



Cambridge IGCSE™

CHEMISTRY

Paper 2 Multiple Choice (Extended)

0620/22

February/March 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

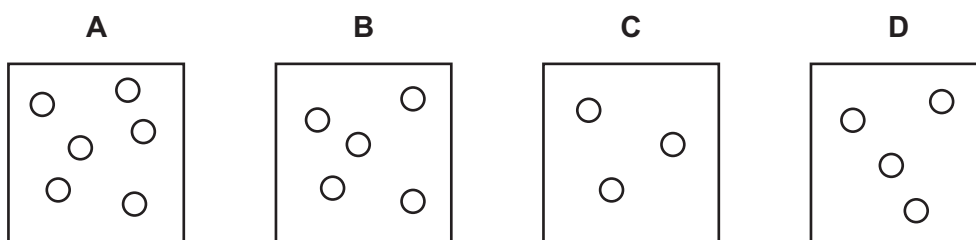
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

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

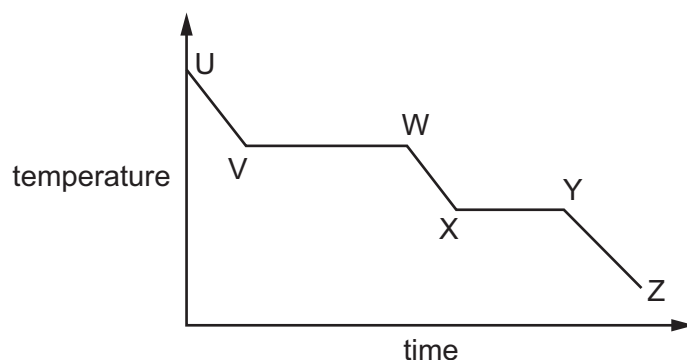


- 1 The diagrams show containers of gas at the same temperature. All containers have the same size.

Which container contains gas at the highest pressure?



- 2 A cooling curve for a substance is shown.



Which statement is correct?

- A Between U and V, the substance is condensing.
 - B Between V and W, heat is being absorbed from the surroundings.
 - C Between W and X, the particles are close together and randomly arranged.
 - D Between Y and Z, the substance is changing from a liquid to a solid.
- 3 Samples of four gases are released in a room at the same time.

The gases are carbon dioxide, CO_2 , hydrogen chloride, HCl , hydrogen sulfide, H_2S , and nitrogen dioxide, NO_2 .

Which gas diffuses fastest?

- A carbon dioxide
- B hydrogen chloride
- C hydrogen sulfide
- D nitrogen dioxide

- 4 Sulfur atoms can form the negative ion S^{2-} .

Three other atoms or ions are listed.

- argon, Ar
- calcium, Ca
- oxide, O^{2-}

How many of these atoms or ions have the same electronic configuration as S^{2-} ?

- A** 0 **B** 1 **C** 2 **D** 3

- 5 Element T has two isotopes, $^{12}_6T$ and $^{14}_6T$.

Which statement about these isotopes is correct?

- A** They have different chemical properties because they have different numbers of neutrons.
- B** They have the same chemical properties because they have the same number of outer shell electrons.
- C** They have the same nucleon number because the sum of the number of protons and electrons is the same.
- D** They have different positions in the Periodic Table because they have different numbers of neutrons.

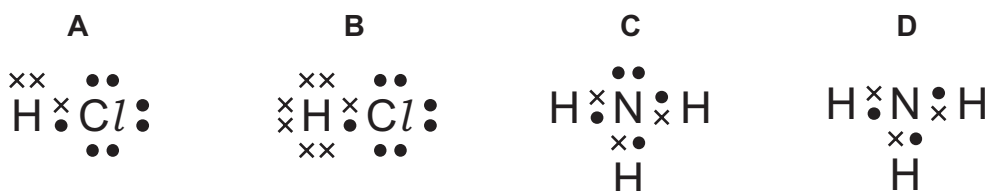
- 6 Lithium is in Group I of the Periodic Table. Nitrogen is in Group V of the Periodic Table.

Lithium reacts with nitrogen to form the ionic compound lithium nitride, Li_3N .

