



DUNMAN SECONDARY SCHOOL

CANDIDATE
NAME

CLASS

INDEX
NUMBER

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PRELIMINARY EXAMINATION 2023 SECONDARY 4 EXPRESS

CHEMISTRY

Paper 1

6092/01

14 September 2023

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 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 When an excess dilute acid is added to a known quantity of calcium carbonate, the temperature of the mixture changes.

A student investigates and measures the temperature changes when calcium carbonate fully reacts with the acid.

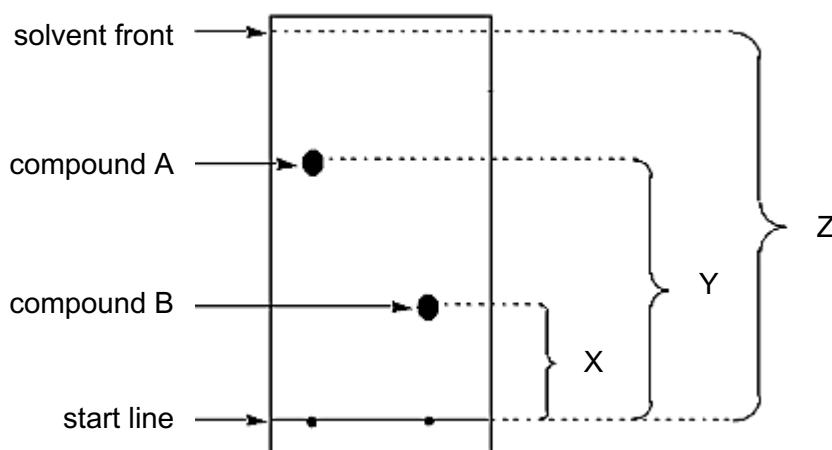
The student is provided with a beaker and thermometer.

Which additional apparatus are needed?

- 1 mass balance
- 2 measuring cylinder
- 3 stopwatch
- 4 styrofoam cup

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

- 2 A paper chromatogram is shown in the diagram below.



Which statement about the paper chromatogram is correct?

- A** Compound A is heavier than B.
B Compound A is more soluble in solvent than B.
C The R_f value of compound A, y, is greater than compound B, x.
D The solvent level is placed above the starting line.

- 3 An organic solvent, hexane and aqueous sodium chloride are accidentally mixed together. Which methods of separation are needed to obtain pure samples of hexane and solid sodium chloride?
- A filtration followed by crystallisation
 B fractional distillation followed by evaporation to dryness
 C simple distillation followed by crystallisation
 D using a separating funnel followed by evaporation to dryness
- 4 A gas, R, has the following properties:
- 1 a choking smell
 - 2 turns damp blue litmus paper red
 - 3 decolourises purple acidified potassium manganate(VII) solution

What is R?

- A ammonia
 B chlorine
 C nitrogen
 D sulfur dioxide
- 5 Two solutions, W and X, are tested with several reagents, and observations are shown in the table.

test	observation with W	observation with X
aqueous ammonia added	green precipitate formed, turned brown upon standing	white precipitate formed, soluble in excess to form a colourless solution
aqueous sodium hydroxide, and aluminium foil added, then warmed	no gas given off	gas given off turns damp red litmus blue
dilute nitric acid added, then aqueous silver nitrate	yellow precipitate formed	no visible reaction

What are solutions W and X?

	W	X
A	iron(II) chloride	aluminium nitrate
B	iron(II) iodide	zinc nitrate
C	iron(II) iodide	aluminium nitrate
D	iron(III) iodide	zinc nitrate

6 Which statement is correct about a solid being heated to become a liquid?

- A The forces of attraction between the particles decreases.
- B The speed of the particles decreases.
- C The size of the particles decreases.
- D The strength of the covalent bonds within each particle decreases.

7 An ion, L^{2-} , has 18 neutrons and 18 electrons.

What does its nucleus contain?

- A 16 protons and 16 neutrons
- B 16 protons and 18 neutrons
- C 18 protons and 16 neutrons
- D 20 protons and 18 neutrons

8 $Cl-35$ and $Cl-37$ are two isotopes of chlorine.

