 They are both greenhouse gases.

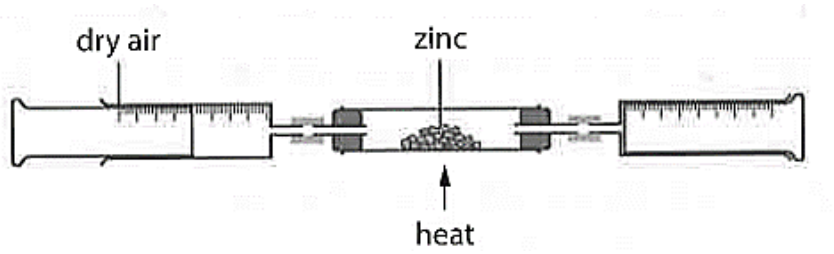
A 1 and 2 only

B 1 and 4 only

C 2 and 3 only

D 3 and 4 only

40 Figure below shows the reaction of zinc in air. When all the grey solid has turned yellow, the source of heat was removed. Upon cooling, the yellow solid turned white.



During the reaction, a sample of 250 cm^3 of air was used. What is volume of the remaining air left after the experiment?

A 52.5 cm^3

B 105 cm^3

C 197.5 cm^3

D 395 cm^3

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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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 –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).
The Avogadro constant, $L = 6.02 \times 10^{23}\ mol^{-1}$.