



Cambridge IGCSE™ (9–1)

CHEMISTRY

0971/12

Paper 1 Multiple Choice (Core)

May/June 2023

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 Four physical changes of ethanol are listed.

- 1 condensation
- 2 evaporation
- 3 freezing
- 4 boiling

In which changes do the particles move further apart?

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

2 Which statement explains why water is a compound?

- A** The hydrogen and oxygen atoms in a molecule of water can only be separated by chemical means.
- B** The hydrogen and oxygen atoms in a molecule of water can be separated using physical means.
- C** The number of hydrogen and oxygen atoms in a molecule of water is variable.
- D** Water has the same chemical properties as both hydrogen and oxygen.

3 An atom of element X contains:

- 5 protons
- 6 neutrons
- 5 electrons.

Which statements about element X are correct?

- 1 X has an atomic number of 6.
- 2 X has a nucleon number of 11.
- 3 X is in Group II of the Periodic Table.
- 4 X is in the second period of the Periodic Table.

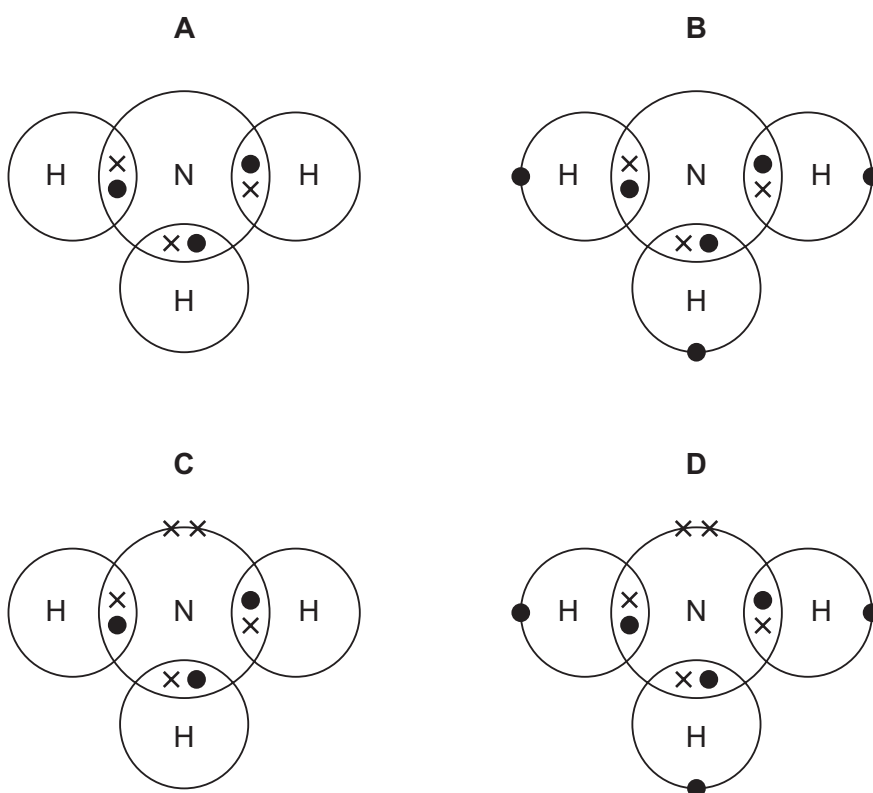
- A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

4 Which row describes properties of lithium fluoride?

| | electrical conductivity when solid | electrical conductivity when molten | melting point |
|----------|------------------------------------|-------------------------------------|---------------|
| A | does not conduct | conducts | high |
| B | does not conduct | does not conduct | low |
| C | conducts | conducts | high |
| D | conducts | does not conduct | low |

5 Ammonia, NH_3 , is a covalent molecule.

Which diagram shows the outer-shell electron arrangement in a molecule of ammonia?



6 Which substance has a giant covalent structure?

- A** ethanol
- B** graphite
- C** methane
- D** sodium chloride

7 Sodium burns in oxygen to form sodium oxide.

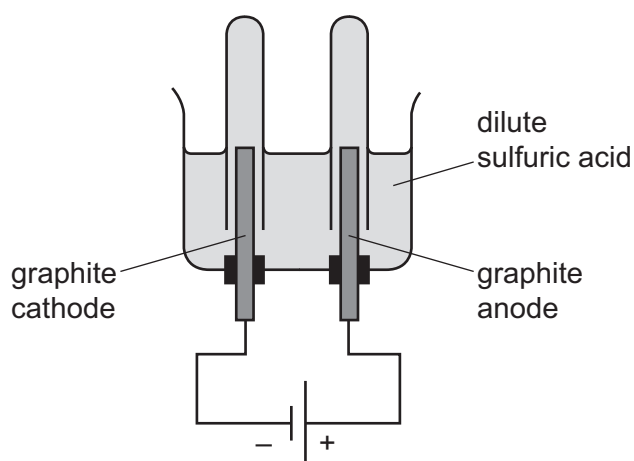
What is the balanced equation for the reaction?