Which statements are correct?

- 1 They have the same atomic number.
 - 2 They have the same mass number.
 - 3 They have the same physical properties.
 - 4 They have the same chemical properties.
-
- A 1 and 2 only
 - B 1 and 4 only
 - C 2 and 3 only
 - D 2 and 4 only

- 9 The table shows four elements, P, Q, R and S with their atomic numbers.

element	P	Q	R	S
atomic number	6	8	13	17

Which row shows the formulae of the compounds formed from the four elements?

	formula of ionic compound formed	formula of covalent compound formed
A	PR_2	QS_2
B	PS_2	R_2Q
C	R_2Q_3	PS_4
D	RS_2	PQ_2

- 10 The properties of substances W, X, Y and Z are shown in the table.

	W	X	Y	Z
melting point ($^{\circ}\text{C}$)	113	3850	-77	1728
boiling point ($^{\circ}\text{C}$)	184	4250	-33	2230
electrical conductivity	no	yes	no	no

Which row correctly describes W, X, Y and Z?

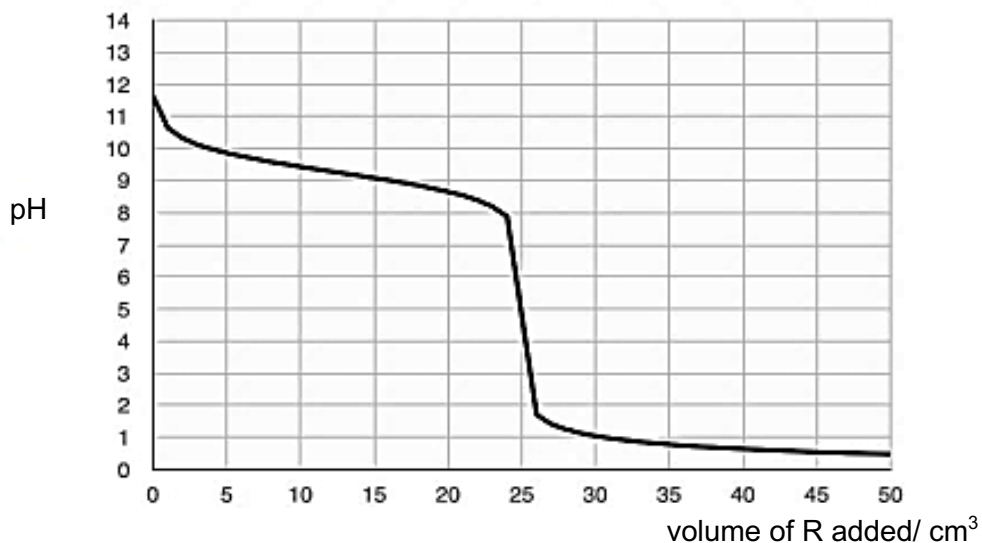
	W	X	Y	Z
A	ammonia	graphite	silicon dioxide	iodine
B	ammonia	iodine	graphite	silicon dioxide
C	iodine	graphite	ammonia	silicon dioxide
D	iodine	silicon dioxide	ammonia	graphite

- 11 Which statement(s) correctly describe(s) properties of a compound, copper(II) sulfide and a mixture of copper and sulfur?

	compound copper(II) sulfide	mixture of copper and sulfur
1	copper and sulfur react when heated to form copper(II) sulfide	copper and sulfur mix together without any heat involved
2	the ratio of copper to sulfur is always 1:1	the ratio of copper to sulfur in the mixture can vary
3	copper(II) sulfide has the properties of copper and sulfur	the mixture does not have the properties of copper and sulfur

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

- 12 An aqueous solution R is gradually added to an aqueous solution S. The changes in pH are shown on the graph.



What are the identities of R and S?

	R	S
A	aqueous ammonia	ethanoic acid
B	aqueous ammonia	hydrochloric acid
C	ethanoic acid	sodium hydroxide
D	hydrochloric acid	aqueous ammonia

- 13 The information about two indicators is given.

