Cambridge Assessment International Education

Cambridge IGCSE™

CHEMISTRY **0620/22**

Paper 2 Multiple Choice (Extended) **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)

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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

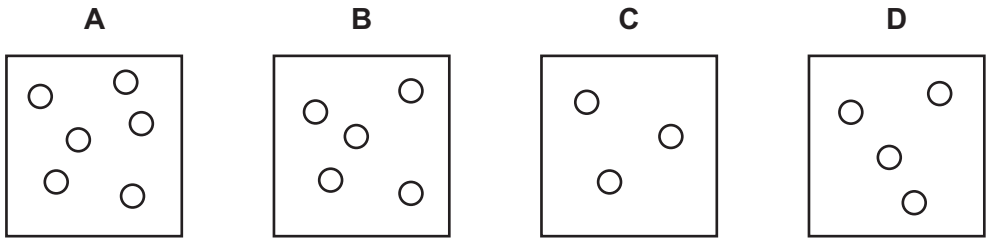
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

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

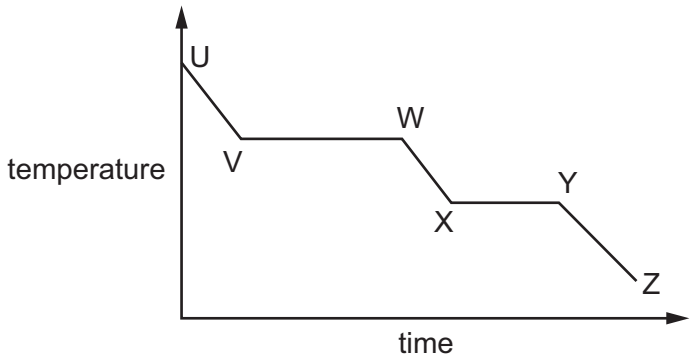
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1 The diagrams show containers of gas at the same temperature. All containers have the same size.

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

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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, $^{12}_{6}T$ and $^{14}_{6}T$.

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.

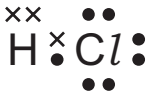
What happens to the electrons when lithium atoms and nitrogen atoms form ions?

	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

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

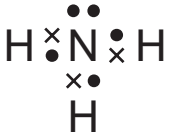
A



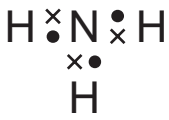
B



C



D



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, $Co_2C\ell$

C sulfur dioxide, S_2O_2

D anhydrous copper(II) sulfate, $Cu(SO_4)_2$

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

$$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$$

[M_r: $MgSO_4$, 120]

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

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

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** $C_3H_6O_3$

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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	$2H^+ + 2e^- \rightarrow H_2$	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$
B	$2H^+ + 2e^- \rightarrow H_2$	$4OH^- + 4H^+ \rightarrow 4H_2O$
C	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$	$2H^+ + 2e^- \rightarrow H_2$
D	$4OH^- + 4H^+ \rightarrow 4H_2O$	$2H^+ + 2e^- \rightarrow H_2$

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

1 They convert chemical energy into electrical energy.

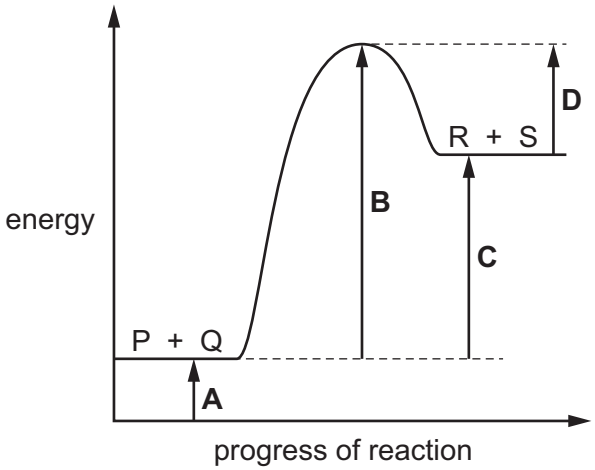
2 Hydrogen is reduced in the fuel cells.

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.

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

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

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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.

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H = -909\,kJ/mol$$

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.

$$2HgO \rightarrow 2Hg + O_2$$

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.

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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.

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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.

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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	$2C + O_2 \rightarrow 2CO$	$FeO + CO \rightarrow Fe + CO_2$
B	$CO_2 + C \rightarrow 2CO$	$FeO + CO \rightarrow Fe + CO_2$
C	$C + O_2 \rightarrow CO_2$	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
D	$CO_2 + C \rightarrow 2CO$	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

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.

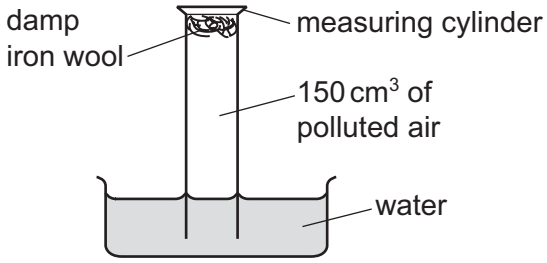
3 The water is treated with carbon to improve the taste.

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

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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 CH_3CH_2OH

B $CH_3CH_2CH_2OH$

C CH_3COOH

D CH_3CH_2COOH

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36 The structural formula of methyl propane is $CH_3CH(CH_3)CH_3$.

The equation represents the reaction of methyl propane with chlorine.

$$C_4H_{10} + Cl_2 \rightarrow C_4H_9Cl + HCl$$

How many structural isomers with the molecular formula C_4H_9Cl 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+}

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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 $R_f = \dfrac{\text{distance travelled by solvent}}{\text{distance travelled by substance}}$

B $R_f = \dfrac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$

C R_f = distance travelled by solvent – distance travelled by substance

D R_f = distance travelled by solvent $\times$ distance travelled by substance

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							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											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

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.).