14–16 years

The change in mass when magnesium burns

ROYAL SOCIETY OF CHEMISTRY

Education
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Learning objectives

- Safely investigate burning magnesium to produce magnesium oxide.

- Correctly record the change in mass.

- Explain why the mass changes.

- Use data to calculate the relative formula mass.

Burning magnesium

In this experiment, you will record the mass of magnesium and heat it in a crucible, calculating the change in mass from before it is heated to after.

You will then calculate the formula of magnesium oxide that is formed.

crucible

pipe clay triangle

magnesium

tripod

Bunsen burner

heat resistant mat
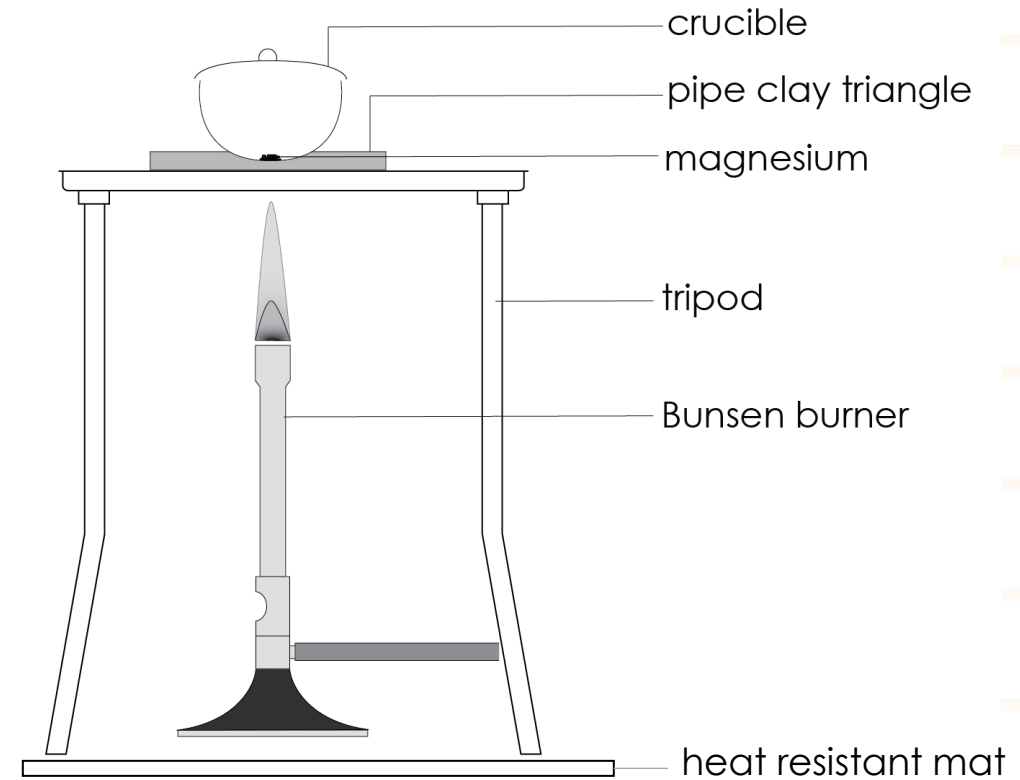
Method (part 1)

1. Take a piece of magnesium ribbon 5–10 cm long. If it looks tarnished or black, then clean it using the emery paper. Twist it into a loose coil.

2. Record the mass of the crucible **with** lid (mass 1) and then again with the magnesium inside (mass 2).

3. Set up the Bunsen burner on the heat resistant mat with the tripod. Place the pipe clay triangle over the tripod, ensuring that it is secure. Place the crucible containing the magnesium in the pipe clay triangle and put the lid on.

Method (part 2)

4. Light the Bunsen burner and begin to heat the crucible. It is best to start with a gentle blue flame, then increase to a roaring flame (with the air hole fully open) to get the reaction to go.

5. Once the crucible is hot, gently lift the lid with tongs a little to allow some oxygen to get in. You may see the magnesium begin to flare up. If the lid is lifted for too long, then the magnesium oxide product will begin to escape. Don't let this happen.

6. Keep heating and lifting the lid until there is no further reaction.
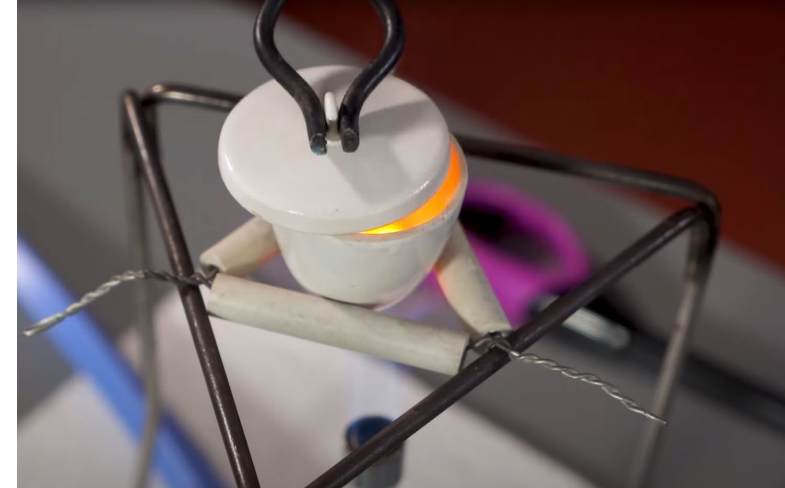
DANGER: do not look directly at magnesium when it is burning.

