



Cambridge IGCSE™ (9–1)

CHEMISTRY**0971/22**

Paper 2 Multiple Choice (Extended)

October/November 2021**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

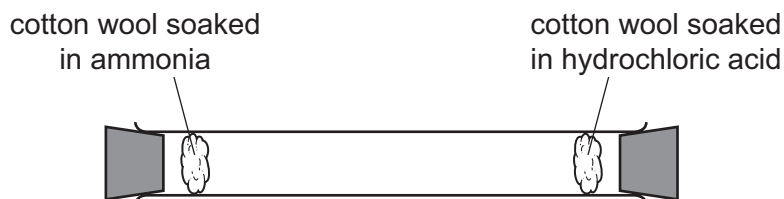
- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple 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

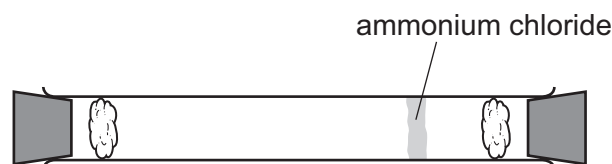
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

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

- 1 An experiment is set up as shown.



After several minutes, a white ring of ammonium chloride appears as shown.



Which statement explains the observation after several minutes?

- A Ammonia gas diffuses faster than hydrogen chloride gas because its molecules have a lower molecular mass.
 - B Ammonia gas diffuses faster than hydrogen chloride gas because its molecules have a higher molecular mass.
 - C Ammonia gas diffuses slower than hydrogen chloride gas because its molecules have a lower molecular mass.
 - D Ammonia gas diffuses slower than hydrogen chloride gas because its molecules have a higher molecular mass.
- 2 A student put exactly 25.00 cm^3 of dilute hydrochloric acid into a conical flask.

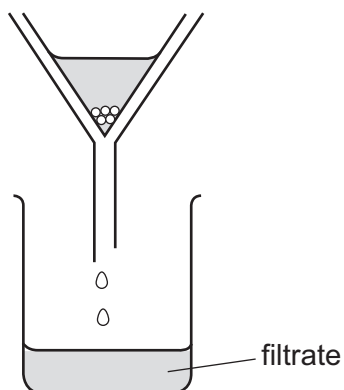
The student added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to use?

- A balance, measuring cylinder, thermometer
- B balance, pipette, stopwatch
- C balance, pipette, thermometer
- D burette, pipette, thermometer

3

- 3 A student separates sugar from pieces of broken glass by dissolving the sugar in water and filtering off the broken glass.



What is the filtrate?

- A** broken glass only
B broken glass and sugar solution
C pure water
D sugar solution
- 4 How many protons, neutrons and electrons are there in one atom of the isotope ${}_{13}^{27}\text{Al}$?

| | protons | neutrons | electrons |
|----------|---------|----------|-----------|
| A | 13 | 13 | 13 |
| B | 13 | 14 | 13 |
| C | 14 | 13 | 13 |
| D | 14 | 14 | 13 |

- 5 Which description of brass is correct?

- A** alloy
B compound
C element
D non-metal

6 Some properties of diamond are shown.

- 1 It is very hard.
- 2 Every atom forms four bonds.
- 3 It does not conduct electricity.

Which properties are also shown by silicon(IV) oxide?

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

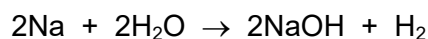
7 Which statement describes the attractive forces between molecules?

- A** They are strong covalent bonds which hold molecules together.
B They are strong ionic bonds which hold molecules together.
C They are weak forces formed between covalently-bonded molecules.
D They are weak forces which hold ions together in a lattice.

8 Which substance is described as a macromolecule?

- A** ammonia
B graphite
C iron
D sodium chloride

9 The equation for the reaction of sodium with water is shown.



What is the volume of hydrogen gas, measured at r.t.p., produced when 18.4 g of sodium reacts with excess water?

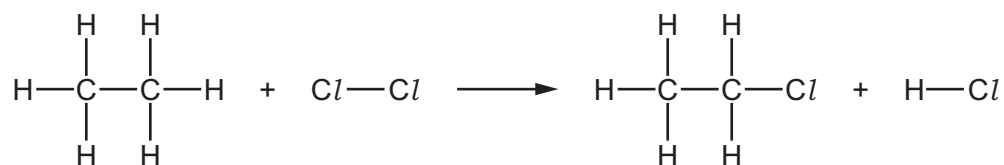
- A** 9.6 dm³ **B** 15.0 dm³ **C** 19.2 dm³ **D** 30.0 dm³

10 Iron can be electroplated with zinc to make it resistant to corrosion.

Which row about electroplating iron with zinc is correct?

| | positive electrode (anode) | negative electrode (cathode) | electrolyte |
|----------|-------------------------------|---------------------------------|--------------|
| A | iron | zinc | iron nitrate |
| B | iron | zinc | zinc nitrate |
| C | zinc | iron | iron nitrate |
| D | zinc | iron | zinc nitrate |

11 Chlorine reacts with ethane to produce chloroethane and hydrogen chloride.



The reaction is exothermic.

