



Cambridge IGCSE™ (9–1)

CHEMISTRY

0971/22

Paper 2 Multiple Choice (Extended)

May/June 2025

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- 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 multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

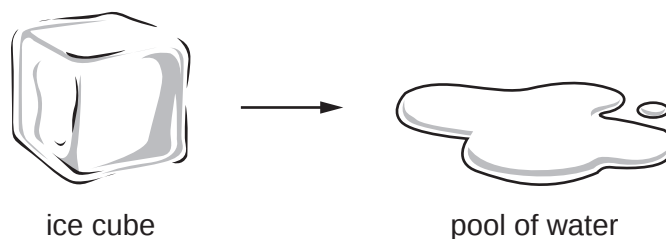
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.



2

- 1 An ice cube melts.

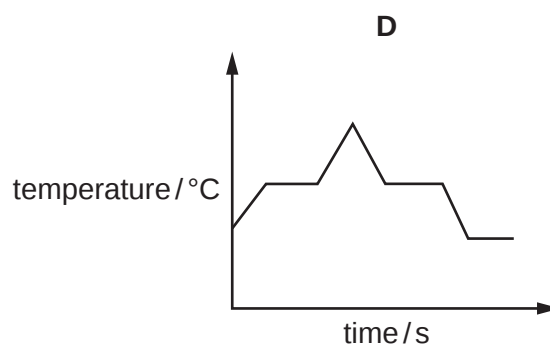
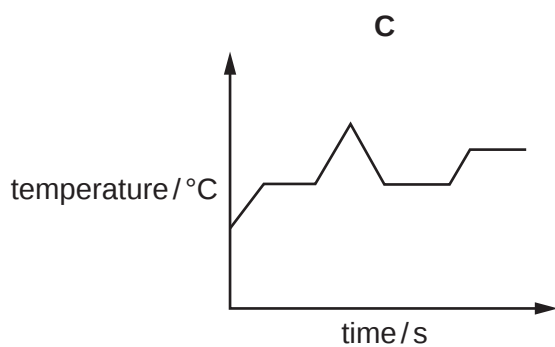
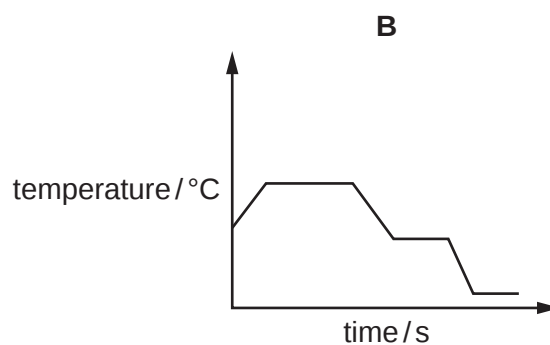
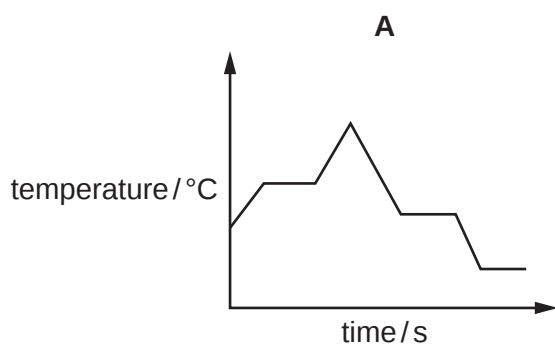


What happens to the molecules of water in the ice cube?

- A They evaporate.
 - B They dissolve.
 - C They gain energy.
 - D They lose energy.
- 2 A sample of a liquid, X, is heated to a temperature above its boiling point.

X is then cooled, so that it condenses and then freezes.

Which graph describes the change in temperature of X over time?



- 3 Which row gives the number of protons, electrons and neutrons in an atom of zinc?

	protons	electrons	neutrons
A	30	30	35
B	30	35	35
C	35	30	30
D	35	35	30

- 4 Which particles have the electronic configuration 2,8,8?

- 1 an argon atom, Ar
- 2 an aluminium ion, Al^{3+}
- 3 a sodium ion, Na^+
- 4 a chloride ion, Cl^-

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

- 5 A sample of element Q has two isotopes.

