Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination
Secondary 4 'O' Level Programme

CHEMISTRY

6092/01

Paper 1

27 August 2024
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, pencil clips, glue or correction fluid.
Write your name, index number and class on the 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** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

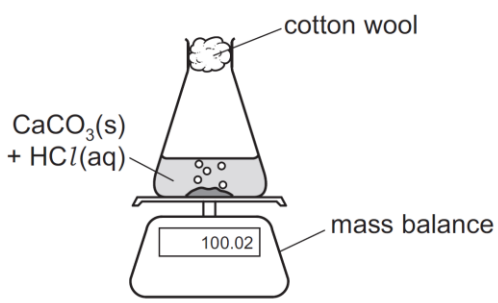
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is given on page **16**.
The use of an approved scientific calculator is expected, where appropriate.

For examiner's use only:	**Total**	**/ 40**

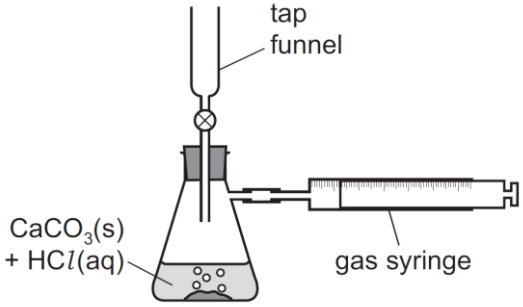
This document consists of **16** printed pages.

1 When calcium carbonate is added to dilute hydrochloric acid, carbon dioxide gas is released.

Three sets of apparatus are shown.



1



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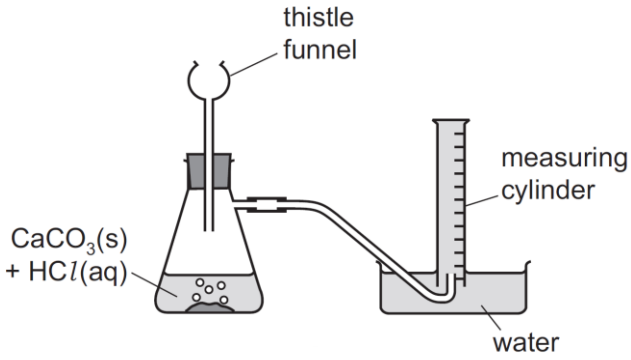


3

Which sets of apparatus are suitable, together with a stopwatch, for following the rate of this reaction?

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

2 Solutions of $Ca(NO_3)_2$ and $Cu(NO_3)_2$ separately undergo a series of reactions.

$$Ca(NO_3)_2(aq) \xrightarrow{Na_2CO_3(aq)} J \xrightarrow[HCl(aq)]{\text{excess}} K \xrightarrow[NH_3(aq)]{\text{excess}} L$$

$$Cu(NO_3)_2(aq) \xrightarrow{Na_2CO_3(aq)} M \xrightarrow[HCl(aq)]{\text{excess}} N \xrightarrow[NH_3(aq)]{\text{excess}} O$$

J, K and L are calcium compounds.

M, N and O are copper(II) compounds.

How many of J, K, L, M, N and O contain precipitates?

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

3 An excess of sodium hydroxide solution is added to a solution of salt P and warmed. A gas that turns damp red litmus paper blue is only given off after aluminium foil is added to the hot solution.

What is salt P?

