

2 Ionic compounds contain ions.

- (a) The numbers of electrons, neutrons and protons in four particles, **W**, **X**, **Y** and **Z**, are shown in Figure 5.

particle	electrons	neutrons	protons
W	9	10	9
X	10	14	12
Y	16	16	16
Z	18	18	16

Figure 5

Explain which particle, **W**, **X**, **Y** or **Z**, is a negative ion.

(2)

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- (b) Calcium nitrate contains calcium ions and nitrate ions.

Calculate the relative formula mass of calcium nitrate, $\text{Ca}(\text{NO}_3)_2$.
(relative atomic masses: Ca = 40, N = 14, O = 16)

(2)

relative formula mass =

4 The method used to prepare a salt depends on its solubility in water.

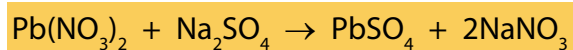
(a) Complete Figure 9 by placing one tick in each row to show whether the salt is soluble or insoluble.

(2)

salt	soluble	insoluble
ammonium chloride		
lithium sulfate		
magnesium carbonate		

Figure 9

(b) Lead nitrate solution mixed with sodium sulfate solution forms lead sulfate as a precipitate.



The theoretical yield of lead sulfate for this reaction was 2.85 g.

The actual yield of lead sulfate obtained was 2.53 g.

Calculate the percentage yield of lead sulfate in this experiment.

Give your answer to two significant figures.

(3)

percentage yield =%

(d) Gold is often alloyed with other metals when it is used to make jewellery.

The proportion of gold in a piece of gold jewellery is measured in carats.

Pure gold is 24 carats.

A 9 carat gold ring has a mass of 12 g.

Calculate the mass of gold in this ring.

(2)

mass of gold ring = g

(Total for Question 5 = 7 marks)

- (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)

- (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.

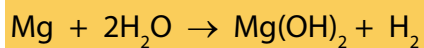
(relative atomic masses: C = 12.0; O = 16.0; Cu = 63.5)

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 8 = 13 marks)

- 10 (a) In an experiment, ammonia gas is made by heating a mixture of ammonium chloride and calcium hydroxide.



10.0 g of ammonium chloride is added to an excess of calcium hydroxide.

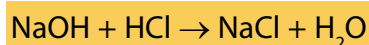
Calculate the maximum volume of ammonia gas that could be formed.

(relative atomic mass H = 1.00, N = 14.0, O = 16.0 and Ca = 40.0; one mole of any gas occupies 24 dm³ at room temperature and pressure)

(2)

volume = dm³

- (b) Sodium hydroxide solution reacts with hydrochloric acid.



- (i) 25.0 cm³ of 0.100 mol dm⁻³ sodium hydroxide, NaOH, solution is added to 35.0 cm³ of 0.0750 mol dm⁻³ dilute hydrochloric acid, HCl.

Use the information to determine which reagent is in excess.

(3)

- (ii) To find the exact amount of dilute hydrochloric acid that reacts with 25.0 cm^3 of the sodium hydroxide solution, a titration is carried out. Figure 14 shows the results for the titrations.

	1st titration	2nd titration	3rd titration	4th titration
final burette reading / cm^3	37.60	36.20	39.15	38.40
initial burette reading / cm^3	1.80	0.00	3.95	2.10
volume of acid used / cm^3	35.80	36.20	35.20	36.30

Figure 14

In this titration, the accurate volumes of acid used that are within 0.20 cm^3 of each other are considered concordant volumes.

Use the concordant results to calculate the mean volume of hydrochloric acid required.

(1)

mean volume = cm^3

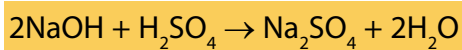
- (iii) During the titration, the indicator used changed colour at the end point.

Which of the following shows an indicator with the colour change that would be seen in this titration?

(1)

	indicator	colour in alkali	colour at end point
<input type="checkbox"/>	A phenolphthalein	colourless	pink
<input type="checkbox"/>	B phenolphthalein	pink	yellow
<input type="checkbox"/>	C methyl orange	red	yellow
<input type="checkbox"/>	D methyl orange	yellow	orange

- (c) In another titration, 25.0 cm³ of a different sodium hydroxide solution is titrated with 0.200 mol dm⁻³ sulfuric acid, H₂SO₄.



24.80 cm³ of acid are required to neutralise 25.0 cm³ of the sodium hydroxide solution.

Calculate the concentration of the sodium hydroxide solution, NaOH, in mol dm⁻³.

(4)

concentration = mol dm⁻³

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

Copper and its compounds

4 (a) Copper is a transition metal.

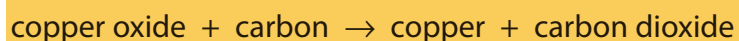
Which of these is a property of copper?