- Thymol blue is red in colour when pH is less than 3. Colour changes to yellow around pH 3, and changes colour a second time to blue around pH 9.
- Phenolphthalein is colourless when pH is less than 10, and changes colour to red at about pH 10.

What would be the colour of aqueous potassium chloride solution when both indicators are added to the solution?

- A** blue
- B** green
- C** orange
- D** yellow

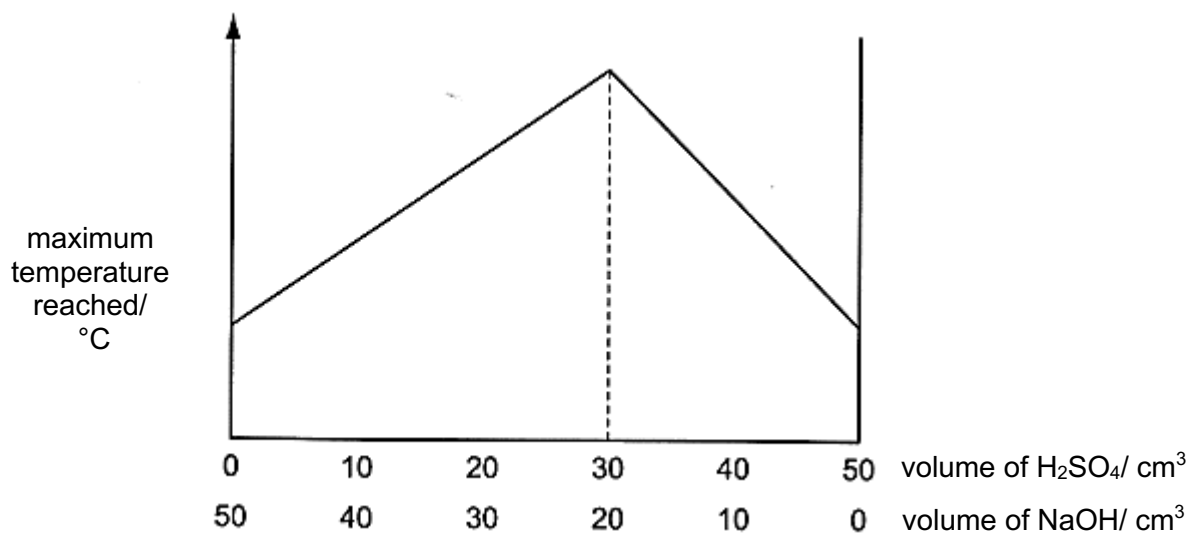
- 14 5.0 cm^3 of gaseous hydrocarbon reacts with excess oxygen to form 30.0 cm^3 of carbon dioxide and 15.0 cm^3 of water vapour.

What is the formula of the hydrocarbon?

- A** C_2H_4 **B** C_3H_6 **C** C_6H_6 **D** C_6H_{10}

- 15 An aqueous solution of sulfuric acid has a concentration of 1.0 mol/dm^3 . Different volumes of this sulfuric acid are added to different volumes of aqueous sodium hydroxide.

The maximum temperature reached in each mixture is measured. The graph shows the results.



What is the concentration of the aqueous sodium hydroxide?

- A** 0.60 mol/dm^3 **B** 0.75 mol/dm^3 **C** 1.50 mol/dm^3 **D** 3.00 mol/dm^3

- 16 The complex ion $[\text{Co}(\text{NH}_3)_x]^{3+}$ consists of 36% by mass of cobalt, Co.

What is the value of x?

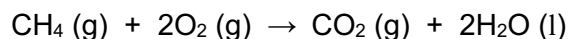
- A** 3 **B** 5 **C** 6 **D** 8

- 17 When 42.0 g of lead(II) carbonate ($M_r = 267$) is strongly heated, 2.5 dm³ of carbon dioxide, measured at room temperature and pressure, is produced.



What is the percentage yield of carbon dioxide?

- A** 15% **B** 28% **C** 35% **D** 66%
- 18 In which process is energy released?
- A** dissolving ammonium chloride in water
B forming a hydrogen molecule from two hydrogen atoms
C molecules change from closely packed to far apart
D thermal decomposition of calcium carbonate
- 19 The equation for the combustion of methane is shown.