Their relative masses and abundances are shown.

relative mass of isotope	abundance /%
238	66
244	34

What is the relative atomic mass of this sample of Q to three significant figures?

- A** 240 **B** 241 **C** 242 **D** 243

- 6 Which statement about silicon(IV) oxide, SiO_2 , is correct?

- A** It conducts electricity because it contains delocalised electrons.
- B** It has a giant covalent structure with each silicon atom bonded to four oxygen atoms.
- C** It is a simple covalent molecule.
- D** Its structure is similar to that of graphite.

- 7 When 65 g of zinc reacts with 32 g of sulfur, 97 g of zinc sulfide is produced.

When 65 g of zinc reacts with 40 g of sulfur, the mass of zinc sulfide produced is still 97 g.

Which statement explains this observation?

- A Some of the zinc sulfide evaporates.
- B The reaction rate is slow.
- C The reaction stops before it is complete.
- D Zinc is the limiting reactant.

- 8 Aluminium reacts with iron(III) oxide to form aluminium oxide and iron.

Which chemical equation for the reaction between aluminium and iron(III) oxide is correct?

- A $Al + FeO \rightarrow AlO + Fe$
- B $2Al + Fe_2O \rightarrow Al_2O + 2Fe$
- C $Al + Fe_2O_3 \rightarrow Al_2O_3 + Fe$
- D $2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$

- 9 The concentration of a solution of aqueous sodium hydroxide is 0.50 mol/dm^3 .

Which mass of sodium hydroxide is used to make 500 cm^3 of this solution?

- A 10 g B 20 g C 40 g D 160 g

- 10 Molten zinc oxide is electrolysed using inert electrodes.

Which row identifies the product at each electrode?

	anode	cathode
A	zinc	oxygen
B	hydrogen	oxygen
C	oxygen	zinc
D	oxygen	hydrogen

11 Dilute aqueous sodium chloride is electrolysed using platinum electrodes.

What is the half-equation for the reaction at the cathode?

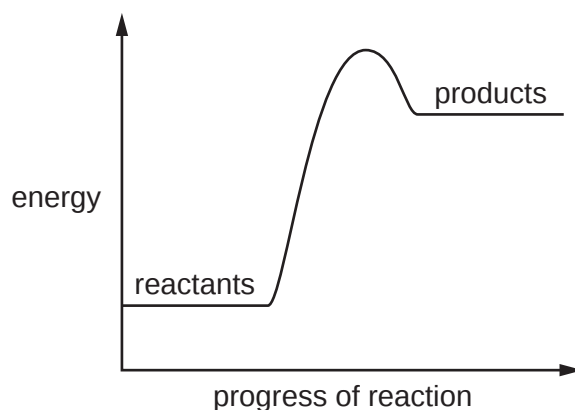
- A** $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
- B** $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$
- C** $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
- D** $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$

12 Hydrogen–oxygen fuel cells can be used to power vehicles.

Which statement about hydrogen–oxygen fuel cells is correct?

- A** The equation for the overall reaction is $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}_2$.
- B** The only chemical products are water and carbon dioxide.
- C** Chemical energy in the fuel is converted into electrical energy.
- D** The hydrogen used in hydrogen–oxygen fuel cells is a fossil fuel.

13 A reaction pathway diagram is shown.



Which row identifies the type of reaction and how the temperature of the surroundings changes during the reaction?

	type of reaction	temperature of the surroundings
A	endothermic	decreases
B	endothermic	increases
C	exothermic	decreases
D	exothermic	increases

- 14 The average bond energy for the C–H bond is 413 kJ/mol.

What is the enthalpy change when 1.0 mol of methane molecules is formed from carbon and hydrogen atoms?

- A –1652 kJ B –413 kJ C +413 kJ D +1652 kJ

- 15 Which statement describes the effect of adding a catalyst to a chemical reaction?

- A The activation energy, E_a , of the reaction is increased.
 B The enthalpy change, ΔH , of the reaction stays unchanged.
 C The frequency of collisions between the particles is decreased.
 D The kinetic energy of the particles is increased.