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

(1)

- A it is a poor conductor of electricity
- B it is brittle
- C it has a low melting point
- D it forms coloured compounds

(b) Jasmine reacted an oxide of copper with carbon.



She reacted 5.0 g of copper oxide.

In her reaction, 2.8 g of copper was formed.

The theoretical yield for this reaction is 4.0 g.

(i) State what is meant by the term **theoretical yield**.

(1)

(ii) The percentage yield of Jasmine's experiment was 70%.

Explain how this value was calculated.

(2)



(iii) State **two** reasons why the yield of Jasmine's experiment was not 100%.

(2)

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(c) Calculate the relative formula mass of copper chloride, CuCl_2 .

(Relative atomic masses: Cu = 63.5, Cl = 35.5)

(1)

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answer =

(d) 14.3 g of an oxide of copper contained 12.7 g of copper.

Calculate the empirical formula of this oxide.

Show your working.

(Relative atomic masses: Cu = 63.5, O = 16)

(3)

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answer =

(Total for Question 4 = 10 marks)



Metal halides

4 (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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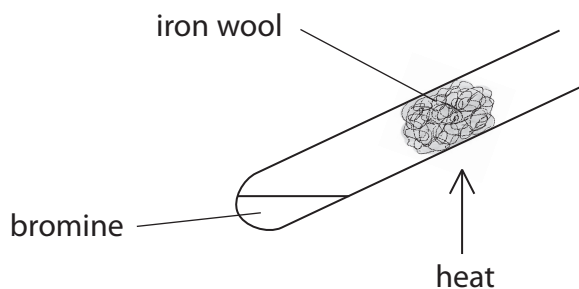
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(b) Bromine reacts with hot iron wool to produce solid iron(III) bromide, FeBr_3 .



(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 4 = 10 marks)



(d) An oxide of lead was analysed.
0.414 g of lead was combined with 0.064 g of oxygen in this oxide.

Calculate the empirical formula of this lead oxide.

(relative atomic masses: O = 16, Pb = 207)

(3)

empirical formula

(Total for Question 4 = 11 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: $\text{Mg} = 24.0$; $\text{Cl} = 35.5$)

(1)

relative formula mass =

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

(2)

percentage by mass of fluorine = %

(Total for Question 2 = 8 marks)



Group 7 elements

- 6 (a) A compound of iron and chlorine was formed by reacting 2.80 g of iron with 3.55 g of chlorine.

Calculate the empirical formula of the compound.
(relative atomic masses: Cl = 35.5, Fe = 56.0)

(3)

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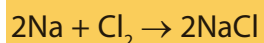
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empirical formula

- (b) Sodium reacts with chlorine to form sodium chloride.



Calculate the maximum mass of sodium chloride that could be formed by reacting 9.20 g of sodium with excess chlorine.
(relative atomic masses: Na = 23.0, Cl = 35.5)

(3)

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mass of sodium chloride g



Compounds of copper

4 Copper hydroxide, copper oxide and copper sulfide are three compounds of copper.

- (a) (i) In solution copper chloride, CuCl_2 , reacts with potassium hydroxide, KOH , to form copper hydroxide, $\text{Cu}(\text{OH})_2$, and potassium chloride.

Write the balanced equation for this reaction.
State symbols are not required.

(3)

- (ii) Copper hydroxide is formed as a precipitate.

Which state symbol would be used in the equation to show that copper hydroxide is a precipitate?

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

(1)

- A (aq)
- B (g)
- C (l)
- D (s)

(b) The formula of copper hydroxide is $\text{Cu}(\text{OH})_2$.

(relative atomic masses: $\text{Cu} = 63.5$, $\text{O} = 16$, $\text{H} = 1$)

Which of the following is the relative formula mass for copper hydroxide?

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

(1)

- A 80.5
- B 81.5
- C 97.5
- D 161.0



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(c) In an analysis of copper sulfide, 12.7 g of copper was found to be combined with 3.2 g of sulfur.

Calculate the empirical formula of the copper sulfide.

Show your working.

(relative atomic masses: Cu = 63.5, S = 32)

(3)

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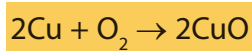
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empirical formula =

(d) Copper reacts with oxygen to form copper oxide.



Calculate the maximum mass of copper oxide that could be formed by reacting 25.4 g of copper with excess oxygen.

(relative atomic masses: O = 16, Cu = 63.5;
relative formula mass: CuO = 79.5)

(2)

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maximum mass of copper oxide =g

(Total for Question 4 = 10 marks)



***(d) A sample of neon contains 90% neon-20 and 10% neon-22.
An atom of neon-20 contains 10 protons, 10 neutrons and 10 electrons.**

Describe the structure of a neon-22 atom and explain why, in this sample, the neon has a relative atomic mass of 20.2.

(6)

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