The bond energies are shown in the table.

| bond | bond energy in kJ/mol |
|-------|--------------------------|
| C-Cl | +340 |
| C-C | +350 |
| C-H | +410 |
| Cl-Cl | +240 |
| H-Cl | +430 |

What is the energy change for the reaction?

- A -1420 kJ/mol
- B -120 kJ/mol
- C +120 kJ/mol
- D +1420 kJ/mol

12 Chlorine gas is bubbled into aqueous potassium iodide.

What is the ionic equation for the reaction that takes place?

- A $\text{Cl} + \text{I}^- \rightarrow \text{Cl}^- + \text{I}$
- B $\text{Cl}_2 + 2\text{I}^- \rightarrow \text{Cl}_2^- + \text{I}_2$
- C $\text{Cl}_2 + 2\text{I}^- \rightarrow 2\text{Cl}^- + \text{I}_2$
- D $\text{Cl}_2 + 2\text{I}^- \rightarrow 2\text{Cl}^- + 2\text{I}$

13 Concentrated aqueous sodium chloride is electrolysed.

Which equation represents the reaction at the cathode?

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

14 Which statements about hydrogen are correct?

- 1 When hydrogen is burned, heat energy is released.
- 2 When hydrogen is used in a fuel cell, electrical energy is generated.
- 3 When hydrogen is used as a fuel, water is the only product.

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

15 Solid X is heated strongly.

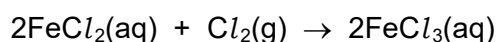
The colour of the solid changes from blue to white.

What is solid X?

- A** anhydrous cobalt(II) chloride
- B** calcium carbonate
- C** hydrated copper(II) sulfate
- D** lead(II) bromide

16 Iron(II) chloride solution reacts with chlorine gas.

The equation is shown.



Which statements about this reaction are correct?

- 1 Fe^{2+} ions are reduced to Fe^{3+} ions.
- 2 Chlorine acts as a reducing agent.
- 3 Fe^{2+} ions each lose an electron.
- 4 Cl_2 molecules are reduced to Cl^- ions.

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

17 Which statements about acids and bases are correct?

- 1 An acid reacts with a metal to give off hydrogen.
- 2 A base reacts with an ammonium salt to give off ammonia.
- 3 An acid reacts with a carbonate to give off carbon dioxide.
- 4 Alkaline solutions are orange in methyl orange.

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

18 Oxide 1 is a solid that reacts with dilute hydrochloric acid.

Oxide 2 is a gas that reacts with sodium hydroxide solution.

What are the formulae of the oxides?

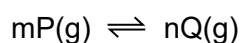
| | oxide 1 | oxide 2 |
|----------|-----------------|-----------------|
| A | CaO | MgO |
| B | MgO | NO ₂ |
| C | NO ₂ | SO ₂ |
| D | SO ₂ | CaO |

19 Which reaction is a photochemical reaction?

- A** addition of bromine to propene
- B** esterification of ethanol and ethanoic acid
- C** oxidation of ethanol
- D** substitution of methane with chlorine

20 The equation shown represents a reaction at equilibrium.

m and n represent the balancing numbers for the reactant and product respectively.



A high temperature increases the concentration of Q.

A high pressure increases the concentration of Q.

Which statement about the reaction is correct?

- A** The forward reaction is exothermic and m is greater than n.
- B** The forward reaction is exothermic and m is less than n.
- C** The forward reaction is endothermic and m is greater than n.
- D** The forward reaction is endothermic and m is less than n.

21 A period of the Periodic Table is shown.

| | | | | | | | | |
|---------|---|----|-----|----|---|----|-----|------|
| group | I | II | III | IV | V | VI | VII | VIII |
| element | R | S | T | V | W | X | Y | Z |

The letters are not their chemical symbols.

Which statement is correct?

- A** Element R does not conduct electricity.
- B** Elements R and Y react together to form an ionic compound.
- C** Element Z exists as a diatomic molecule.
- D** Element Z reacts with element T.

