Cambridge Assessment International Education

Cambridge O Level

CHEMISTRY **5070/12**

Paper 1 Multiple Choice **May/June 2023**

1 hour

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 A sample of iodine is at room temperature and pressure.

Which statement about the particles in the sample is correct?

A The particles are arranged in a giant lattice.

B The particles have zero kinetic energy.

C The particles move randomly through the solid.

D The particles vibrate about a fixed point.

2 Element Z, nucleon number 31, forms an ion Z^{3-}.

Where is Z found in the Periodic Table?

A Group III

B Group V

C Period 4

D Period 5

3 Naturally occurring bromine has a relative atomic mass of 80 and consists entirely of two isotopes of relative atomic masses 79 and 81.

What can be deduced about naturally occurring bromine from this information only?

A Bromine contains the two isotopes in equal proportions.

B Bromine has different oxidation states.

C Bromine isotopes have different numbers of protons.

D Bromine is radioactive.

4 Element X and element Y react together to form a compound.

The electronic configurations of X and Y are X = 2,8,3 and Y = 2,6.

Which row shows the electron transfer that takes place and the type of compound formed?

	element X	element Y	type of compound
A	2 atoms each lose 3 electrons	3 atoms each receive 2 electrons	covalent
B	2 atoms each lose 3 electrons	3 atoms each receive 2 electrons	ionic
C	2 atoms each receive 3 electrons	3 atoms each lose 2 electrons	covalent
D	2 atoms each receive 3 electrons	3 atoms each receive 2 electrons	ionic

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5 Which molecule has the **largest** number of electrons involved in covalent bonds?

A C_2H_4 **B** CO_2 **C** CH_3OH **D** N_2

6 X is the arrangement of bonds around a carbon atom in graphite.

Y is the arrangement of bonds around a carbon atom in diamond.

Z is the arrangement of bonds around a silicon atom in silicon(IV) oxide, SiO_2.

Which arrangements of bonds are the same?

A X and Y only **B** X and Z only **C** Y and Z only **D** X, Y and Z

7 What is the equation for the reaction between sodium carbonate and dilute nitric acid?

A $NaCO_3 + H_2NO_3 \rightarrow NaNO_3 + H_2O + CO_2$

B $NaCO_3 + 2HNO_3 \rightarrow NaNO_3 + H_2O + CO_2$

C $Na_2CO_3 + H_2NO_3 \rightarrow Na_2NO_3 + H_2O + CO_2$

D $Na_2CO_3 + 2HNO_3 \rightarrow 2NaNO_3 + H_2O + CO_2$

8 Which statements about relative atomic mass and relative molecular mass are correct?

1 The mass of the different isotopes does **not** affect relative atomic masses.

2 Only covalent compounds have a relative molecular mass.

3 Relative atomic masses are compared to $\frac{1}{12}$ of the mass of one atom of ^{12}C.

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

9 Aqueous hydrogen peroxide, H_2O_2, decomposes slowly at 25 °C.

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

The decomposition reaction takes place faster when a catalyst is added.

A student adds a small amount of catalyst to 10 cm^3 of 1.0 mol / dm^3 $H_2O_2(aq)$ and collects the gas formed. The volume of gas collected is 90 cm^3.

All measurements are at room temperature and pressure.

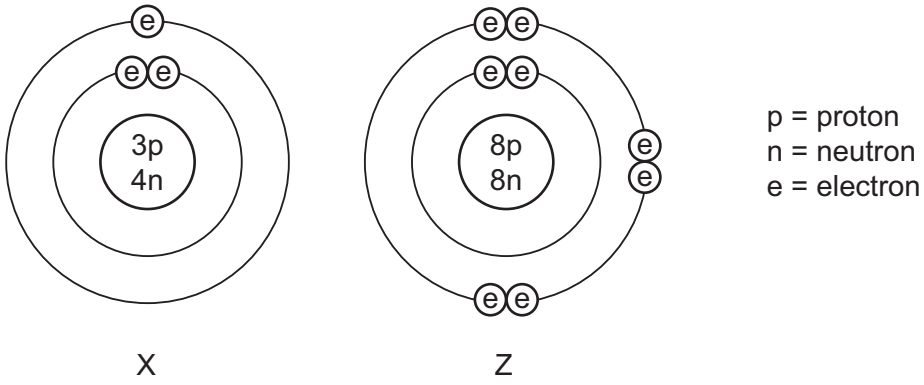
What is the percentage yield of $O_2(g)$?

A 28.1% **B** 37.5% **C** 56.3% **D** 75.0%

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10 The diagram shows the structures of the atoms of two elements, X and Z.

X and Z are **not** the atomic symbols for these elements.



The elements combine to form a compound.

What is the mass of one mole of this compound?