What happens to the electrons when lithium atoms and nitrogen atoms form ions?

	lithium	nitrogen
A	each lithium atom loses one electron to form an Li^+ ion	each nitrogen atom gains three electrons to form an N^{3-} ion
B	each lithium atom loses one electron to form an Li^+ ion	each nitrogen atom gains five electrons to form an N^{5-} ion
C	each lithium atom gains one electron to form an Li^- ion	each nitrogen atom loses three electrons to form an N^{3+} ion
D	each lithium atom gains one electron to form an Li^- ion	each nitrogen atom loses five electrons to form an N^{5+} ion

- 7 For which covalent compound does the dot-and-cross diagram correctly show the outer shell electrons?



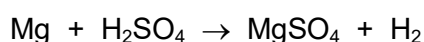
- 8 Which row identifies the positive and the negative particles present in a giant metallic lattice?

	positive particles	negative particles
A	anions	cations
B	anions	delocalised electrons
C	cations	anions
D	cations	delocalised electrons

- 9 Which formula for the named compound is correct?

- A** calcium oxide, CaO
B cobalt(II) chloride, Co_2Cl
C sulfur dioxide, S_2O_2
D anhydrous copper(II) sulfate, $\text{Cu}(\text{SO}_4)_2$

- 10 The equation for the reaction of magnesium with dilute sulfuric acid is shown.



[M_r : MgSO_4 , 120]

Which mass of magnesium sulfate is formed when 12 g of magnesium completely reacts with dilute sulfuric acid?

- A** 5g **B** 10g **C** 60g **D** 120g

- 11 An organic compound, Q, contains carbon, hydrogen and oxygen only.

Q contains 40.0% carbon and 6.7% hydrogen by mass.

What is the empirical formula of Q?

- A** CHO **B** CH_2O **C** C_2HO_2 **D** $\text{C}_3\text{H}_6\text{O}_3$

- 12 The value of the Avogadro constant is 6.02×10^{23} .

What is the total number of atoms in 2.00 mol of ammonia gas?

- A** 1.20×10^{24} **B** 2.41×10^{24} **C** 4.82×10^{24} **D** 2.89×10^{25}

- 13 Three aqueous solutions, L, M and N, are electrolysed using inert electrodes.

L is concentrated hydrochloric acid.

M is concentrated aqueous sodium chloride.

N is dilute aqueous sodium chloride.

Which solutions produce a pale yellow-green gas at the anode?

- A** L and M **B** L only **C** M and N **D** N only

- 14 Dilute sulfuric acid is electrolysed using inert electrodes.

What are the ionic half-equations for the reactions that take place at each electrode?

	positive electrode	negative electrode
A	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$
B	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	$4\text{OH}^- + 4\text{H}^+ \rightarrow 4\text{H}_2\text{O}$
C	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
D	$4\text{OH}^- + 4\text{H}^+ \rightarrow 4\text{H}_2\text{O}$	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$

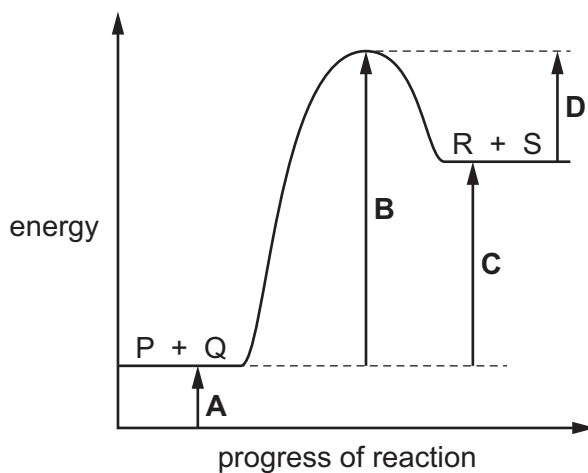
- 15 Which statements about hydrogen–oxygen fuel cells are correct?

- 1 They convert chemical energy into electrical energy.
- 2 Hydrogen is reduced in the fuel cells.
- 3 They do **not** produce any atmospheric pollutants.