	C-H	O=O	O-H	C=O
bond energy in kJ / mol	413	498	463	799

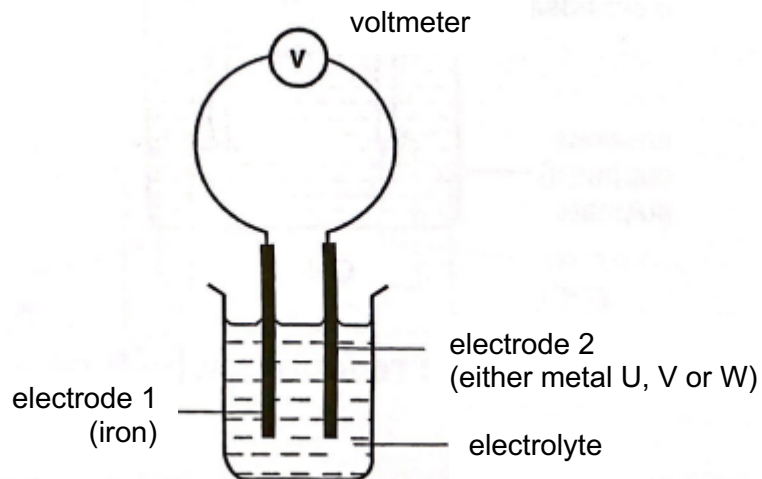
What is the enthalpy change of this reaction?

- A** -802 kJ / mol
B -374 kJ / mol
C +374 kJ / mol
D +802 kJ / mol
- 20 In an electrolysis experiment, the same amount of charge deposited 32 g of zinc and 8.5 g of chromium.
 [Ar: Zn, 65; Cr, 52]

What is the charge on the chromium ion?

- A** 2+ **B** 3+ **C** 5+ **D** 6+

- 21 Three simple cells are set up using iron metal as electrode 1 and three other unknown metals, U, V and W, separately as electrode 2.



The results of the experiments are shown in the table.

metal used as electrode 2	voltmeter reading/ V	positive electrode
U	-1.93	Fe
V	+0.78	V
W	+1.09	W

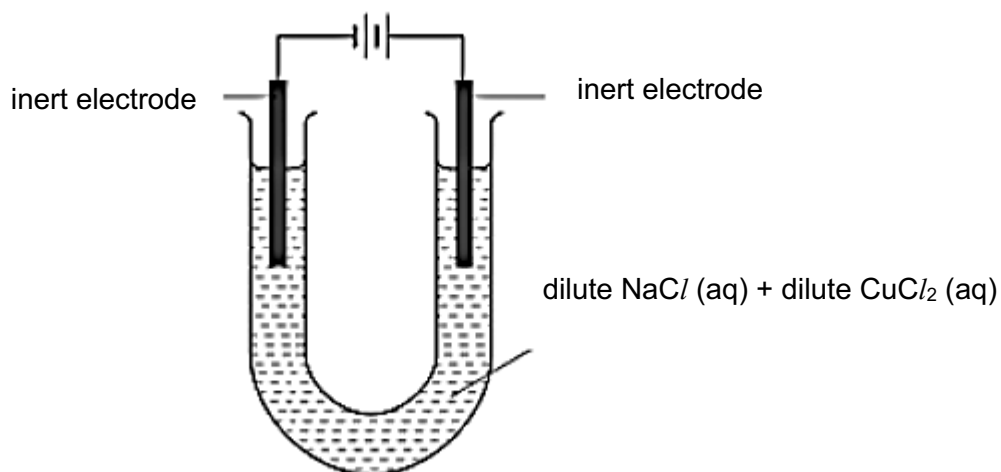
Which row shows the correct metal for U, V and W?

	metal U	metal V	metal W
A	copper	lead	magnesium
B	lead	magnesium	copper
C	magnesium	copper	lead
D	magnesium	lead	copper

- 22 Which statement about hydrogen-oxygen fuel cell is correct?

- A** Electricity is required to generate hydrogen and oxygen.
- B** Hydrogen reacts with oxygen to produce electricity.
- C** Oxygen is oxidised and hydrogen is reduced in the reaction.
- D** Pure water is used as the electrolyte in the fuel cell.