A 11 g **B** 12 g **C** 23 g **D** 30 g

11 Which compound contains 45.2% nitrogen by mass?

[A_r: C, 12; H, 1; N, 14]

A ethane-1,2-diamine, $NH_2C_2H_4NH_2$

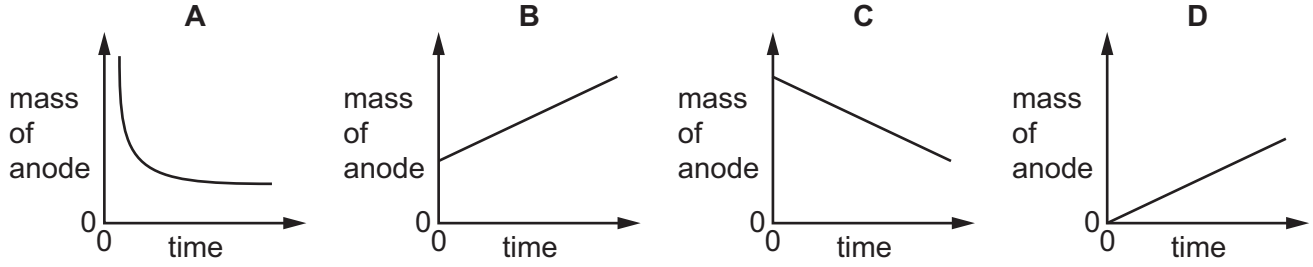
B hydroxylamine, NH_2OH

C methanamide, $HCONH_2$

D methylamine, CH_3NH_2

12 Aqueous copper(II) sulfate is electrolysed using copper electrodes. The current is constant and the anode is weighed at regular time intervals.

Which graph is obtained when the mass of the anode is plotted against time?



13 What is a chemical product of a hydrogen–oxygen fuel cell?

A electricity

B hydrogen

C oxygen

D water

14 Hydrogen can be produced by reacting methane with steam.

$$CH_4 + 2H_2O \rightarrow CO_2 + 4H_2$$

Using the bond energies in the table, what is the enthalpy change of reaction, ΔH?

bond	bond energy in kJ / mol
C–H	435
O–H	463
H–H	436
C=O	805

A –620 kJ / mol

B –238 kJ / mol

C +238 kJ / mol

D +620 kJ / mol

15 What is the best way of slowing down the reaction between magnesium and sulfuric acid?

A adding a catalyst to the reactants

B diluting the acid used in the reaction

C stirring the reagents

D using magnesium powder instead of a strip of magnesium

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16 The volume of gas produced by the reaction of 100 cm^3 of hydrochloric acid with an excess of calcium carbonate is measured in two experiments.

The volumes of gas are measured at r.t.p. and the results are shown.

time / s	0	30	60	90	120	150	180	300
volume of gas in experiment 1 / cm^3	0	20	30	38	44	48	50	50
volume of gas in experiment 2 / cm^3	0	30	42	55	65	70	75	75

Which **one** change in conditions to experiment 1 gives the results for experiment 2?

Assume all other conditions are unchanged.

A A greater volume of acid is added.

B A higher concentration of acid is used.

C Smaller pieces of calcium carbonate are used.

D The temperature of the acid is higher.

17 Hydrogen is made industrially by the reaction shown.

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g) \qquad \Delta H = -41\,kJ/mol$$

Statements about this industrial process are given.

1 A high pressure can be used to increase the rate of formation of hydrogen.

2 A high pressure can be used to shift the equilibrium to the right.

3 A high temperature can be used to increase the rate of formation of hydrogen.

4 A high temperature can be used to shift the equilibrium to the right.

Which statements are correct?

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

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18 The table refers to two important industrial gaseous reactions.

reaction	reactants	product	catalyst
1	hydrogen + nitrogen	ammonia	nickel
2	oxygen + sulfur dioxide	sulfur trioxide	vanadium(V) oxide

Which catalysts are correctly stated?

	reaction 1	reaction 2
A	no	no
B	no	yes
C	yes	no
D	yes	yes

19 Iron(II) ions react with chlorine.

$$2Fe^{2+}(aq) + Cl_2(g) \rightarrow 2Fe^{3+}(aq) + 2Cl^-(aq)$$

Which statement about this reaction is correct?

A Chlorine is reduced by iron(II) ions.

B Chlorine is the reducing agent.

C Iron(II) ions are reduced by chlorine.

D Iron(II) ions are the oxidising agent.

20 Which reagent and observation describes the test for a reducing agent?

	reagent	colour change
A	acidified aqueous potassium manganate(VII)	colourless to purple
B	acidified aqueous potassium manganate(VII)	purple to colourless
C	aqueous potassium iodide	colourless to purple
D	aqueous potassium iodide	purple to colourless

21 Compound X is a gas at room temperature. X dissolves in water to give a solution with a pH of 4.

Which statement about compound X is correct?