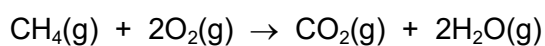
- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

- 16 The reaction pathway diagram for the reaction between P and Q to form R and S is shown.

Which letter represents the enthalpy change for the reaction?



- 17 The equation for the complete combustion of methane is shown.



The table shows some bond energies.

bond	bond energy in kJ/mol
C–H	410
C=O	805
O=O	496
O–H	460

What is the enthalpy change for this reaction?

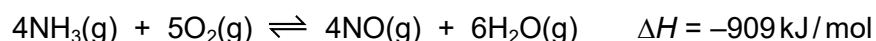
- A** –1458 kJ/mol
B –818 kJ/mol
C –359 kJ/mol
D +102 kJ/mol
- 18 Which change is a physical change?
- A** cracking an alkane
B evaporating ethanol
C fermenting glucose
D neutralising an acid

19 Which statements explain why increasing the temperature in a reaction involving gases increases the rate of reaction?

- 1 It increases the collision frequency between the gas particles.
- 2 It lowers the activation energy.
- 3 It increases the kinetic energy of the gas particles.
- 4 It increases the number of gas particles per unit volume.

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

20 The equation for the reaction between ammonia and oxygen is shown.

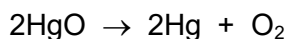


Which two changes to the reaction conditions will **both** move the position of equilibrium to the right?

	change 1	change 2
A	increasing the temperature	decreasing the pressure
B	increasing the temperature	increasing the pressure
C	decreasing the temperature	increasing the pressure
D	decreasing the temperature	decreasing the pressure

21 Mercury(II) oxide, HgO , decomposes when heated.

The equation is shown.



Why is this a reduction reaction?

- A The products weigh less than the reactants.
- B There are fewer reactants than products.
- C There is a gain of oxygen.
- D There is a loss of oxygen.

22 Some information about two dilute acids is shown.

dilute acid	acid concentration in mol/dm ³	pH
nitric acid	0.1	1.0
propanoic acid	0.4	2.6

Three statements about the acids are listed.

- 1 Nitric acid has a lower pH because it dissociates more than propanoic acid.
- 2 Propanoic acid has a lower concentration of hydrogen ions than nitric acid.
- 3 Propanoic acid has a higher pH because it has a higher concentration.

Which statements are correct?

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

23 Element E is a metal in Group I of the Periodic Table and element G is a non-metal in Group VII. Both of these elements form oxides.

Which statement about their oxides is correct?

- A** Both oxides are acidic.
B Both oxides are basic.
C The oxide of E is acidic and the oxide of G is basic.
D The oxide of G is acidic and the oxide of E is basic.

24 Lead(II) sulfate is an insoluble salt.

Which method is suitable for obtaining pure solid lead(II) sulfate?

- A** Mix aqueous lead(II) nitrate and aqueous potassium sulfate, heat to evaporate all of the water, collect the solid and then wash and dry it.
B Mix aqueous lead(II) nitrate and aqueous potassium sulfate, filter, collect the filtrate, crystallise, then wash and dry the crystals.
C Mix aqueous lead(II) nitrate and dilute sulfuric acid, filter, then wash and dry the residue.
D Titrate aqueous lead(II) hydroxide with dilute sulfuric acid, crystallise, then wash and dry the crystals.

25 The elements oxygen and sulfur are in the same group of the Periodic Table.

Which statement about oxygen and sulfur is **not** correct?

- A** They are non-metals.
- B** They have giant covalent structures.
- C** They have six electrons in the outer electron shells of their atoms.
- D** They react together to form an acidic oxide.

26 Tennessine, Ts, is at the bottom of Group VII of the Periodic Table.

What are the predicted properties of tennessine at room temperature?

- A** a black solid, more dense than iodine
- B** a black solid, more reactive than iodine
- C** a colourless gas, less dense than chlorine
- D** a colourless gas, less reactive than chlorine

27 An example of sacrificial protection is the fitting of zinc blocks to the outside of a ship's steel hull.

Which statement explains why zinc is used to protect the iron in the steel from rusting?

