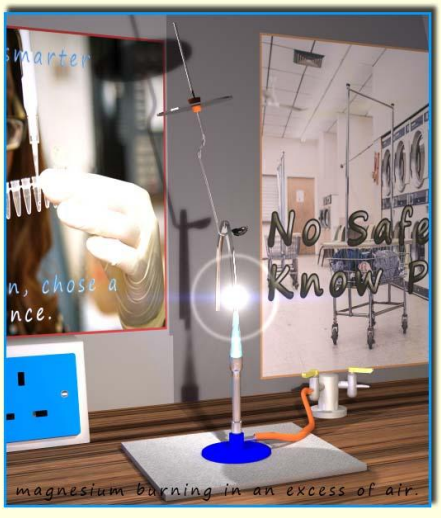
Answer all the questions below and then check your answers.

Use the equation box below to help answer the questions:

$$\text{percentage yield} = \frac{\text{mass of product actually made in grams}}{\text{maximum theoretical mass of product in grams}} \times 100\%$$

1. Billy burned 2.4g of magnesium ribbon. He held the magnesium on a burning spoon as shown in the diagram. Once the magnesium had stopped burning he scrapped the magnesium oxide off the burning spoon and onto a balance to weigh his product. He expected to obtain 4g of magnesium oxide. However he only managed to get 1.75g of magnesium oxide.



a. Calculate the percentage yield in this reaction.

b. Suggest why his percentage yield was so low.

c. What could Billy have done to improve the yield in this reaction?

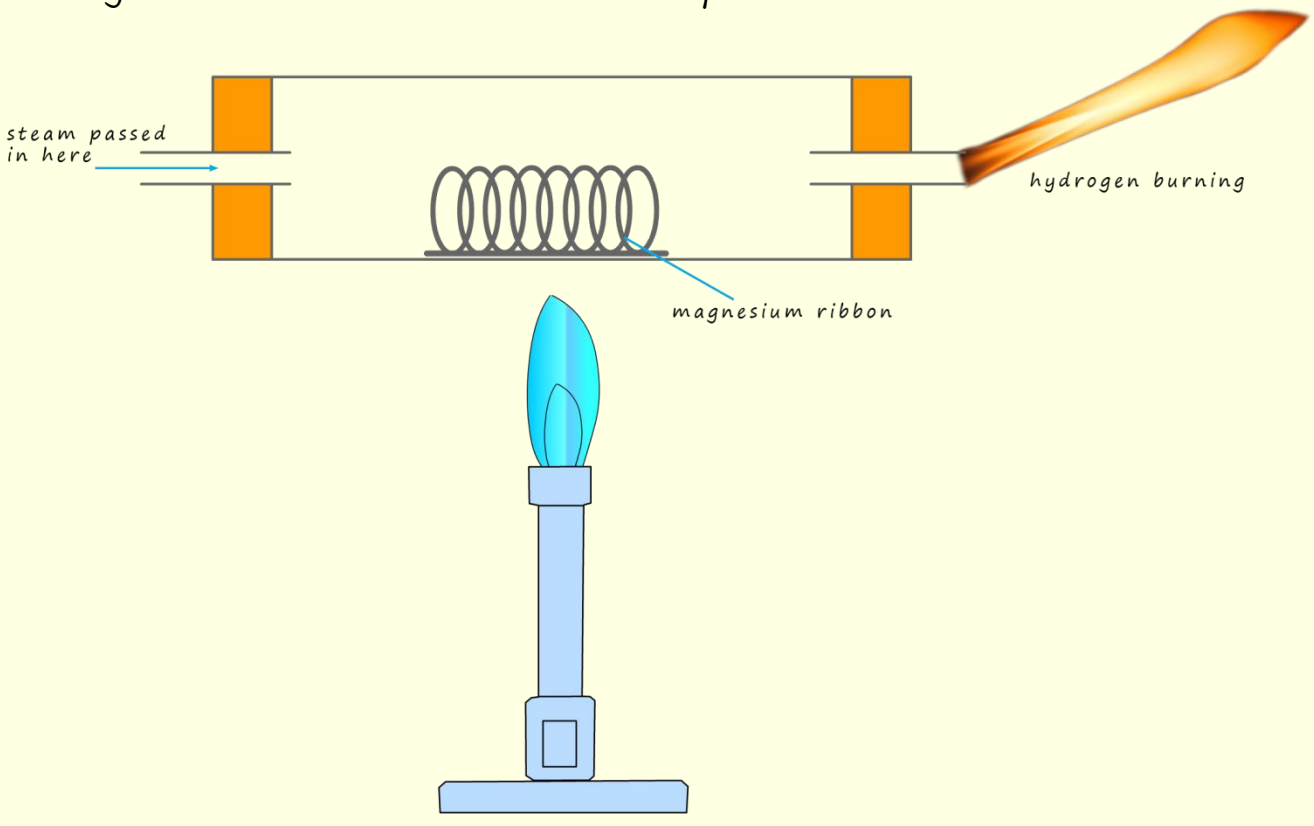
2. The Kroll process is used to extract titanium metal from its ore. An equation for this process is shown below.