- A** $4\text{Na} + 2\text{O} \rightarrow 2\text{Na}_2\text{O}$
B $4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$
C $2\text{Na}_2 + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$
D $2\text{Na}_2 + 2\text{O} \rightarrow 2\text{Na}_2\text{O}$

8 What is the relative formula mass of $\text{Mg}(\text{OH})_2$?

- A** 21 **B** 30 **C** 42 **D** 58

9 Dilute sulfuric acid is electrolysed using inert electrodes. The apparatus is set up as shown.



30 cm^3 of a gas is collected at the cathode. A different gas is collected at the anode.

Which row is correct?

| | gas at cathode | gas at anode | volume of gas collected at anode / cm^3 |
|----------|----------------|--------------|--|
| A | hydrogen | oxygen | 15 |
| B | hydrogen | oxygen | 30 |
| C | oxygen | hydrogen | 15 |
| D | oxygen | hydrogen | 30 |

10 Four statements about hydrogen fuel cells are listed.

- 1 The fuel cell converts chemical energy into electrical energy.
- 2 In the fuel cell, hydrogen combines with oxygen.
- 3 Carbon dioxide and water are produced in the fuel cell.
- 4 The hydrogen fuel is extracted from the air.

Which statements are correct?

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

11 5g of four different fuels are set alight and placed under a beaker containing 50 cm³ of water.

The temperature of the water is taken at the start and after five minutes.

Which fuel releases the most energy?

| | temperature at start /°C | temperature after five minutes /°C |
|----------|--------------------------------|--|
| A | 15 | 23 |
| B | 21 | 31 |
| C | 28 | 47 |
| D | 30 | 48 |

12 Which changes increase the rate of reaction?

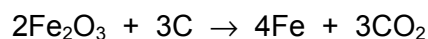
- 1 increasing the concentration of the reactants
- 2 increasing the particle size of a solid reactant
- 3 increasing the temperature

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

13 Which reaction is reversible?

- A** an iron nail rusting when left in moist air
- B** limestone reacting with an acid to form carbon dioxide gas
- C** magnesium burning in air to produce a white ash
- D** white anhydrous copper(II) sulfate turning blue when water is added

- 14 The equation for the reaction between iron(III) oxide and carbon is shown.



Which type of reaction does iron(III) oxide undergo?

- A reduction
 - B precipitation
 - C oxidation
 - D combustion
- 15 Copper(II) chloride is made when copper(II) carbonate reacts with dilute hydrochloric acid.

What are the other products in this reaction?

- A water and carbon dioxide
 - B carbon dioxide only
 - C water and hydrogen
 - D hydrogen only
- 16 Rubidium is in Group I and strontium is in Group II of the Periodic Table.
- Which row describes the nature of rubidium oxide, Rb_2O , and strontium oxide, SrO ?

| | Rb_2O | SrO |
|----------|-----------------------|--------------|
| A | acidic | acidic |
| B | acidic | basic |
| C | basic | acidic |
| D | basic | basic |

- 17 Magnesium sulfate is a soluble solid which is formed when insoluble magnesium oxide reacts with dilute sulfuric acid.

Which method is used to prepare solid magnesium sulfate?

- A Excess sulfuric acid is reacted with magnesium oxide. The mixture is evaporated to dryness.
- B Excess sulfuric acid is reacted with magnesium oxide. The precipitate is filtered, washed and dried.
- C Sulfuric acid is reacted with excess magnesium oxide. The mixture is filtered and the filtrate is evaporated to dryness.
- D Sulfuric acid is reacted with excess magnesium oxide. The precipitate is filtered, washed and dried.

18 Q and R are elements in the same period of the Periodic Table.

Q has 7 electrons in its outer shell and R has 2 electrons in its outer shell.

Which statement about Q and R is correct?

- A Q is a metal and R is a non-metal.
- B Q and R have different numbers of electron shells.
- C R is found to the right of Q in the Periodic Table.
- D The proton number of R is less than the proton number of Q.

19 Which statement about alkali metals is correct?

- A Lithium is more dense than sodium.
- B Sodium is more reactive than potassium.
- C Sodium has a higher melting point than potassium.
- D They are in Group II of the Periodic Table.

