Pearson Edexcel

Additional Assessment Materials
Summer 2021

Pearson Edexcel GCSE in Chemistry (1CH0)
Higher

Resource Set Topic C: Calculations involving masses

Questions

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

2

(b) A nickel sulfate solution is made by dissolving 23.5 g of nickel sulfate to make 250 cm^3 of solution.

Calculate the concentration of the solution in g dm^{-3}.

(2)

$\frac{23.5}{250 \times 10^{-3}} = 94$

concentration = 94 g dm^{-3}

3 Most metals are extracted from ores found in the Earth's crust.

The method used to extract a metal from its ore is linked to the reactivity of the metal.

Part of the reactivity series is shown in Figure 2.

calcium	most reactive
aluminium	↑
zinc	
iron	
copper	
gold	least reactive

Figure 2

(ii) The formula of the iron oxide is Fe_2O_3.

Calculate the maximum mass of iron that can be obtained from 240 tonnes of iron oxide, Fe_2O_3.

(relative atomic masses: O = 16, Fe = 56)

(3)

$$\frac{2(56)}{2(56)+3(16)} \times 240 = 168$$

mass of iron = 168 tonnes

9

(b) When iron reacts with copper sulfate solution, solid copper is formed.

Two possible equations for this reaction are

A $CuSO_4 + Fe \rightarrow Cu + FeSO_4$

B $3CuSO_4 + 2Fe \rightarrow 3Cu + Fe_2(SO_4)_3$

It was found that 10.00 g of iron powder reacted with excess copper sulfate solution to produce 11.34 g of copper.

Carry out a calculation to decide which equation, **A** or **B**, represents the reaction taking place.
(relative atomic masses: Fe = 56.0, Cu = 63.5)

(2)

moles of Fe $= \frac{10}{56} = 0.17857$ mol

moles of copper $= \frac{11.34}{63.5} = 0.17858$ mol

ratio $\approx$ 1 : 1

$\therefore$ A is the reaction taking place

(e) Calculate the mass, in g, of a hydrogen atom, using the data below.
(relative atomic mass: H = 1.00;
Avogadro constant = 6.02×10^{23})

(3)

$\frac{1.00}{6.02 \times 10^{23}} = 1.66 \times 10^{-24}$

mass of hydrogen atom = 1.66×10^{-24} g

2

(d) In an experiment, 3.5 g of element **A** reacted with 4.0 g of element **G** to form a compound.

Calculate the empirical formula of this compound.
(relative atomic masses: **A** = 7, **G** = 16)

You must show your working.

(3)

A : $\frac{3.5}{7} = 0.5$ $\quad \frac{0.5}{0.25} = 2$

G : $\frac{4}{16} = 0.25$ $\quad \frac{0.25}{0.25} = 1$

empirical formula of this compound = A_2G

6c

(c) Calculate the number of atoms combined in one mole of copper iodide, CuI_2.
(Avogadro constant = 6.02×10^{23})

(2)

$3 \times 6.02 \times 10^{23} = 1.806 \times 10^{24}$

number of atoms = 1.806×10^{24}

2

(b) The sodium sulfate solution was made by dissolving 28.4 g of sodium sulfate in water to make 250 cm^3 of solution.

Calculate the concentration of this solution in $g\,dm^{-3}$.

Give your answer to three significant figures.

(3)

$\frac{28.4}{250 \times 10^{-3}} = 113.6$

$\simeq 114$

concentration = 114 $g\,dm^{-3}$

3aii

3 The word equation for the reaction between copper carbonate and dilute sulfuric acid is

copper carbonate + sulfuric acid → copper sulfate + carbon dioxide + water

(ii) Calculate the relative formula mass of copper carbonate, $CuCO_3$.
(relative atomic masses: C = 12.0, O = 16.0, Cu = 63.5)

(2)

$63.5 + 12.0 + 3(16.0) = 123.5$

relative formula mass of $CuCO_3$ = 123.5

1

(c) A gold ring contains 3.94 g of gold.

Calculate the number of gold atoms in the ring.
(relative atomic mass: Au = 197,
Avogadro constant = 6.02×10^{23})

Show your working.

(2)

$\frac{3.94}{197} \times 6.02 \times 10^{23} = 1.204 \times 10^{22}$

number of gold atoms = 1.204×10^{22}

6b

(ii) The equipment shown in Figure 7 can be used to find the mass of oxygen that combines with iron.

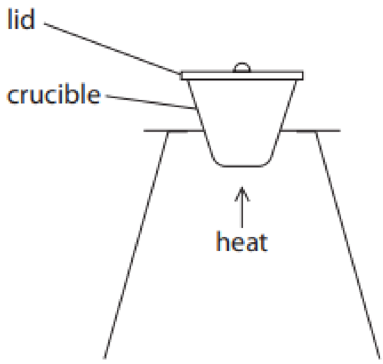

Figure 7

Describe how the equipment shown in Figure 7 could be used to find the mass of oxygen that combines with 0.500 g of iron wool in a crucible and lid of known mass.

(3)

After all of the iron wool has reacted, measure the total mass of crucible containing the product with the lid. Minus the mass of the iron wool, crucible, and lid, to find the mass of oxygen reacted.

(c) 2.24 g of iron combines with 0.96 g of oxygen to form an oxide of iron.

Determine the formula of this oxide of iron and use it to complete the balanced equation.

(relative atomic masses: Fe = 56.0, O = 16.0)

You must show your working.