Titanium chloride + magnesium ⟶ magnesium chloride + titanium

$$TiCl_4 + 2Mg \longrightarrow 2MgCl_2 + Ti$$

a. 380kg of titanium chloride underwent a displacement with magnesium. The expected yield of titanium was 96Kg. However only 55kg was obtained. Calculate the percentage yield for this reaction.

3. Magnesium was placed in a glass tube and heated strongly using a Bunsen burner as shown below. Hot steam from a generator was passed over the hot magnesium and a violent reaction took place:



The magnesium reacted according to the equation below:

The student placed 1g of magnesium ribbon in the tube.

A_r of Mg = 24 A_r of O = 16

a. Calculate the maximum mass of magnesium oxide that could be produced.

b. When the student carried out the reaction she collected 1.2g of magnesium oxide. Calculate the percentage yield for this reaction.

c. Suggest why the yield was less than 100%

d. The student repeated the experiment 3 times and record the mass of the magnesium oxide produced. Her results are shown below:

	Experiment 1	Experiment 1	Experiment 1
Mass of magnesium oxide produced/g	1.2	1.1	1.3

i. Calculate the mean mass of magnesium oxide produced.

ii. How could the experimental results be made more precise?

iii. The three experiments produced slightly different masses of magnesium oxide. This was due to experimental error. Suggest the causes of these experimental errors.

Answers

1. Billy burned 2.4g of magnesium ribbon. He held the magnesium on a burning spoon as shown in the diagram. Once the magnesium had stopped burning he scrapped the magnesium oxide off the burning spoon and onto a balance to weigh his product. He expected to obtain 4g of magnesium oxide. However he only managed to get 1.75g of magnesium oxide.

a. Calculate the percentage yield in this reaction.

% yield = 1.75g/4 x 100% = 44%

b. Suggest why his percentage yield was so low.

A lot of the magnesium oxide escaped into the air when the magnesium was being burned.

Some of the magnesium oxide was left on the burning spoon.

c. What could Billy have done to improve the yield in this reaction?

Burn the magnesium inside a crucible with a lid on. This would have prevented most the magnesium oxide from escaping into the air.

2. The Kroll process is used to extract titanium metal from its ore. An equation for this process is shown below.

Titanium chloride + magnesium ⟶ magnesium chloride + titanium

$$TiCl_4 + 2Mg \longrightarrow 2MgCl_2 + Ti$$

a. 380kg of titanium chloride underwent a displacement with magnesium. The expected yield of titanium was 96Kg. However only 55kg was obtained. Calculate the percentage yield for this reaction.

% yield = 55kg/96kg x 100% = 57%

3. Magnesium was placed in a glass tube and heated strongly using a Bunsen burner as shown below. Hot steam from a generator was passed over the hot magnesium and a violent reaction took place:

   The magnesium reacted according to the equation below:

$$Mg_{(s)} + H_2O_{(g)} \longrightarrow MgO_{(s)} + H_{2(g)}$$

The student placed 1g of magnesium ribbon in the tube.

A_r of Mg = 24 A_r of O = 16

a. Calculate the maximum mass of magnesium oxide that could be produced.

M_r of magnesium oxide is 24= 16= 40. So 1 mole is 40g.

From the equation 1 mole of Mg ⟶ 1 mole of MgO

24g Mg ⟶ 40g MgO

1g Mg 40/24= 1.67g MgO

b. When the student carried out the reaction she collected 1.2g of magnesium oxide. Calculate the percentage yield for this reaction.

% yield = 1.2g/1.67g x 100% = 72%

c. Suggest why the yield was less than 100%

- Not all the Mg reacted.
- Some MgO could have escaped from the tube into the air.
- Some MgO could have been left in the apparatus and not weighed.

- Mg not 100% pure.

d. The student repeated the experiment 3 times and record the mass of the magnesium oxide produced. Her results are shown below:

	Experiment 1	Experiment 1	Experiment 1
Mass of magnesium oxide produced/g	1.2	1.1	1.3

i. Calculate the mean mass of magnesium oxide produced.

Mean = (1.2 + 1.1 + 1.3)/3 = 1.2g

ii. How could the experimental results be made more precise?

Use apparatus with smaller scale division, e.g. scales that measure to 2 d.p.

iii. The three experiments produced slightly different masses of magnesium oxide. This was due to experimental error. Suggest the causes of these experimental errors.

- Incorrectly read the balance.
- Spilled some magnesium oxide.
- Incorrect use of the balance.
- Balance faulty.
- Impurities in Magnesium oxide.
- Magnesium oxide damp