- A** Zinc is more reactive than iron so it loses electrons more easily.
- B** Zinc is less reactive than iron so it loses electrons more easily.
- C** Zinc is more reactive than iron so it gains electrons more easily.
- D** Zinc is less reactive than iron so it gains electrons more easily.

28 Which statement about alloys is correct?

- A** Alloys are harder than pure metals because they contain strong intermolecular forces.
- B** Brass is an alloy containing mainly copper and tin.
- C** The different-sized atoms in an alloy mean that the layers **cannot** easily slide over each other.
- D** There are no alloys containing carbon because carbon is a non-metal.

29 Separate pieces of aluminium foil and copper foil are heated in air.

The copper foil reacts to give a black solid.

The aluminium foil does **not** react.

Which statement explains these observations?

- A** Aluminium has an unreactive layer, but copper does **not**.
- B** Aluminium is below copper in the reactivity series.
- C** Copper reacts with moisture in the air, but aluminium does **not**.
- D** Copper reacts with nitrogen in the air, but aluminium does **not**.

30 Which row gives the symbol equation for the formation of carbon monoxide and for the reduction of iron(III) oxide in a blast furnace?

	equation for the formation of carbon monoxide	equation for the reduction of iron(III) oxide
A	$2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$	$\text{FeO} + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$
B	$\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$	$\text{FeO} + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$
C	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$
D	$\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$

31 A sample of river water contains a high concentration of nitrates from fertilisers.

Which statements about the river water are correct?

- 1 It has a boiling point of 100 °C.
- 2 Its melting point is below 0 °C.
- 3 It turns anhydrous cobalt(II) chloride from pink to blue.
- 4 It turns anhydrous copper(II) sulfate from white to blue.

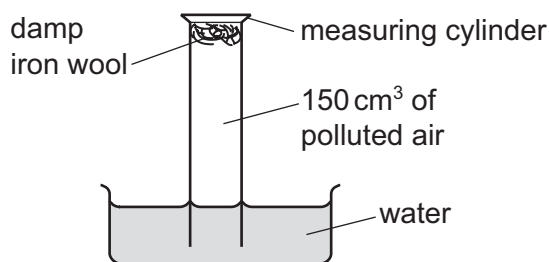
- A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

32 Which statements about the treatment of domestic water supplies are correct?

- 1 The water undergoes sedimentation to remove dissolved solids.
- 2 The water is filtered to remove insoluble solids.
- 3 The water is treated with carbon to improve the taste.
- 4 The water is chlorinated to decrease the pH.

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

- 33 An experiment to find the percentage of oxygen in 150 cm^3 of polluted air is shown.



The apparatus is left for one week.

After this time, the volume of gas in the measuring cylinder is 122 cm^3 .

What is the percentage of oxygen, to the nearest whole number, in the polluted air?

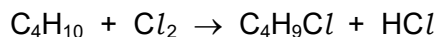
- A** 19% **B** 21% **C** 28% **D** 81%
- 34 Nitrogen monoxide, NO, and carbon monoxide, CO, are both removed from the exhaust gases of a car by a catalytic converter.
- Which statement describes how nitrogen monoxide and carbon monoxide are removed by a catalytic converter?
- A** Nitrogen monoxide and carbon monoxide are both reduced.
B Nitrogen monoxide and carbon monoxide are both oxidised.
C Nitrogen monoxide is oxidised and carbon monoxide is reduced.
D Nitrogen monoxide is reduced and carbon monoxide is oxidised.
- 35 Propan-1-ol is oxidised by acidified aqueous potassium manganate(VII) in a similar way to ethanol.

Which compound is produced by the oxidation of propan-1-ol with acidified aqueous potassium manganate(VII)?

- A** $\text{CH}_3\text{CH}_2\text{OH}$
B $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
C CH_3COOH
D $\text{CH}_3\text{CH}_2\text{COOH}$

36 The structural formula of methyl propane is $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_3$.

The equation represents the reaction of methyl propane with chlorine.



How many structural isomers with the molecular formula $\text{C}_4\text{H}_9\text{Cl}$ can be formed from this reaction?

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

37 Which statements describe disadvantages of manufacturing ethanol by fermentation?

- 1 The process uses a renewable resource.
- 2 The process produces impure ethanol.
- 3 The process requires a high temperature.
- 4 The process is slow.