22 All metal nitrates are soluble in water.

All metal chlorides are soluble except silver and lead.

All metal carbonates are insoluble except sodium and potassium.

Which aqueous solutions produce a precipitate when mixed together?

- 1 silver nitrate + sodium carbonate
- 2 silver nitrate + sodium chloride
- 3 barium nitrate + potassium chloride

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

23 Which row describes properties of transition elements?

| | property 1 | property 2 | property 3 |
|----------|--------------------|--------------------|---------------------------|
| A | coloured compounds | high density | variable oxidation states |
| B | high density | high melting point | one oxidation state |
| C | high melting point | coloured compounds | one oxidation state |
| D | low melting point | high density | variable oxidation states |

24 The noble gases are in Group VIII of the Periodic Table.

Which statement explains why noble gases are unreactive?

- A** They all have eight electrons in their outer shells.
- B** They all have full outer shells.
- C** They are all gases.
- D** They are all monoatomic.

25 Which statement is correct for **all** metals?

- A** They conduct electricity when molten.
- B** They gain electrons when they form ions.
- C** They have a low density.
- D** They have a low melting point.

26 Carbon dioxide is produced during the extraction of aluminium from bauxite.

Which statement describes how this carbon dioxide is made?

- A** Carbon monoxide reduces aluminium oxide forming carbon dioxide and aluminium.
- B** Carbon is burned in the blast furnace to release heat energy.
- C** Oxygen made in the process reacts with the carbon electrode.
- D** The ore of aluminium undergoes thermal decomposition.

27 Aluminium objects do not need protection from corrosion.

Iron objects must be protected from corrosion.

Which statement explains why aluminium resists corrosion?

- A** Aluminium does not form ions easily.
- B** Aluminium does not react with water or air.
- C** Aluminium has a protective oxide layer.
- D** Aluminium is below iron in the reactivity series.

28 Which statements explain why zinc is used to protect iron from rusting?

- 1 Zinc is more reactive than iron.
- 2 Zinc is less reactive than iron.
- 3 Zinc can form alloys with iron.
- 4 Zinc acts as a sacrificial metal.

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

29 Which conditions are used in the Haber process?

| | temperature /°C | pressure /atmospheres |
|---|--------------------|--------------------------|
| A | 100 | 10 |
| B | 450 | 10 |
| C | 450 | 200 |
| D | 1000 | 500 |

30 Which process does **not** produce a greenhouse gas?

- A acid rain on limestone buildings
- B combustion of wood
- C digestion in cows
- D zinc reacting with sulfuric acid

31 Which reaction involving sulfur dioxide is correct?

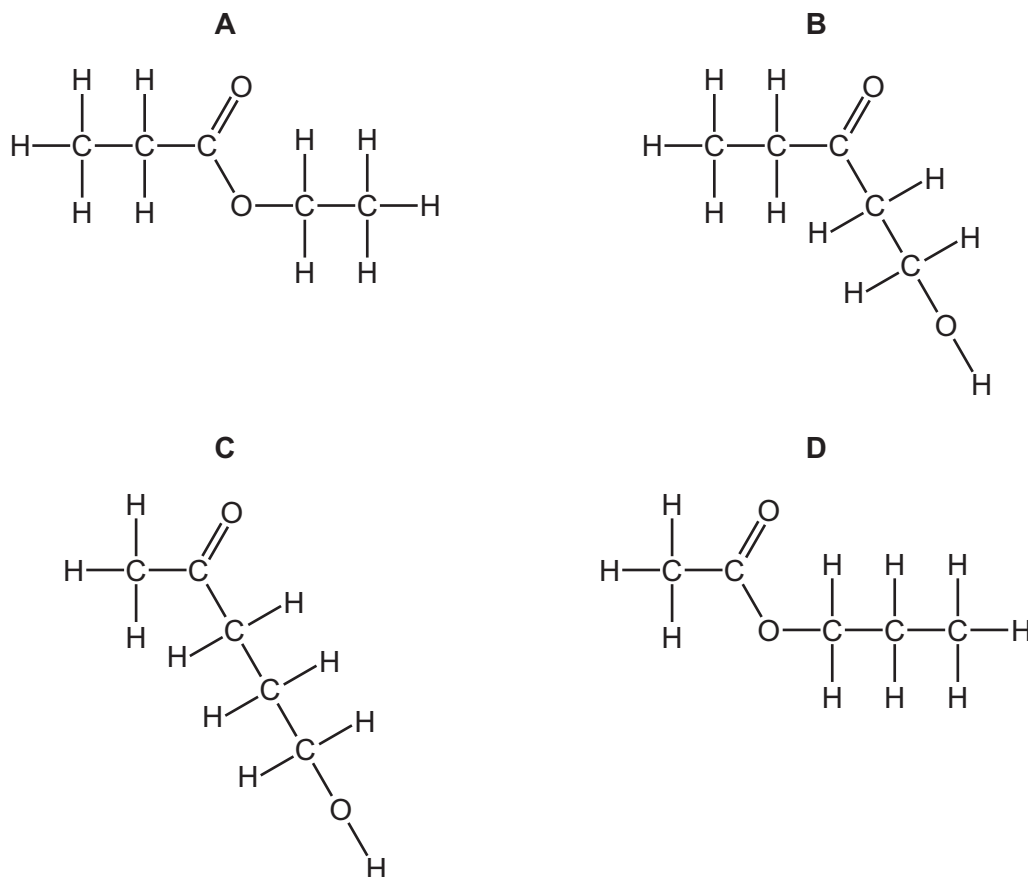
- A It is produced during the extraction of zinc from zinc blende.
- B It reacts with concentrated sulfuric acid to form oleum.
- C It reacts with sulfur to form sulfur trioxide.
- D It turns an acidified solution of potassium manganate(VII) purple.