- 16 Which row describes the conditions used in the manufacture of sulfuric acid by the Contact process?

	catalyst	pressure	temperature
A	iron	high	high
B	iron	low	low
C	vanadium(V) oxide	high	low
D	vanadium(V) oxide	low	high

- 17 Which equations show the underlined species acting as a reducing agent?

- 1 Fe₂O₃ + 3CO → 2Fe + 3CO₂
 2 Fe + CuSO₄ → FeSO₄ + Cu
 3 5Fe²⁺ + MnO₄[–] + 8H⁺ → 5Fe³⁺ + Mn²⁺ + 4H₂O
 4 Fe(OH)₂ + H₂SO₄ → FeSO₄ + 2H₂O

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

- 18 A farmer incorrectly adds two substances to the soil at the same time.

They react together to form a gas which turns damp red litmus paper blue.

What are the two substances?

- A a basic oxide and a potassium salt
 B a basic oxide and an ammonium salt
 C an acidic oxide and a potassium salt
 D an acidic oxide and an ammonium salt

- 19 Which row shows the equations for the dissociation of hydrochloric acid and of ethanoic acid in aqueous solution?

	hydrochloric acid	ethanoic acid
A	$\text{HCl}(\text{aq}) \rightarrow \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$	$\text{CH}_3\text{COOH}(\text{aq}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{CH}_3\text{COO}^-(\text{aq})$
B	$\text{HCl}(\text{aq}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$	$\text{CH}_3\text{COOH}(\text{aq}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{CH}_3\text{COO}^-(\text{aq})$
C	$\text{HCl}(\text{aq}) \rightarrow \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$	$\text{CH}_3\text{COOH}(\text{aq}) \rightarrow \text{H}^+(\text{aq}) + \text{CH}_3\text{COO}^-(\text{aq})$
D	$\text{HCl}(\text{aq}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$	$\text{CH}_3\text{COOH}(\text{aq}) \rightarrow \text{H}^+(\text{aq}) + \text{CH}_3\text{COO}^-(\text{aq})$

- 20 Which three oxides are **all** acidic?

- A** CaO, NO₂, SO₂
B CaO, CO₂, Na₂O
C CO₂, NO₂, SO₂
D CO₂, Na₂O, SO₂

- 21 The table shows some properties of noble gases.

noble gas	density in g/dm ³	boiling point in °C
helium	0.2	−269
neon	0.9	−246
argon	1.8	−186
krypton		
xenon	5.9	−108

Which row predicts the density and the boiling point of krypton?

	density in g/dm ³	boiling point in °C
A	1.4	−75
B	2.4	−195
C	3.8	−153
D	8.5	−213

22 Sodium is a Group I metal.

What is a physical property of sodium?

- A non-conductor of electricity
- B high melting point
- C high density
- D malleable

23 Tennessine (atomic number 117) is a manufactured element that is below astatine in Group VII of the Periodic Table.

What is the expected state of tennessine at room temperature and pressure?

- A a diatomic gas
- B a liquid
- C a monatomic gas
- D a solid

24 When chlorine is bubbled into aqueous sodium bromide, a displacement reaction occurs.

Which description of this reaction is correct?

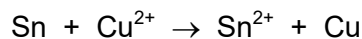
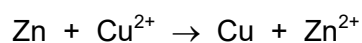
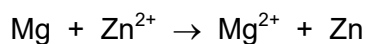
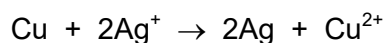
- A Chloride displaces bromide.
- B Chlorine displaces bromine.
- C Chloride displaces bromine.
- D Chlorine displaces bromide.

25 Brass is an alloy of copper.

Which statement about brass or copper is correct?

- A Brass does **not** conduct electricity because it is a compound.
- B Copper conducts electricity because its atoms are free to move.
- C Brass is harder than copper because its layers of atoms **cannot** easily slide over each other.
- D Copper is stronger than brass because it is a pure metal.

26 The ionic equations for some reactions between metals and aqueous metal ions are shown.



Which further information can be used to place copper, magnesium, silver, tin and zinc in order of their reactivity?

- A Zinc reacts with Sn^{2+} ions.
- B Copper does **not** react with Sn^{2+} ions.
- C Magnesium reacts with Cu^{2+} ions.
- D Magnesium reacts with Ag^+ ions.