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

38 Nylon is made in a polymerisation reaction.

Which row describes the type of polymerisation and identifies the other product of the reaction?

	type of polymerisation	other product
A	addition	water
B	addition	none
C	condensation	water
D	condensation	none

39 Which ion forms a green precipitate with aqueous sodium hydroxide that dissolves in an excess of aqueous sodium hydroxide?

- A** Ca^{2+} **B** Cr^{3+} **C** Cu^{2+} **D** Fe^{2+}

- 40** A mixture of soluble substances can be separated by paper chromatography. Each substance can be identified using its R_f value.

Which formula shows how the R_f value is calculated?

- A** $R_f = \frac{\text{distance travelled by solvent}}{\text{distance travelled by substance}}$
- B** $R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$
- C** $R_f = \text{distance travelled by solvent} - \text{distance travelled by substance}$
- D** $R_f = \text{distance travelled by solvent} \times \text{distance travelled by substance}$

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The Periodic Table of Elements

Group																							
I	II											III	IV	V	VI	VII	VIII						
		1Hhydrogen1																					
		Key atomic number atomic symbol name relative atomic mass																					
3Li lithium 7	4Be beryllium 9																	5B boron 11	6C carbon 12	7N nitrogen 14	8O oxygen 16	9F fluorine 19	2He helium 4
11Na sodium 23	12Mg magnesium 24																	13Al aluminium 27	14Si silicon 28	15P phosphorus 31	16S sulfur 32	17Cl chlorine 35.5	18Ar argon 40
19K potassium 39	20Ca calcium 40	21Sc scandium 45	22Ti titanium 48	23V vanadium 51	24Cr chromium 52	25Mn manganese 55	26Fe iron 56	27Co cobalt 59	28Ni nickel 59	29Cu copper 64	30Zn zinc 65	31Ga gallium 70	32Ge germanium 73	33As arsenic 75	34Se selenium 79	35Br bromine 80	36Kr krypton 84						
37Rb rubidium 85	38Sr strontium 88	39Y yttrium 89	40Zr zirconium 91	41Nb niobium 93	42Mo molybdenum 96	43Tc technetium —	44Ru ruthenium 101	45Rh rhodium 103	46Pd palladium 106	47Ag silver 108	48Cd cadmium 112	49In indium 115	50Sn tin 119	51Sb antimony 122	52Te tellurium 128	53I iodine 127	54Xe xenon 131						
55Cs caesium 133	56Ba barium 137	57–71lanthanoids	72Hf hafnium 178	73Ta tantalum 181	74W tungsten 184	75Re rhenium 186	76Os osmium 190	77Ir iridium 192	78Pt platinum 195	79Au gold 197	80Hg mercury 201	81Tl thallium 204	82Pb lead 207	83Bi bismuth 209	84Po polonium —	85At astatine —	86Rn radon —						
87Fr francium —	88Ra radium —	89–103actinoids	104Rf rutherfordium —	105Db dubnium —	106Sg seaborgium —	107Bh bohrium —	108Hs hassium —	109Mt meitnerium —	110Ds darmstadtium —	111Rg roentgenium —	112Cn copernicium —	113Nh nihonium —	114Fl flerovium —	115Mc moscovium —	116Lv livermorium —	117Ts tennessine —	118Og oganesson —						
lanthanoids		57La lanthanum 139	58Ce cerium 140	59Pr praseodymium 141	60Nd neodymium 144	61Pm promethium —	62Sm samarium 150	63Eu europium 152	64Gd gadolinium 157	65Tb terbium 159	66Dy dysprosium 163	67Ho holmium 165	68Er erbium 167	69Tm thulium 169	70Yb ytterbium 173	71Lu lutetium 175							
actinoids		89Ac actinium —	90Th thorium 232	91Pa protactinium 231	92U uranium 238	93Np neptunium —	94Pu plutonium —	95Am americum —	96Cm curium —	97Bk berkelium —	98Cf californium —	99Es einsteinium —	100Fm fermium —	101Md mendelevium —	102No nobelium —	103Lr lawrencium —							

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).