20 Aqueous bromine is added to aqueous sodium iodide.



What are the products of this reaction?

| | 1 | 2 |
|----------|--------|----------------|
| A | iodide | sodium bromide |
| B | iodide | sodium bromine |
| C | iodine | sodium bromide |
| D | iodine | sodium bromine |

21 Which row describes the properties of a transition element?

| | melting point | density | forms coloured compounds |
|----------|---------------|---------|--------------------------|
| A | high | low | no |
| B | high | high | yes |
| C | low | low | no |
| D | low | low | yes |

22 Which row describes the properties of argon?

| | property 1 | property 2 |
|----------|------------|------------|
| A | inert | diatomic |
| B | inert | monatomic |
| C | reactive | diatomic |
| D | reactive | monatomic |

23 Which row identifies the properties of zinc?

| | thermal conductivity | reacts with dilute acid |
|----------|----------------------|-------------------------|
| A | good | yes |
| B | good | no |
| C | poor | yes |
| D | poor | no |

24 Uses of metals depend on their properties.

Which property is necessary for the use given?

| | use of the metal | property of the metal |
|----------|----------------------------|-----------------------|
| A | car bodies | ductile |
| B | cutlery | conducts heat |
| C | food containers | resists corrosion |
| D | overhead electrical cables | high density |

25 Which compounds **both** contribute to acid rain?

- A** carbon monoxide and carbon dioxide
- B** carbon monoxide and oxides of nitrogen
- C** oxides of nitrogen and sulfur dioxide
- D** sulfur dioxide and carbon dioxide

26 P, Q, R and S are metals.

P reacts with dilute hydrochloric acid, forming hydrogen.

Q reacts violently with water.

R reacts with water to give hydrogen.

S is formed by heating its oxide with carbon.

Which row identifies the metals?

| | P | Q | R | S |
|----------|--------|-----------|-----------|-----------|
| A | copper | sodium | potassium | iron |
| B | zinc | magnesium | calcium | iron |
| C | zinc | sodium | calcium | magnesium |
| D | iron | potassium | sodium | zinc |

27 Which compound is formed when iron rusts?

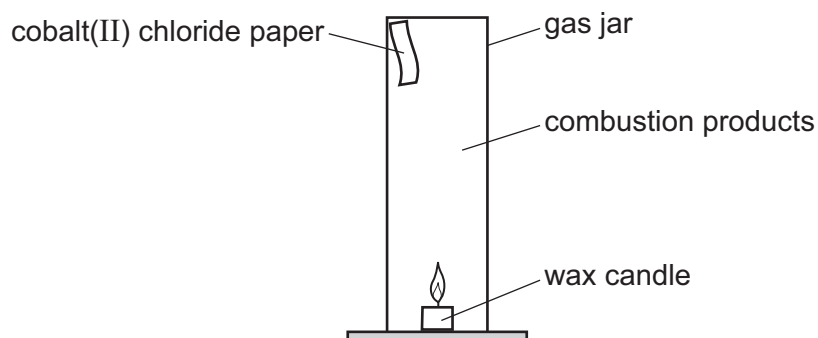
- A** anhydrous iron(II) oxide
- B** anhydrous iron(III) oxide
- C** hydrated iron(III) hydroxide
- D** hydrated iron(III) oxide

28 Which reaction in the blast furnace releases heat energy?

- A** $C + O_2 \rightarrow CO_2$
- B** $CaCO_3 \rightarrow CaO + CO_2$
- C** $CO_2 + C \rightarrow 2CO$
- D** $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

29 A wax candle is made from a mixture of hydrocarbons.

The candle is lit and placed in a gas jar along with a strip of cobalt(II) chloride test paper as shown.



After a short time, the oxygen in the jar is used up and the candle flame goes out.

Which substance does the cobalt(II) chloride paper identify?

- A carbon dioxide
- B carbon monoxide
- C sulfur dioxide
- D water

30 Urea, $\text{CO}(\text{NH}_2)_2$, is used as a fertiliser.

Which element that plants need for improved plant growth is provided by urea?

- A carbon
- B hydrogen
- C nitrogen
- D oxygen

31 The percentage composition of gases on Neptune is shown.

| gas | percentage composition / % |
|-------------|----------------------------|
| hydrogen | 80 |
| helium | 18 |
| methane | 1.5 |
| other gases | 0.5 |

Which statement about the atmospheres on Neptune and on the Earth is correct?