A An aqueous solution of X will **not** conduct electricity.

B Atoms of a metallic element are present in X.

C Atoms of hydrogen are present in X.

D X is ionically bonded.

22 Which statement about hydrochloric acid is correct?

A Hydrochloric acid reacts with magnesium carbonate to form three different products.

B Hydrochloric acid reacts with magnesium to form magnesium chloride and water.

C When hydrochloric acid is added to a colourless solution of thymolphthalein, it turns blue.

D When hydrochloric acid is warmed with ammonium chloride, ammonia is formed.

23 The addition of calcium hydroxide to soil reduces its acidity but also reduces the efficiency of fertilisers.

Which two equations explain this?

1 $Ca(OH)_2(s) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

2 $Ca(OH)_2(s) + 2H^+(aq) \rightarrow Ca^{2+}(aq) + 2H_2O(l)$

3 $Ca(OH)_2(s) + 2NH_4NO_3(aq) \rightarrow Ca(NO_3)_2(aq) + 2NH_3(g) + 2H_2O(l)$

4 $Ca(OH)_2(s) + Cu^{2+}(aq) \rightarrow Cu(OH)_2(s) + Ca^{2+}(aq)$

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

24 Which anions are contained in salts that are always soluble in water?

A carbonates

B chlorides

C nitrates

D sulfates

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25 The element phosphorus, P, is immediately below nitrogen in the Periodic Table.

It forms an oxide with the empirical formula P_2O_5.

From the position of phosphorus in the Periodic Table, the element is expected to be .....1..... and the bonds in its oxide to be .....2..... .

Which words correctly complete gaps 1 and 2?

	1	2
A	a metal	covalent
B	a metal	ionic
C	a non-metal	covalent
D	a non-metal	ionic

26 Which statement is correct?

A Group I elements are less reactive than the Group II element in the same period because they only need to lose one electron to have complete shells.

B Group I elements are stored under oil to avoid reaction with oxygen and water in the air.

C Group I elements become more reactive as the group is descended because the number of outer shell electrons increases.

D The melting point of Group I elements decreases as the group is descended because there is more attraction between positive ions and the 'sea' of delocalised electrons.

27 The table shows some properties of transition elements and the reasons why they have these properties.

Which row shows a correct property and the reason why transition elements show this property?

	property	reason
A	iron has two common oxidation states (I) and (II)	iron atoms can lose one or two electrons to form compounds
B	nickel can be used as a catalyst	the use of nickel raises the activation energy of the reaction
C	the reaction of aqueous sodium hydroxide with the salt of a transition element can be used to identify the element	transition metal hydroxides are often coloured
D	transition elements have high melting points	the presence of varying numbers of electrons in the 'sea' of delocalised electrons weakens the metallic lattice

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28 Which equation is correct?

A $Cu(s) + O_2(g) \rightarrow 2CuO(s)$

B $Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$

C $Na(s) + H_2O(l) \rightarrow NaO(aq) + H_2(g)$

D $2Zn(s) + 2HNO_3(aq) \rightarrow 2ZnNO_3(aq) + H_2(g)$

29 Metal X reacts with cold water to form a gas.

Zinc displaces metal Y from solutions of its salts.

The carbonate of metal Z is insoluble.

What could be the identities of X, Y and Z?

	X	Y	Z
A	sodium	magnesium	sodium
B	sodium	copper	copper
C	copper	magnesium	copper
D	sodium	copper	sodium

30 Which statement about alloys is correct?

A They are compounds of two or more metals.

B They are mixtures of metals with other metals or non-metals.

C They conduct electricity because they have ionic bonds between the metal atoms.

D They have identical physical properties to the metals they contain.

31 Pieces of magnesium can be attached to the steel hull of a ship to prevent rusting.

This is sacrificial protection.

Which statements about sacrificial protection are correct?

1 Iron atoms gain electrons and form hydrated iron(III) oxide.

2 Magnesium atoms gain electrons to form magnesium ions.

3 Magnesium is oxidised.

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

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32 Why is carbon used in water purification?

A It acts as a filter to remove insoluble solids.

B It adds oxygen to the water.

C It disinfects the water.

D It removes tastes and odours.

33 Which statement about air pollutants is correct?

A Catalytic converters in vehicles change a toxic gas into a non-toxic gas.

B Flue gas desulfurisation uses calcium nitrate.

C Photosynthesis is a process that releases carbon dioxide.

D Sulfur dioxide is responsible for photochemical smog.

34 What is the structural formula of propyl methanoate?

A $CH_3COOCH_2CH_2CH_3$

B $CH_3COOCCH_2CH_3$

C $CH_3CH_2COOCH_3$

D $CH_3CH_2CH_2OOCH$

35 Which statement about ethane is correct?

A Each ethane molecule contains exactly seven bonds, all of which are single covalent bonds.