27 Zinc is used to galvanise iron to prevent it from rusting.

Which statements are correct?

- 1 Galvanising is an example of a barrier method.
- 2 If the zinc is scratched, the iron will rust very quickly.
- 3 Galvanising is an example of sacrificial protection.
- 4 Zinc is more reactive than iron and so accepts electrons more readily.

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

28 Which equation represents a reaction that occurs in a blast furnace during the extraction of iron from hematite?

- A $\text{Ca} + \text{CO}_2 \rightarrow \text{CaO} + \text{CO}$
- B $\text{Fe}_2\text{O}_3 + 3\text{Ca} \rightarrow 2\text{Fe} + 3\text{CaO}$
- C $\text{Ca}(\text{OH})_2 \rightarrow \text{CaO} + \text{H}_2\text{O}$
- D $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$

29 Water is added separately to anhydrous copper(II) sulfate and to anhydrous cobalt(II) chloride.

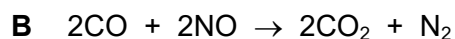
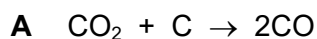
Which row shows the colour changes?

	anhydrous copper(II) sulfate	anhydrous cobalt(II) chloride
A	blue to white	blue to pink
B	blue to white	pink to blue
C	white to blue	blue to pink
D	white to blue	pink to blue

30 Gases which cause acid rain form in car engines.

These gases can be removed using a catalytic converter.

Which equation represents the removal of one of these gases using a catalytic converter?



31 Which statements about carbon dioxide are correct?

- 1 Carbon dioxide absorbs thermal energy from the Earth.
- 2 Carbon dioxide increases the thermal energy loss to space.
- 3 The level of carbon dioxide in the atmosphere has increased due to the burning of fossil fuels.
- 4 Carbon dioxide is the only gas that causes global warming.

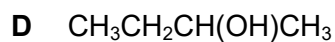
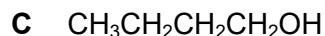
A 1 and 2

B 1 and 3

C 2 and 3

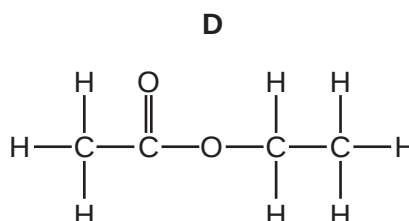
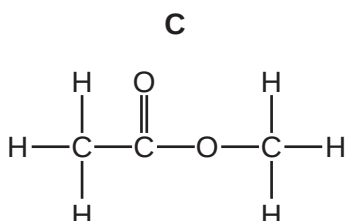
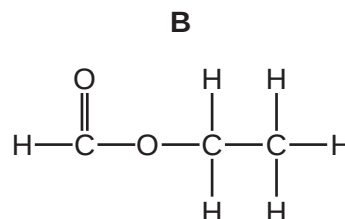
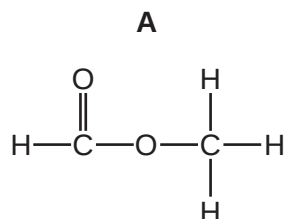
D 2 and 4

32 What is the structural formula of butan-2-ol?



33 Methanol reacts with ethanoic acid to form an ester.

What is the displayed formula for this ester?



34 Petroleum can be separated into useful fractions by fractional distillation.

Which row shows a correct use of the named fraction?

	fraction	use
A	bitumen	lubricant
B	naphtha	fuel for home heating
C	kerosene	jet fuel
D	refinery gas	making chemicals

35 Ethane reacts with chlorine in the presence of ultraviolet light.

Which products are formed?

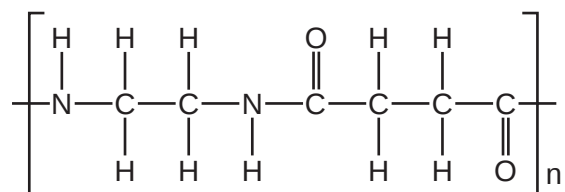
- A** $\text{ClCH}_2\text{CH}_2\text{Cl}$ and H_2
- B** $2\text{CH}_3\text{Cl}$ and H_2
- C** $\text{C}_2\text{H}_5\text{Cl}$ and HCl
- D** $\text{CH}_2=\text{CH}_2$ and 2HCl

- 36** Ethanol can be made by the fermentation of aqueous glucose and by the catalytic addition of steam to ethene.