- 23 The diagram shows an electrolysis of dilute aqueous sodium chloride and dilute aqueous copper(II) chloride.



Which statement(s) about the experiment is/are correct?

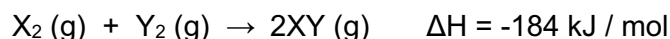
- 1 Green-yellow gas can be observed at the anode.
- 2 Reddish-brown solid deposit on the surface of the cathode.
- 3 The colour intensity of the solution remains unchanged.

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

- 24 How are the activation energy and enthalpy change for a reaction between two gases changed when it is carried out in the presence of a catalyst?

	change in	
	activation energy	enthalpy change
A	decrease	decrease
B	decrease	no change
C	increase	no change
D	no change	decrease

- 25 X and Y are two elements which react to form the compound, XY, as shown below.



Which statements are **not** true?

- 1 Increasing the temperature will lead to more effective collisions between X_2 and Y_2 molecules.
- 2 Increasing the concentrations of X_2 and Y_2 has no effect on the rate of reaction.
- 3 Increasing the pressure has no effect on the total volume of XY obtained.
- 4 More bonds are broken than formed in the reaction.

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

- 26 Which reaction does **not** involve oxidation and/or reduction?

- A** $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
B $\text{CuO} + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{H}_2\text{O}$
C $\text{Fe}_2(\text{SO}_4)_3 + 2\text{KI} \rightarrow 2\text{FeSO}_4 + \text{K}_2\text{SO}_4 + \text{I}_2$
D $2\text{Pb}(\text{NO}_3)_2 \rightarrow 2\text{PbO} + 4\text{NO}_2 + \text{O}_2$

- 27 Silver nitrate is made by reacting an excess of a powdered solid with an aqueous solution.

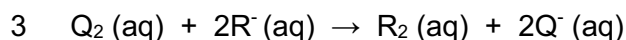
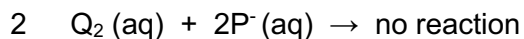
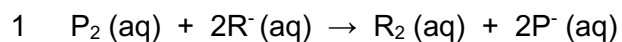
The mixture is filtered and the filtrate crystallised.

Which row identifies a powdered solid and an aqueous solution that can be used to prepare a pure sample of silver nitrate?

	powdered solid	aqueous solution
A	silver	zinc nitrate
B	silver oxide	sodium nitrate
C	silver carbonate	dilute nitric acid
D	silver chloride	zinc nitrate

- 30 P, Q and R are elements found in Group VII of the Periodic Table.

Three reactions are carried out to determine the reactivity of P, Q and R.



Which statement about P, Q and R is correct?

- A P has a darker colour than R.
 - B Q is a stronger oxidising agent than R.
 - C Q is more reactive than P.
 - D R is a gas at room temperature and pressure.
- 31 Which reaction is **not** a step in the production of iron from haematite in the blast furnace?
- A Carbon dioxide reacts with carbon to produce carbon monoxide.
 - B Coke burns in the air to produce carbon dioxide.
 - C Iron(III) oxide reacts with carbon monoxide to form iron.
 - D Limestone reacts with sand to produce slag.
- 32 Which statement about transition metals is **incorrect**?
- A Transition metals form coloured compounds.
 - B Only transition metals or their compounds are used as catalyst.
 - C Transition metals conduct electricity due to free-moving electrons.
 - D Transition metals have variable oxidation states.
- 33 Metal Q is above zinc and below magnesium in the reactivity series.

Which row correctly shows how metal Q can be obtained from its oxide?

	heating with carbon	heating with hydrogen	by electrolysis
A	✓	✗	✗
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

- 34 In an experiment to determine the order of reactivity of four metals, P, Q, R and S, each metal is placed into four separate solutions containing aqueous metal ions.

