Triple - Chemistry - Key Stage 4

Quantitative Chemistry

Reacting masses and yield

Mrs. Begum

Independent practice

1. What mass of magnesium oxide is formed when 96 g of magnesium reacts with oxygen?

   $2Mg + O_2 \longrightarrow 2MgO$

2. What mass of aluminium oxide is produced when 108 g of aluminium is burned in oxygen?

   $4Al + 3O_2 \longrightarrow 2Al_2O_3$

3. What mass of hydrogen is produced when 192 g of magnesium is reacted with hydrochloric acid?

   $Mg + 2HCl \longrightarrow MgCl_2 + H_2$

Independent task

1. What mass of oxygen is needed to react with 8.5 g of hydrogen sulphide (H_2S)?

   $$2H_2S + 3O_2 \longrightarrow 2SO_2 + 2H_2O$$

2. What mass of potassium oxide is formed when 7.8 g of potassium is burned in oxygen?

   $$4K + O_2 \longrightarrow 2K_2O$$

3. What mass of aluminium oxide is produced when 135 g of aluminium is burned in oxygen?

   $$4Al + 3O_2 \longrightarrow 2Al_2O_3$$

Independent practice

1. An industrial process to produce fertiliser obtained 56.0 tonnes of fertiliser. The theoretical yield was 84.0 tonnes. What is the percentage yield?

2. An industrial process to extract iron produces 670 tonnes of iron. The theoretical yield is 700 tonnes. What is the percentage yield?

3. An experiment to produce magnesium oxide gives an actual yield of 0.80 g. The theoretical yield is 1.6 g. What is the percentage yield?

4. A student carries out an experiment to make copper sulfate. She obtains 3.93 g of copper sulfate crystals. The theoretical yield is 7.50 g. What is the percentage yield?

Question 1

Some students investigated calcium oxide.

(a) Calcium oxide has the formula CaO.

(i) Calculate the relative formula mass (M_r) of calcium oxide.

Relative atomic masses: O = 16; Ca = 40.

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Relative formula mass (M_r) = ______________ **(1)**

(ii) Calculate the percentage by mass of calcium in calcium oxide.

____

____

Percentage by mass of calcium in calcium oxide = ______%**(1)**

Question 1

(iii) Calculate the mass of calcium needed to make 30 g of calcium oxide.

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Mass of calcium = ____________________ g

(1)

Question 2

(a) The formula of iron(II) sulfate is $FeSO_4$

Calculate the relative formula mass (M_r) of $FeSO_4$

Relative atomic masses: O = 16; S = 32; Fe = 56.

____

The relative formula mass (M_r) = ________________

(2)

(b) What is the mass of one mole of iron(II) sulfate?

________________**(1)**

(c) What mass of iron(II) sulfate would be needed to provide 14 grams of iron?

Remember to give the unit.

________________**(1)**

(Total 4 marks)

Question 3

A bag of fertiliser contains 18.56 kg of ammonium nitrate (NH_4NO_3).

Relative formula mass (M_r): NH_4NO_3 = 80

Calculate the number of moles of ammonium nitrate in the bag of fertiliser.

Give your answer in standard form to 2 significant figures.

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Moles of ammonium nitrate = ____________________ mol

(4)

Question 4

Magnesium reacts with steam to produce hydrogen gas and magnesium oxide.

The equation for the reaction is:

$$Mg(s) + H_2O(g) \longrightarrow MgO(s) + H_2(g)$$

(a) The teacher used 2.00 g of magnesium.

Use the equation to calculate the maximum mass of magnesium oxide produced.

Give your answer to three significant figures.

Relative atomic masses (A_r): O = 16; Mg = 24

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Maximum mass = ________________ g **(3)**

Question 4

(b) The teacher's demonstration produced 2.72 g of magnesium oxide.

Use your answer from part (b)(i) to calculate the percentage yield.

If you could not answer part (b)(i), use 2.92 g as the maximum mass of magnesium oxide. This is **not** the answer to part (b)(i).

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Percentage yield = ____________________ %

(2)

(c) Give **one** possible reason for why the percentage yield is less than 100%.

____

____

(1)

Question 1 answers

(a) (i) 40 + 16 = 56

(ii) 40 / 56 x 100% = 71%

(iii) 71 /100 x 30 = 21.3 g

Question 2 answers

(a) $56 + 32 + (4 \times 16) = 152$

(b) 152g

(c) $152 / 4 = 38$(g)

Question 3

Convert 18.56kg in to grams

mass = 18.56x 1000 = 18560 g

Moles = mass / Mr

= 18560 / 80

= 232 mol

= 2.3×10^2 mol

Question 4 answers

(a) 3.33(g)

For 2.00 g of Mg → 40 / 24 x 2

(b) 81.7 % or 82%

if 2.92 g used

87.7% or 88%

(c) any **one** from:

- not all the magnesium reacted
- *allow the reaction may be reversible*
- some of the magnesium oxide / product may have been left in the tube **or** may have been lost