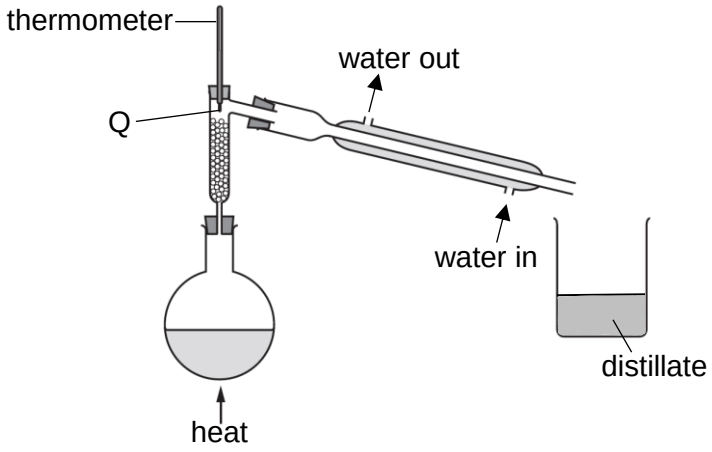
A ammonium chloride

B ammonium nitrate

C sodium chloride

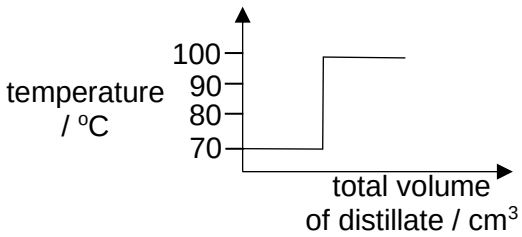
D sodium nitrate

4 The diagram shows the apparatus used to separate hexane (boiling point, 70 °C) and heptane (boiling point, 98 °C).

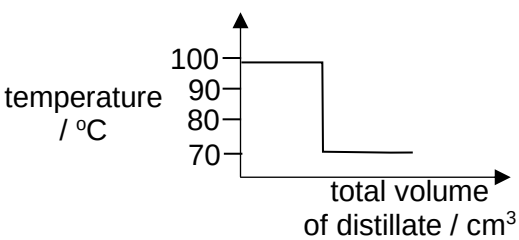


Which graph would be obtained if the temperature at point Q was plotted against the total volume of distillate collected?

A



B



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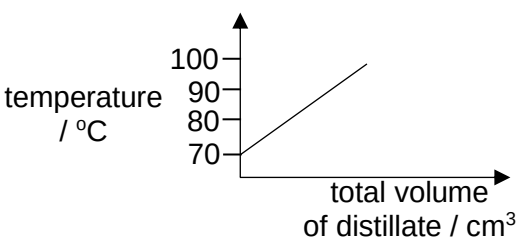

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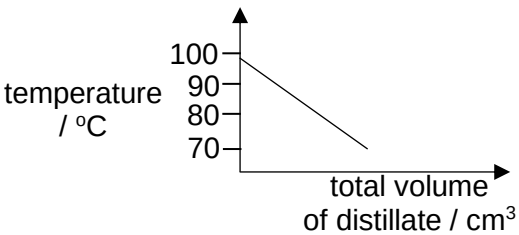
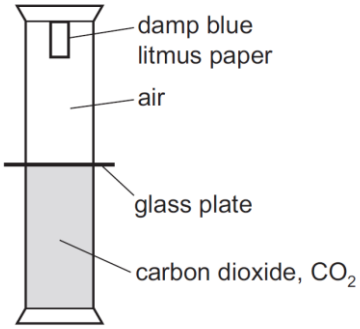


5 Four experiments, each containing a different acidic gas, are set up as shown.

The dividing glass plates are removed at the same time.

In which set of apparatus does the litmus paper turn red first?

A



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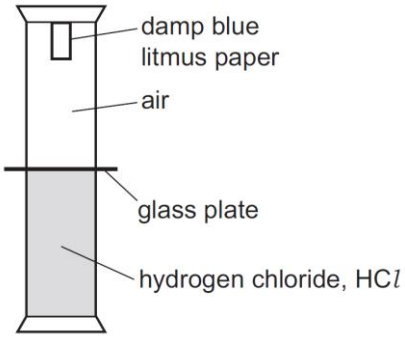
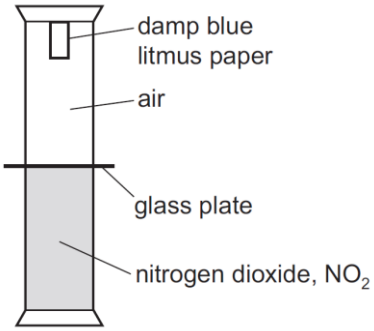


C



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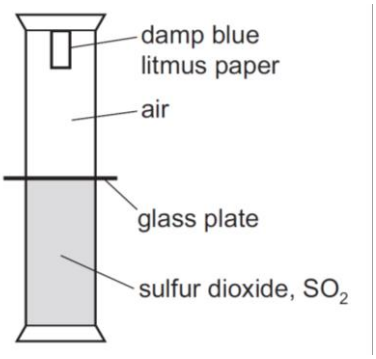


6 The melting points and boiling points of four elements are shown.

element	melting point / °C	boiling point / °C
W	−183	−89
X	−78	−33
Y	−7	59
Z	44	280

In which elements are the particles far apart at 0 °C?