32 Lime (calcium oxide) is used to treat waste water from a factory.

Which substance is removed by the lime?

- A ammonia
- B sodium chloride
- C sodium hydroxide
- D sulfuric acid

33 What is the structure of the ester formed from ethanoic acid and propanol?

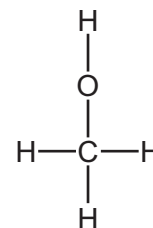
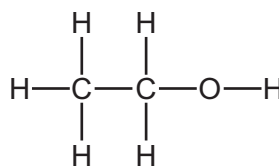
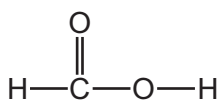
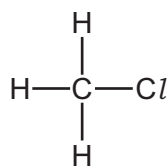


34 Fuel X produces carbon dioxide and water when it is burned in air. So does fuel Y.

What could X and Y be?

| | X | Y |
|----------|-----------------|--------------------------------|
| A | C | H ₂ |
| B | C | C ₈ H ₁₈ |
| C | CH ₄ | H ₂ |
| D | CH ₄ | C ₈ H ₁₈ |

35 The structures of four organic molecules are shown.



How many different homologous series are represented by these molecules?

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

36 Which statement about ethene is correct?

- A** It has the chemical formula C_2H_6 .
B It burns in excess oxygen producing carbon dioxide and water.
C It reacts with Br_2 to produce an orange solution.
D It reacts with oxygen to form ethanol.

37 Ethanol is manufactured by fermentation of sugars or by catalytic hydration of ethene.

Which row states an advantage of each method?

| | fermentation | hydration |
|----------|---------------------------|-------------------------|
| A | produces purer ethanol | is a batch process |
| B | produces purer ethanol | is a continuous process |
| C | uses a renewable resource | is a batch process |
| D | uses a renewable resource | is a continuous process |

38 Which statements about unsaturated hydrocarbons are correct?

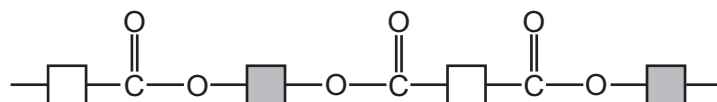
- 1 They contain both single and double bonds.
- 2 They turn aqueous bromine from colourless to brown.
- 3 They can be manufactured by cracking.

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

39 Which polymers have the same linkage between monomer units?

- A carbohydrate and polyamide
- B carbohydrate and polyester
- C protein and polyamide
- D protein and polyester

40 The diagram shows the partial structure of *Terylene*.



From which pair of compounds is it made?

- A $\text{HO}-\text{C}(=\text{O})-\square-\text{C}(=\text{O})-\text{OH}$ + $\text{HO}-\square-\text{OH}$
- B $\text{HO}-\square-\text{C}(=\text{O})-\text{OH}$ + $\text{HO}-\square-\text{C}(=\text{O})-\text{OH}$
- C $\text{HO}-\square-\text{OH}$ + $\text{HO}-\text{C}(=\text{O})-\square-\text{C}(=\text{O})-\text{OH}$
- D $\text{HO}-\text{C}(=\text{O})-\square-\text{C}(=\text{O})-\text{OH}$ + $\text{HO}-\text{C}(=\text{O})-\square-\text{C}(=\text{O})-\text{OH}$

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