(4)

moles of iron : $\frac{2.24}{56.0} = 0.04$

$\frac{0.04}{0.04} = 1$

moles of oxygen atoms : $\frac{0.96}{16.0} = 0.06$ mol

$\frac{0.06}{0.04} = 1.5$

Ratio of Fe : O

1 : 1.5

×2 ×2

2 : 3

Formula of oxide : Fe_2O_3

balanced equation for the reaction is

4 Fe + 3 O_2 → 2 Fe_2O_3

3 Lithium, sodium and potassium are reactive metals in group 1 of the periodic table.

(a) Sodium metal tarnishes in air to form a layer of sodium oxide on its surface. 0.92 g of sodium combined with 0.32 g of oxygen in this oxide.

Calculate the empirical formula of this sodium oxide. (relative atomic masses: O = 16, Na = 23)

You must show your working.

(3)

moles of Na : $\frac{0.92}{23} = 0.04$

$\frac{0.04}{0.02} = 2$

moles of O : $\frac{0.32}{16} = 0.02$

$\frac{0.02}{0.02} = 1$

empirical formula of sodium oxide = Na_2O

9 (a) The rate of reaction between magnesium ribbon and dilute hydrochloric acid at room temperature is investigated.

The apparatus used is shown in Figure 11.

The volume of hydrogen gas given off was measured at regular intervals during the reaction.

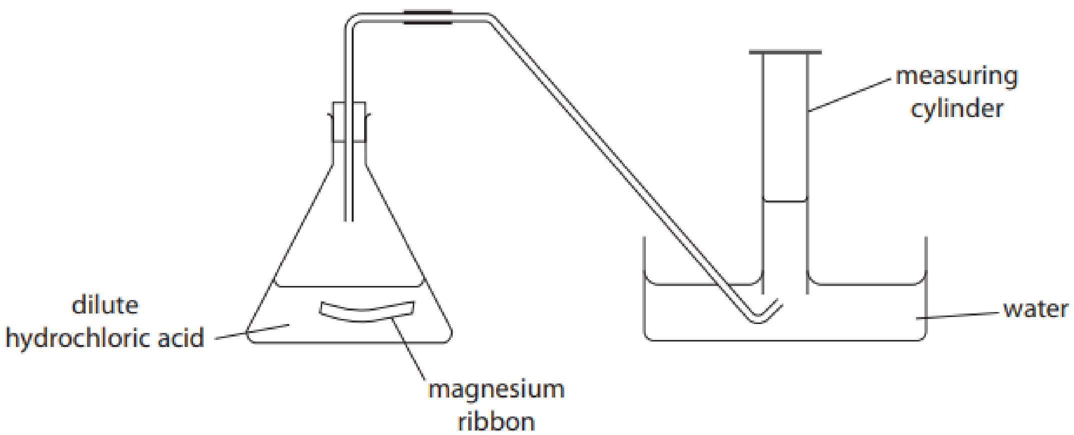

Figure 11

(b) The balanced equation for this reaction is

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

(i) In another experiment, 0.1 moles of hydrochloric acid, HCl, were reacted with 0.1 g of magnesium ribbon.

Calculate the number of moles of magnesium, Mg, in the 0.1 g sample of magnesium ribbon.
(relative atomic mass: Mg = 24)

(1)

$\frac{0.1}{24} = 4.17 \times 10^{-3}$

number of moles = 4.17×10^{-3}

(ii) In a further experiment, 0.5 mol of hydrochloric acid, HCl, were mixed with 0.5 mol of magnesium, Mg.

Use the equation to show that, in this experiment, the magnesium is in excess.

(1)

The mole ratio of Mg to HCl is 1:2, so 0.5mol of HCl will react with 0.25 mol of Mg.

2c

(ii) Butane has the formula C_4H_{10}.

Calculate the mass of carbon in 100 g of butane.

Give your answer to three significant figures.

(relative atomic masses: H = 1.00, C = 12.0;
relative formula mass: C_4H_{10} = 58.0)

You must show your working.

(3)

$\frac{4(12)}{58} \times 100 = 82.7586$

≈ 82.8

mass of carbon = 82.8 g

3

(b) Magnesium burns in excess oxygen to form magnesium oxide.
The balanced equation for this reaction is

$$2Mg + O_2 \rightarrow 2MgO$$

2 : 2

Starting with 1.35 g of magnesium, calculate the maximum mass of magnesium oxide that could be formed in this reaction.
(relative atomic masses: O = 16.0, Mg = 24.0)

You must show your working.

(3)

moles of Mg : $\frac{1.35}{24.0} = 0.05625$

using mole ratio, 0.05625 moles of MgO will be formed.

mass : $(24.0 + 16.0) \times 0.05625 = 2.25$

mass of magnesium oxide = 2.25 g

5

(c) Calculate the number of molecules in 0.11 g of carbon dioxide.

Give your answer to two significant figures.

(relative formula mass : CO_2 = 44
Avogadro constant = 6.02×10^{23})

(3)

moles of CO_2 : $\frac{0.11}{44} = 2.5 \times 10^{-3}$

$2.5 \times 10^{-3} \times 6.02 \times 10^{23} = 1.505 \times 10^{21}$

number of molecules = 1.505×10^{21}

(b) The equation for the fermentation of a carbohydrate is

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

1 : 2 : 2

Calculate the maximum mass of carbon dioxide that could be produced if 135 g of this carbohydrate is fully fermented.

(relative formula masses: $CO_2 = 44$; $C_6H_{12}O_6 = 180$)

(3)

moles of $C_6H_{12}O_6 = \frac{135}{180} = 0.75$ mol

using mole ratio, $2 \times 0.75 = 1.5$ moles of CO_2 will be produced.

mass of $CO_2 = 1.5 \times 44$

$= 66$

mass of carbon dioxide = 66 g

TOTAL FOR PAPER IS 46 MARKS