A W and X **B** X and Y **C** X and Z **D** Y and Z

7 In which species are the numbers of protons, neutrons and electrons all different?

A $^{27}_{13}Al$ **B** $^{35}_{17}Cl^-$ **C** $^{32}_{16}S^{2-}$ **D** $^{39}_{19}K^+$

8 Which molecule has an equal number of valence electrons involved in bonding and not involved in bonding?

A CH_4 **B** H_2O **C** NH_3 **D** O_2

9 Which statement explains why sodium chloride, NaC*l*, has a lower melting point than magnesium oxide, MgO?

A Sodium chloride has a simple molecular structure while magnesium oxide has a giant ionic structure.

B Sodium is more reactive than magnesium.

C The attraction between Na^+ and Cl^- is weaker than that between Mg^{2+} and O^{2-}.

D The particles in sodium chloride are more closely packed than in magnesium oxide.

10 In the structure of solid SiO_2,

- each silicon atom is bonded to x oxygen atoms
- each oxygen atom is bonded to y silicon atoms
- the bonding is z.

What is the correct combination of x, y and z in these statements?

	x	y	z
A	2	1	covalent
B	2	1	ionic
C	4	2	covalent
D	4	2	ionic

11 Which statement is correct?

A 1.00 mol of zinc chloride contains 1.20×10^{24} ions.

B 2.00 mol of sodium nitrate contains 1.20×10^{24} ions.

C 24.0 dm^3 of chlorine gas, measured at room temperature and pressure, contains 1.20×10^{24} atoms.

D 48.0 dm^3 of hydrogen gas, measured at room temperature and pressure, contains 1.20×10^{24} atoms.

12 Calcium oxide and magnesium sulfide each reacts with acid.

$$CaO(s) + 2H^+(aq) \rightarrow Ca^{2+}(aq) + H_2O(l)$$

$$MgS(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2S(g)$$

A mixture of these two compounds, X, reacts with exactly 0.125 mol of dilute hydrochloric acid.

The amount of hydrogen sulfide formed is 0.0250 mol.

What is the mass of calcium oxide in mixture X?

A 2.1 g **B** 2.8 g **C** 4.2 g **D** 5.6 g

13 The formula of an oxide of element Y is Y_2O_5.

5.4 g of Y_2O_5 contains 1.4 g of Y.

How many moles of Y does 1.4 g of the element contain?

A $\frac{1.4}{16} \times \frac{2}{5}$ **B** $\frac{1.4}{16} \times \frac{5}{2}$ **C** $\frac{4.0}{16} \times \frac{2}{5}$ **D** $\frac{4.0}{16} \times \frac{5}{2}$

14 Which statements about hydrogen–oxygen fuel cells are correct?

1 A hydrogen-oxygen fuel cell is used to generate electricity.
2 Hydrogen is extracted from clean, dry air.
3 The waste product in a hydrogen-oxygen fuel cell is water.

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

15 Aqueous copper(II) sulfate is electrolysed using copper electrodes.

Which row correctly describes what happens?

	colour of electrolyte	mass of anode	mass of cathode
A	becomes colourless	decreases	decreases
B	becomes colourless	remains the same	increases
C	remains blue	remains the same	decreases
D	remains blue	decreases	increases

16 Hydrogen reacts with iodine to form hydrogen iodide. The equation for the reaction and enthalpy change are shown.

$$H_2(g) + I_2(g) \rightarrow 2HI(g) \qquad \Delta H = +27 \text{ kJ/mol}$$

What can be deduced from this information?

A The energy absorbed in forming bonds is greater than the energy released in breaking bonds.

B The energy absorbed in forming bonds is less than the energy released in breaking bonds.