- A There is more helium on Neptune than oxygen on the Earth.
- B There is less methane on Neptune than carbon dioxide on the Earth.
- C There is less hydrogen on the Earth than on Neptune.
- D There is more helium on the Earth than on Neptune.

32 Which row shows the general formula for alkenes and for alcohols?

| | alkenes | alcohols |
|----------|---------------|-------------------|
| A | C_nH_{2n} | $C_nH_{2n+1}COOH$ |
| B | C_nH_{2n} | $C_nH_{2n+1}OH$ |
| C | C_nH_{2n+2} | $C_nH_{2n+1}COOH$ |
| D | C_nH_{2n+2} | $C_nH_{2n+1}OH$ |

33 A molecule has the formula C_2H_5Cl .

What is its chemical name?

- A chloroethane
- B chloroethanol
- C chloroethene
- D chloromethanol

34 Which compound rapidly decolourises aqueous bromine?

- A ethane
- B ethanoic acid
- C ethanol
- D ethene

35 Compound Z has the molecular formula C_2H_6O .

Which statement about compound Z is correct?

- A Z is unsaturated.
- B Z is a carboxylic acid.
- C Z is formed by the reaction of ethane with steam.
- D Z is used as a fuel.

36 What is the formula of the salt formed when aqueous ethanoic acid reacts with calcium carbonate?

- A $Ca(CH_3COOH)_2$
- B $Ca(CH_3COO)_2$
- C Ca_2CH_3COOH
- D Ca_2CH_3COO

37 Rock salt is a mixture of salt and sand.

The method used to separate the sand from the salt is listed.

step 1 Crush the rock salt, add to warm water and stir.

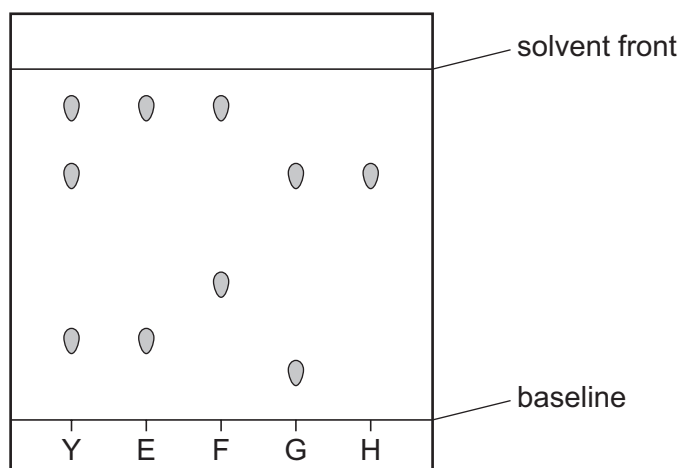
step 2 Pour the mixture through a filter paper held in a funnel.

step 3 Evaporate the water to crystallise the salt.

Which statement about the method is correct?

- A The filtrate in step 2 is pure water.
- B The residue in step 2 is pure crystals of salt.
- C The solute is salt.
- D The solvent is a mixture of salt and water.

- 38 Chromatography is carried out on mixture Y and dyes E, F, G and H. The chromatogram is shown.



Which dyes are present in mixture Y?

- A** E and G **B** E and H **C** F and G **D** F and H
- 39 A fractionating column is used to separate the hydrocarbon fractions in petroleum by fractional distillation.

Which row describes the properties of the fractions that condense at the top of the fractionating column?

| | size of molecule | boiling point |
|----------|------------------|---------------|
| A | large | high |
| B | large | low |
| C | small | high |
| D | small | low |

- 40 When acid is added to salt X, a gas is produced which turns limewater milky.

When sodium hydroxide is added to salt X, a gas is produced which turns litmus paper blue.

What is X?

- A** CaCO_3 **B** $(\text{NH}_4)_2\text{CO}_3$ **C** NH_4NO_3 **D** ZnCO_3

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The Periodic Table of Elements

| | | Group | | | | | | | | | | | | | | | |
|----------------------------|-----------------------------|----------------------------|---------------------------------|--|------------------------------|-----------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|------------------------------|-----------------------------|
| I | II | III | IV | V | VI | VII | VIII | | | | | | | | | | |
| 3 Li lithium 7 | 4 Be beryllium 9 | 11 Na sodium 23 | 12 Mg magnesium 24 | <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> Key atomic number atomic symbol name relative atomic mass </div> | | | | | | | | | | | | | |
| 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 — |

| |
|-------------------------|
| 1 H hydrogen 1 |
|-------------------------|

| |
|--|
| 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 dm³ at room temperature and pressure (r.t.p.).