B Ethane is a member of the homologous series of alkanes, a family of unsaturated hydrocarbons.

C The equation for the complete combustion of ethane is $C_2H_6 + 3O_2 \rightarrow 2CO_2 + 3H_2O$.

D When a molecule of ethane reacts with chlorine, one hydrogen atom is replaced by a chlorine molecule.

36 Isoprene is an alkene which is commonly found in plants.

Which properties does isoprene have?

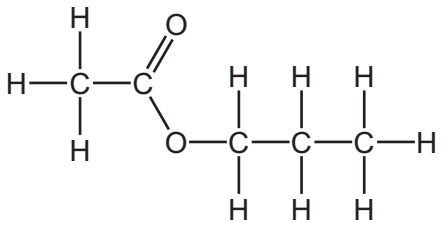
1 It burns in air.

2 It can form polymers.

3 It decolourises aqueous bromine.

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

37 The structure of an ester is shown.



Which two compounds react to form this ester?

A butan-1-ol and methanoic acid

B ethanol and propanoic acid

C propan-1-ol and ethanoic acid

D propan-1-ol and methanoic acid

38 25.0 cm^3 of 1.0 mol/dm^3 sodium hydroxide is titrated with dilute sulfuric acid, using a suitable indicator.

25.0 cm^3 of the sulfuric acid is required to reach the end-point.

What is the concentration of the sulfuric acid and which indicator is used?

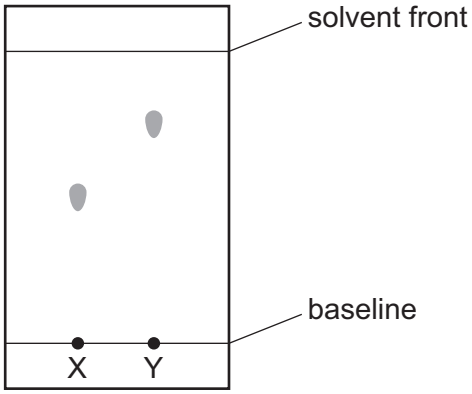
	concentration of sulfuric acid in mol/dm^3	indicator
A	0.5	methyl orange
B	0.5	universal indicator
C	2.0	methyl orange
D	2.0	universal indicator

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39 The results of a paper chromatography experiment are shown.

X is an aqueous solution of a salt of a Group I element.

Y is an aqueous solution of a salt of a transition element.

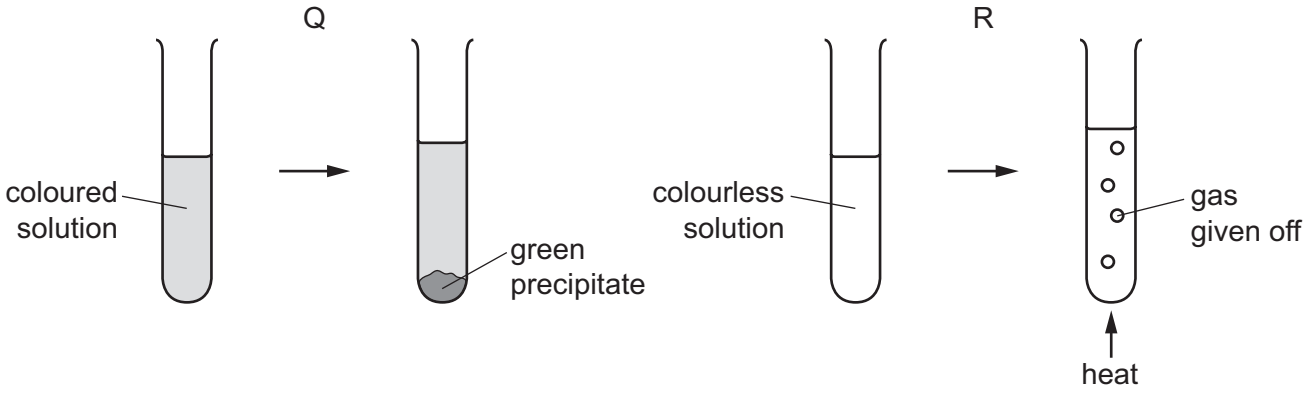


Which row is correct?

	larger R_f value	requires a locating agent
A	X	X
B	X	Y
C	Y	X
D	Y	Y

40 Aqueous sodium hydroxide is used to identify the ions present in aqueous solutions of compounds Q and R.

The results are shown.



Which row is correct?

	ion in compound Q	ion in compound R
A	Cr^{3+}	NH_4^+
B	Cu^{2+}	CO_3^{2-}
C	Fe^{2+}	CO_3^{2-}
D	Fe^{3+}	NH_4^+

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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.).