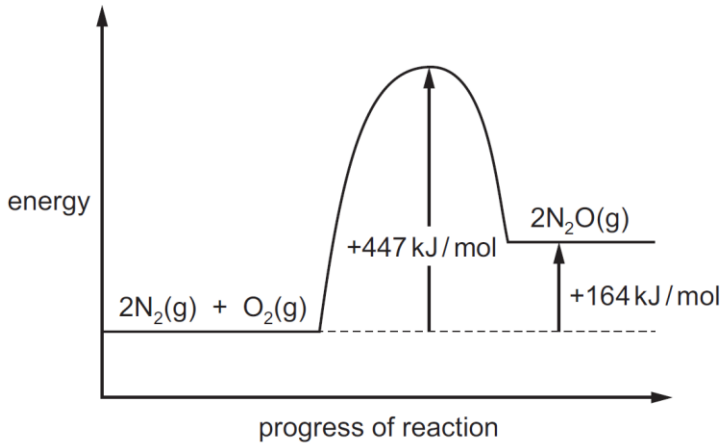
C The energy released in forming bonds is greater than the energy absorbed in breaking bonds.

D The energy released in forming bonds is less than the energy absorbed in breaking bonds.

17 Under certain conditions, nitrogen reacts with oxygen to form N_2O.

$$2N_2(g) + O_2(g) \rightleftharpoons 2N_2O(g)$$

The energy profile diagram is shown.



What is the activation energy of the **reverse** reaction?

A –447 kJ/mol

B –283 kJ/mol

C +164 kJ/mol

D +283 kJ/mol

18 During the Contact process, sulfuric acid, H_2SO_4, is produced from sulfur in a series of stages.

The sulfur compound produced in each stage is shown.

$$S \rightarrow SO_2 \rightarrow SO_3 \rightarrow H_2S_2O_7 \rightarrow H_2SO_4$$

Which statement correctly describes these stages?

A All stages involve oxidation and the highest oxidation state of sulfur is +12.

B Only three of the stages involve oxidation and the highest oxidation state of sulfur is +6.

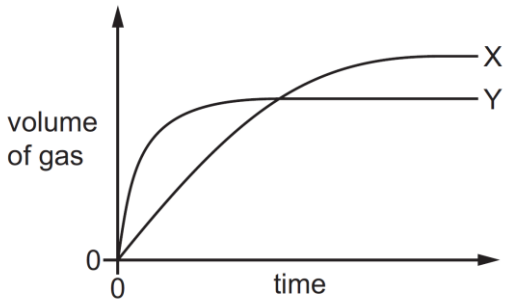
C Only three of the stages involve oxidation and the highest oxidation state of sulfur is +12.

D Only two of the stages involve oxidation and the highest oxidation state of sulfur is +6.

19 The decomposition of hydrogen peroxide in the presence of MnO_2 is shown.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

The volume of gas collected when 0.2 g of MnO_2 is added to two different hydrogen peroxide solutions at 20 ^oC is shown on the graph as curves X and Y.

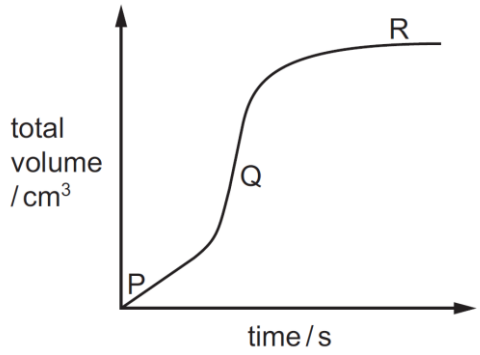


Which row shows the conditions that will result in curves X and Y?

	curve X			curve Y		
	volume of H_2O_2 / cm^3	concentration of H_2O_2 in mol/dm^3	form of MnO_2	volume of H_2O_2 / cm^3	concentration of H_2O_2 in mol/dm^3	form of MnO_2
A	50	0.1	lumps	50	0.2	powder
B	25	0.2	powder	25	0.1	lumps
C	50	0.1	lumps	20	0.2	powder
D	20	0.2	powder	40	0.1	lumps

20 An excess of magnesium ribbon is added to dilute hydrochloric acid and the volume of gas produced is measured as the reaction proceeds. The reaction is exothermic.

The results are shown.



Which row explains the changes in the rate of reaction between points P and Q and between points Q and R?

	between points P and Q	between points Q and R
A	reaction temperature is increasing	concentration of acid is decreasing
B	reaction temperature is increasing	magnesium has been used up
C	surface area of magnesium is decreasing	concentration of acid is decreasing
D	surface area of magnesium is decreasing	magnesium has been used up

21 Samples of HC*l*(aq) and HNO_3(aq) are tested using Universal Indicator.

The sample of HC*l*(aq) has a pH of 4 and the sample of HNO_3(aq) has a pH of 2.