What are two advantages of making ethanol by the catalytic addition of steam to ethene rather than by the fermentation of aqueous glucose?

- A** faster reaction and renewable raw materials
- B** purer product and faster reaction
- C** renewable raw materials and continuous process
- D** uses more energy and forms a purer product

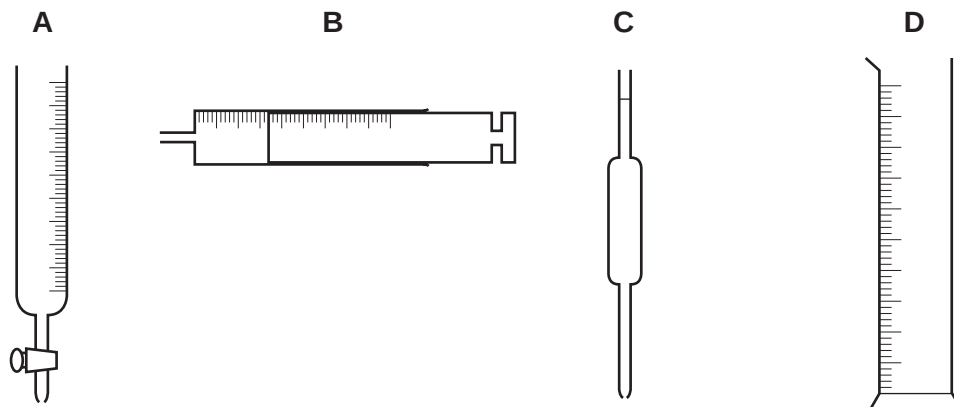
- 37** The structure of a polymer repeat unit is shown.



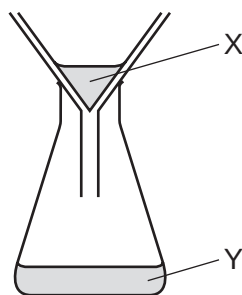
Which pair of monomers is used to make this polymer?

	monomer 1	monomer 2
A	$\begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{N}- & \text{C}- & \text{C}- & \text{N} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array}$	$\begin{array}{c} \text{H}-\text{O} \quad \text{O}-\text{H} \\ \quad \\ \text{C}-\text{C} \\ \quad \\ \text{O} \quad \text{O} \end{array}$
B	$\begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{N}- & \text{C}- & \text{C}- & \text{N} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array}$	$\begin{array}{ccccccc} \text{H}-\text{O} & & \text{H} & & \text{H} & & \text{O}-\text{H} \\ & & & & & & \\ \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{C} \\ & & & & & & \\ \text{O} & & \text{H} & & \text{H} & & \text{O} \end{array}$
C	$\begin{array}{ccccccc} \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & & & \\ \text{N}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{N} \\ & & & & & & \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array}$	$\begin{array}{c} \text{H}-\text{O} \quad \text{O}-\text{H} \\ \quad \\ \text{C}-\text{C} \\ \quad \\ \text{O} \quad \text{O} \end{array}$
D	$\begin{array}{ccccccc} \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & & & \\ \text{N}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{N} \\ & & & & & & \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array}$	$\begin{array}{ccccccc} \text{H}-\text{O} & & \text{H} & & \text{H} & & \text{O}-\text{H} \\ & & & & & & \\ \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{C} \\ & & & & & & \\ \text{O} & & \text{H} & & \text{H} & & \text{O} \end{array}$

38 Which item of apparatus is used to measure exactly 26.3 cm^3 of a liquid?



39 A mixture containing an aqueous salt and an insoluble salt is filtered.



Which row describes X and Y?

	X	Y
A	solute	pure water
B	solute	filtrate
C	residue	pure water
D	residue	filtrate

40 Pure ethanol has a melting point of -114°C and a boiling point of 78°C .

What are the melting and boiling points of a sample of ethanol with glucose dissolved in it?

	melting point/ $^\circ\text{C}$	boiling point/ $^\circ\text{C}$
A	-116	77
B	-116	79
C	-112	77
D	-112	79

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