

1 (a) Copper(II) chloride contains copper ions, Cu^{2+} , and chloride ions, Cl^- .

(i) What is the formula of this copper chloride?

Put a cross (☒) in the box next to your answer.

A CuCl

B Cu_2Cl

C CuCl_2

D Cu_2Cl_2

(1)

(ii) In a reaction 0.64 g copper are reacted to produce copper chloride.
The theoretical yield of this reaction is 1.35 g copper chloride.

Explain what is meant by **theoretical yield**.

(2)

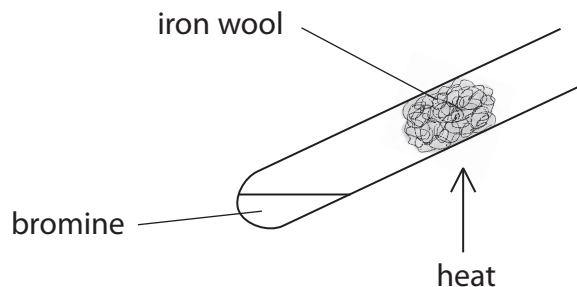
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(b) Bromine reacts with hot iron wool to produce solid iron(III) bromide, FeBr_3 .



(i) Write the balanced equation for the reaction between iron and bromine gas. Include state symbols.

(3)

(ii) Calculate the relative formula mass of iron(III) bromide, FeBr_3 .
(Relative atomic masses: Fe = 56, Br = 80)

(1)

relative formula mass =

(iii) Iron also reacts with iodine to form iron(II) iodide, FeI_2 .

Calculate the percentage by mass of iron in iron(II) iodide.
(Relative formula mass $\text{FeI}_2 = 310$)

(2)

percentage by mass of iron =%

(iv) Hydrogen peroxide reacts with some iron compounds.
The molecular formula of hydrogen peroxide is H_2O_2 .

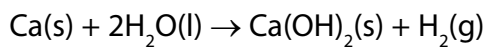
Give the empirical formula of hydrogen peroxide.

(1)

(Total for Question 1 = 10 marks)

2 Magnesium and calcium are in group 2 of the periodic table. They are less reactive than the metals in group 1.

(a) Calcium reacts with water to form calcium hydroxide, Ca(OH)_2 , and hydrogen, H_2 .



Describe what would be **seen** when a piece of calcium is dropped into a container of water.

(2)

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(b) Magnesium reacts very slowly with cold water but it reacts faster with steam, H_2O , and forms magnesium oxide, MgO , and hydrogen.

Write the balanced equation for the reaction between magnesium and steam.

(2)

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(c) The electronic configurations of magnesium and calcium are

magnesium 2.8.2
calcium 2.8.8.2

When magnesium and calcium react with water they form positive ions.

Suggest an explanation, in terms of their electronic configurations, why calcium is more reactive than magnesium.

(2)

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(d) A sample of calcium bromide contains 0.2 g calcium and 0.8 g bromine by mass.

Calculate the empirical formula of calcium bromide.

(relative atomic masses: Ca = 40, Br = 80)

(3)

empirical formula =

(Total for Question 2 = 9 marks)

3 Figure 13 shows a model of how particles are arranged in a solid.

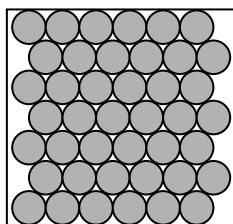


Figure 13

(a) (i) State **two** ways in which this model fails to accurately represent a crystal of sodium chloride.

(2)

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(ii) Magnesium oxide has a melting point of 2852 °C.

Explain why magnesium oxide has such a high melting point.

(3)

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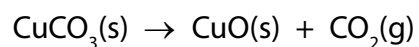
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- (b) (i) Carbon dioxide can be formed by the reaction of calcium carbonate, CaCO_3 , with dilute hydrochloric acid.

Write the balanced equation for this reaction.

(3)

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- (ii) The thermal decomposition of copper carbonate forms copper oxide and carbon dioxide.



15.0g of pure copper carbonate is decomposed completely.

Calculate the mass of solid produced.

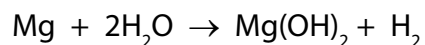
(relative atomic masses: C = 12.0; O = 16.0; Cu = 63.5)

Give your answer to two significant figures.

(2)

mass of solid = g

(c) Magnesium reacts with water in the form of steam as shown in the equation.



2.4 g of magnesium reacts with sufficient steam for a complete reaction to form 5.8 g of magnesium hydroxide and 0.2 g of hydrogen.

Show, by calculation, that the law of conservation of mass applies to this reaction.

(relative atomic masses: H = 1.0, O = 16, Mg = 24)

(3)

(Total for Question 3 = 13 marks)

(c) The halogens react with hydrogen to form hydrogen halides.

Complete the balanced equation for the reaction between hydrogen and bromine forming hydrogen bromide.

(2)



(d) Calculate the relative formula mass of magnesium chloride, MgCl_2 .
(relative atomic masses: Mg = 24.0; Cl = 35.5)

(1)

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relative formula mass =

(e) Calculate the percentage by mass of fluorine in sodium fluoride, NaF.
(relative atomic masses: F = 19; Na = 23)

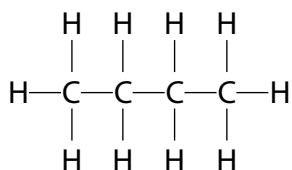
(2)

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percentage by mass of fluorine = %

(Total for Question 4 = 8 marks)

5 Alkanes and alkenes are hydrocarbons.

The structure of a molecule of butane is shown.



(a) Which of the following is the empirical formula for butane?

(1)

- A CH
- B CH₂
- C C₂H₅
- D C₄H₁₀

(b) Figure 5 shows some information about the alkenes, ethene and propene.

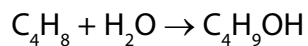
Complete the table. The structure of propene must show all covalent bonds.

(2)

name of alkene	molecular formula	structure
ethene		$\begin{array}{ccc} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C}=\text{C} & \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$
propene	C ₃ H ₆	

Figure 5

(c) Butene reacts with steam to produce butanol.



- (i) Calculate the maximum mass of butanol, $\text{C}_4\text{H}_9\text{OH}$, that can be produced when 1.4 kg of butene, C_4H_8 , reacts with excess steam.

(relative atomic masses: $\text{H} = 1$, $\text{C} = 12$, $\text{O} = 16$
relative molecular mass of butene, $\text{C}_4\text{H}_8 = 56$)

(3)

mass of butanol = kg

- (ii) What type of reaction takes place between butene and steam?

(1)

- A** addition
- B** dehydration
- C** neutralisation
- D** substitution

(d) A sample of each of three hydrocarbons, **X**, **Y** and **Z**, was shaken with bromine water. Bromine water is orange coloured.

The results are:

X orange mixture becomes colourless

Y orange mixture becomes colourless

Z mixture remains orange

Using the results, comment on the structures of the hydrocarbons **X**, **Y** and **Z**.

(2)

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(Total for Question 5 = 9 marks)