Which statement explains why the samples of HC*l*(aq) and HNO_3(aq) have different pH values?

A HC*l*(aq) is a weak acid and HNO_3(aq) is a strong acid.

B HNO_3(aq) has a higher relative molecular mass than HC*l*(aq).

C The sample of HC*l*(aq) has ionised more than the sample of HNO_3(aq).

D The sample of HNO_3(aq) is more concentrated than the sample of HC*l*(aq).

22 Hydrazine has the formula $H_2N{-}NH_2$. It has similar properties to ammonia.

Which statements about hydrazine is correct?

1 It dissolves in water to form hydroxide ions.

2 It forms salts with alkalis.

3 It reacts with hydrogen chloride to form $ClH_3N{-}NH_3Cl$.

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

23 Which method gives the best yield of lead(II) sulfate?

A Add excess dilute hydrochloric acid to lead(II) oxide, followed by dilute sulfuric acid.

B Add excess dilute nitric acid to lead(II) carbonate, followed by dilute sulfuric acid.

C Add excess water to lead(II) carbonate, followed by dilute sulfuric acid.

D Add excess water to lead(II) oxide, followed by dilute sulfuric acid.

24 Copper(II) nitrate is made by reacting an excess of a powdered solid with an aqueous solution.

The mixture is filtered and the filtrate is crystallised.

Which row identifies a solid and an aqueous solution that can be used to make a pure sample of copper(II) nitrate?

	solid in excess	aqueous solution
A	copper	dilute nitric acid
B	copper	silver nitrate
C	copper(II) chloride	dilute nitric acid
D	copper(II) oxide	silver nitrate

25 Ammonia is produced by the Haber process.

Which statement is **not** correct?

A Iron provides an alternative pathway with a lower activation energy.

B The nitrogen and hydrogen react in a 1:3 ratio by mass.

C The nitrogen for the process is obtained from liquid air.

D The reaction is reversible.

26 Astatine is below iodine in Group 17 of the Periodic Table.

Which row describes the properties of astatine?

	state at room temperature	reactivity
A	gas	does not displace chlorine, bromine and iodine
B	gas	displaces iodine but does not displace chlorine or bromine
C	solid	does not displace chlorine, bromine and iodine
D	solid	displaces iodine but does not displace chlorine or bromine

27 The properties of the element cobalt, Co, can be predicted from its position in the Periodic Table.

Which row describes the properties of cobalt?

	conducts electricity when solid	has low density	has variable oxidation states	forms coloured compounds
A	✓	✓	✓	×
B	✓	✓	×	✓
C	✓	×	✓	✓
D	×	✓	✓	✓

28 Three elements, X, Y and Z have consecutive, increasing proton (atomic) numbers.

If element X is a noble gas, what will be the chemical symbol for the ions of element Z in its compounds?

A Z^- **B** Z^{2-} **C** Z^+ **D** Z^{2+}

29 Metal Q is between iron and copper in the reactivity series.

Which methods could be used to extract metal Q?

1 electrolysis of the molten metal oxide

2 heating the metal oxide with carbon

3 heating the metal oxide with copper

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

30 A small piece of metal is added to a large beaker of water.

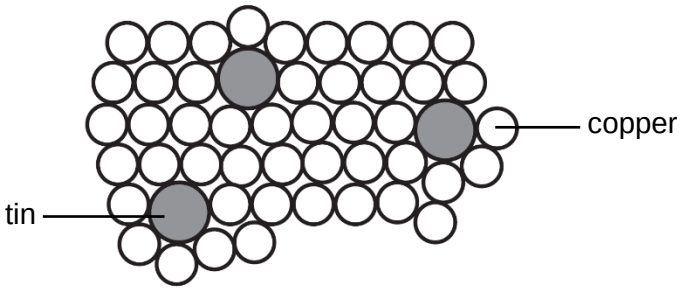
A vigorous reaction occurs.

When the reaction stops, a few drops of Universal Indicator are added to the solution.

What is the metal and the colour of the solution after the Universal Indicator is added?

	metal	colour of solution
A	sodium	purple
B	sodium	red
C	zinc	purple
D	zinc	red

31 The diagram shows the structure of bronze.



Why is bronze harder than pure copper?