The results are shown in the table.

metal	aqueous metal ion			
	P^{2+}	Q^{2+}	R^{2+}	S^{2+}
P	✗	✗	✓	✗
Q	✓	✗	✓	✓
R	✗	✗	✗	✗
S	✓	✗	✓	✗

Key

✓ = reaction observed

✗ = no reaction observed

Which row shows the order of reactivity of the metals?

	most reactive  least reactive			
A	Q	S	P	R
B	Q	P	S	R
C	R	P	S	Q
D	R	S	P	Q

- 35 Which row correctly shows both the source and effect of the named pollutant?

	pollutant	source	effect
A	methane	incomplete combustion of carbon-containing substances	irritation to eyes
B	oxides of nitrogen	volcanic emission	acid rain
C	ozone	photochemical reactions	irritation to eyes
D	sulfur dioxide	lightning activity	acid rain

- 36 Which row shows the product(s) of the complete combustion of propane and the product(s) of the reaction of propane with chlorine under sunlight?

	product(s) of complete combustion	product(s) of reaction with chlorine
A	carbon dioxide only	a chlorine compound only
B	carbon dioxide, water	a chlorine compound only
C	carbon dioxide, water	a chlorine compound, hydrogen chloride
D	carbon monoxide, carbon dioxide	a chlorine compound, hydrogen chloride

- 37 When dodecane, $C_{12}H_{26}$, is cracked, only three compounds are formed.

The compounds are ethene, ethane and propene.

What is the ratio of the compounds formed?

	ethene	ethane	propene
A	1	1	2
B	1	2	2
C	2	1	2
D	2	2	1

- 38 Petroleum can be separated into fractions using fractional distillation.

Which statement(s) is/are correct?

- Any of the fractions could be used as fuels because their enthalpy change of combustion is negative.
- The fraction used as a fuel for aircraft engines has a higher boiling point than the fraction used for polishes and waxes.
- The fraction used as a feedstock for making plastics is obtained from higher up the fractionating column than the fraction used as a fuel for buses and lorries.
- The fraction obtained at a particular point in the fractionating column always contains the same compounds in the same ratio.

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

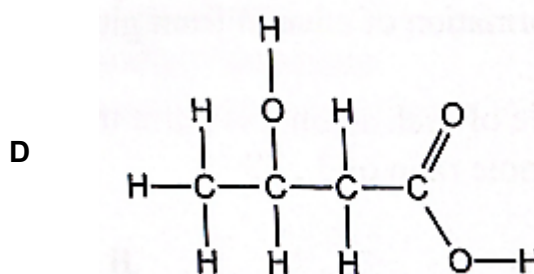
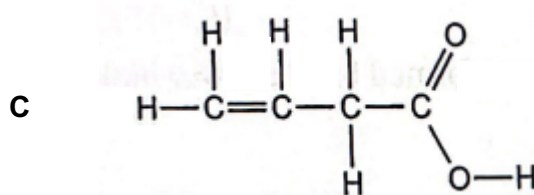
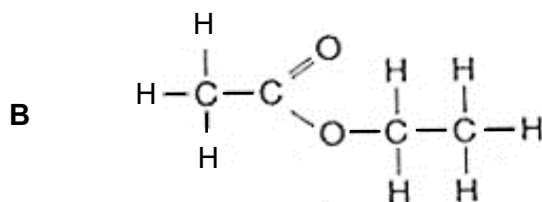
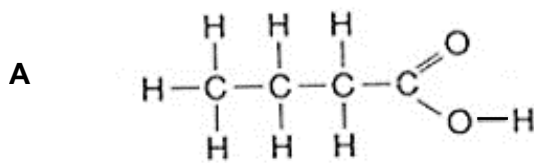
39 Which statement about alcohols is correct?

- A Alcohols can be produced from ethene using steam at 60°C and 300 atm.
- B Alcohols contain hydroxide ion, OH⁻.
- C Alcohols decolourise aqueous acidified potassium manganate(VII).
- D Ethanol can react with propanoic acid to form propyl ethanoate.

40 The following is known about compound Y.

- 1 has the empirical formula C₂H₄O
- 2 remains reddish-brown when bromine water is added
- 3 effervescence observed when aqueous sodium carbonate is added

Which structure could be compound Y?



The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
Key proton (atomic) number atomic symbol name relative atomic mass																	
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											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	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 –			

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