A The tin atoms form strong ionic bonds with copper atoms.

B The tin atoms prevent the layers of copper atoms from sliding over each other easily.

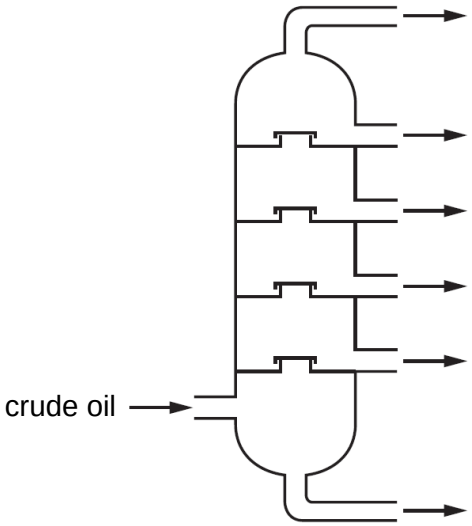
C The tin atoms prevent the 'sea of electrons' from moving freely.

D The tin atoms strengthen the metallic bonds in bronze.

32 What is the harmful effect of chloroflurocarbons, sulfur dioxide and carbon monoxide?

	chloroflurocarbons	sulfur dioxide	carbon monoxide
A	depletion of the ozone layer	acid rain	toxic
B	depletion of the ozone layer	respiratory problems	global warming
C	global warming	acid rain	depletion of the ozone layer
D	respiratory problems	global warming	toxic

33 The diagram shows the fractional distillation column used to separate crude oil into fractions.



Which statement about the fractional distillation of crude oil is correct?

A Each fraction contains one compound only.

B The fraction collected at the bottom of the column has the lowest boiling point.

C The fraction collected at the top of the column has the smallest molecules.

D The higher up the column, the higher the temperature.

34 Which pair contains a substance that is **not** made during the reaction of CH_4 with excess chlorine in the presence of ultraviolet light?

A CH_3Cl, CCl_4

B CH_2Cl_2, HCl

C CH_2Cl_2, $CHCl_3$

D $CHCl_3$, H_2

35 The general formula of the alkanes is C_nH_{2n+2}.

Which physical property **decreases** as n increases?

A boiling point

B flammability

C melting point

D viscosity

36 The structures of two isomers, with the molecular formula, C_4H_8, are given below.

$CH_2=CHCH_2CH_3$ and $CH_3CH=CHCH_3$

How many of the statements about these two isomers are correct?

- Complete combustion of 1 mole of each isomer produces equal number of moles of carbon dioxide and water.
- Both produce the same molecule when reacted with hydrogen.
- Both produce the same molecule when reacted with steam.
- When polymerised, the same polymer is produced.

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

37 An aqueous solution contains 7.4 g of a carboxylic acid, Q.

When excess magnesium is added to this solution, 1200 cm^3 of gas is produced at room temperature and pressure.

What is Q?

A CH_3COOH

B C_2H_5COOH

C C_3H_7COOH

D HCOOH

38 Butanol and methanoic acid react to form an ester, R.

What is the formula of R?

A $CH_3CH_2CH_2CO_2CH_3$

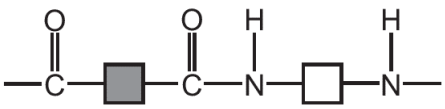
B $CH_3CH_2CO_2CH_2CH_3$

C $CH_3CO_2CH_2CH_2CH_2CH_3$

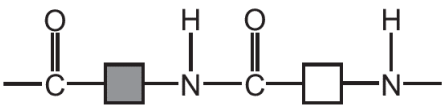
D $HCO_2CH_2CH_2CH_2CH_3$

39 Part of the structures of two different polymers, X and Y, are shown.

X



Y



Which row about the monomers and the linkages between the monomers in polymers X and Y is correct?

	monomers in X and Y	linkages in X and Y
A	different	different
B	different	same
C	same	different
D	same	same

40 Which are methods of recycling plastics?

1 cracking of plastic waste

2 hydrolysis of polyesters

3 melting poly(ethene) waste into pellets

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

- End of Paper -

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, $L = 6.02 \times 10^{23}\ mol^{-1}$

[Turn Over