Method (part 3)

7. Turn off the Bunsen burner and allow the apparatus to cool.

8. Re-record the mass of the crucible with lid containing the product (mass 3).

9. Heat the crucible again for a couple of minutes and once again allow to cool. Repeat this step until the mass readings are consistent. This is known as heating to constant mass.
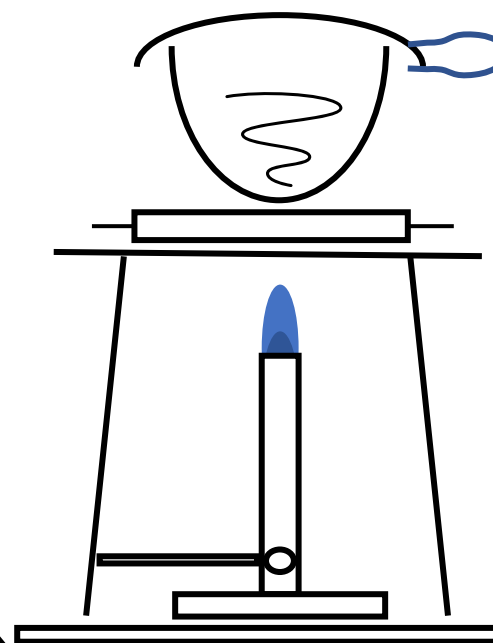
❶ Record mass of crucible with lid (mass 1) ❑

`0.00 g`
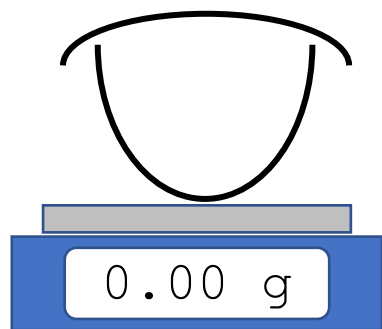
❷ Coil Mg ribbon ❑
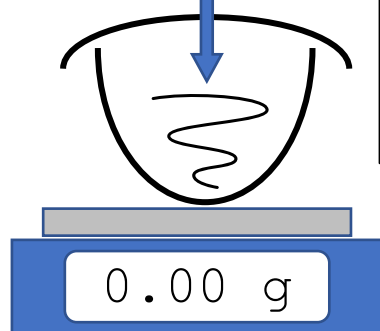
❸ Record mass of Mg inside crucible with lid (mass 2) ❑
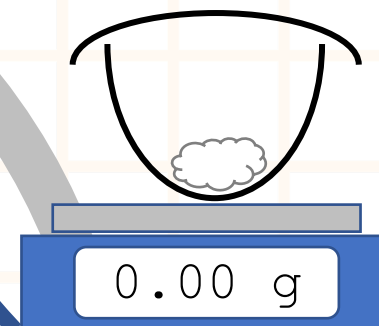
`0.00 g`

❹ Heat Mg in crucible on roaring flame ❑

❺ Gently lift lid with tongs then replace lid ❑

❻ Keep heating until no further reaction ❑

❼ Leave to cool ❑

❽ Record mass of crucible with lid containing product (mass 3) ❑

`0.00 g`

❾ Repeat steps 4–8 until mass remains constant ❑

Results table

Mass 1 (g) crucible + lid	Mass 2 (g) crucible + magnesium + lid before heating	Mass 3 (g) crucible + product + lid after heating

Questions

1. Using the data you recorded in your table, state what happened to the mass during this reaction.

2. In this experiment, magnesium (Mg) was heated with oxygen (O_2) in the air to form magnesium oxide (MgO).

(a) Write a word equation for the reaction.

(b) Write a balanced symbol equation for this reaction.

(c) Identify the reactants in this reaction.

(d) Identify the product in this reaction.

3. Describe what happened to the mass during this reaction.

4. Explain why the lid must not be fully removed from the crucible during this reaction.

Finding the formula of magnesium oxide

Method one: calculation method

To find the formula of magnesium oxide, you will need to calculate the ratio between the number of moles of magnesium and the number of moles of oxygen in the compound.

The equation to calculate the number of moles is:

$$\text{Number of moles of element} = \frac{\text{mass of element}}{A_{\text{r}} \text{ of element}}$$

The relative atomic mass (A_{r}) of magnesium is 24 and the A_{r} of oxygen is 16.

To calculate the ratio, you need to divide the number of moles of magnesium by the number of moles of oxygen.

Example calculation

Mass of magnesium $=$ 2.39 g

Mass of magnesium oxide $=$ 3.78 g

Mass of oxygen $=$ 1.39 g

A_r of Mg $=$ 24

A_r of O $=$ 16

Number of moles Mg $= \frac{2.39}{24} = 0.0995$

Number of moles of O $= \frac{1.39}{16} = 0.0868$

Divide the number of moles of magnesium by the number of moles of oxygen to give the ratio:

$$\text{Ratio of Mg: O} = 1:\frac{\text{Number of moles of Mg}}{\text{Number of moles of O}} = 1:\frac{0.0995}{0.0868} = 1:1.15$$

Your turn

Mass of magnesium = _____

Mass of magnesium oxide = _____

Mass of oxygen = _____

A_r of Mg $= 24$

A_r of O $= 16$

Number of moles Mg = _____

Number of moles of O = _____

Divide the number of moles of magnesium by the number of moles of oxygen to give the ratio.

- If the ratio is close to 1:1, the formula of magnesium oxide is MgO.

- If the ratio is close to 1:2, the formula of magnesium oxide is MgO_2.

- If the ratio is close to 2:1, the formula of magnesium oxide is Mg_2O.

Class results

Method two: graphical method

Collect all the mass of magnesium and mass of oxygen data for your class.

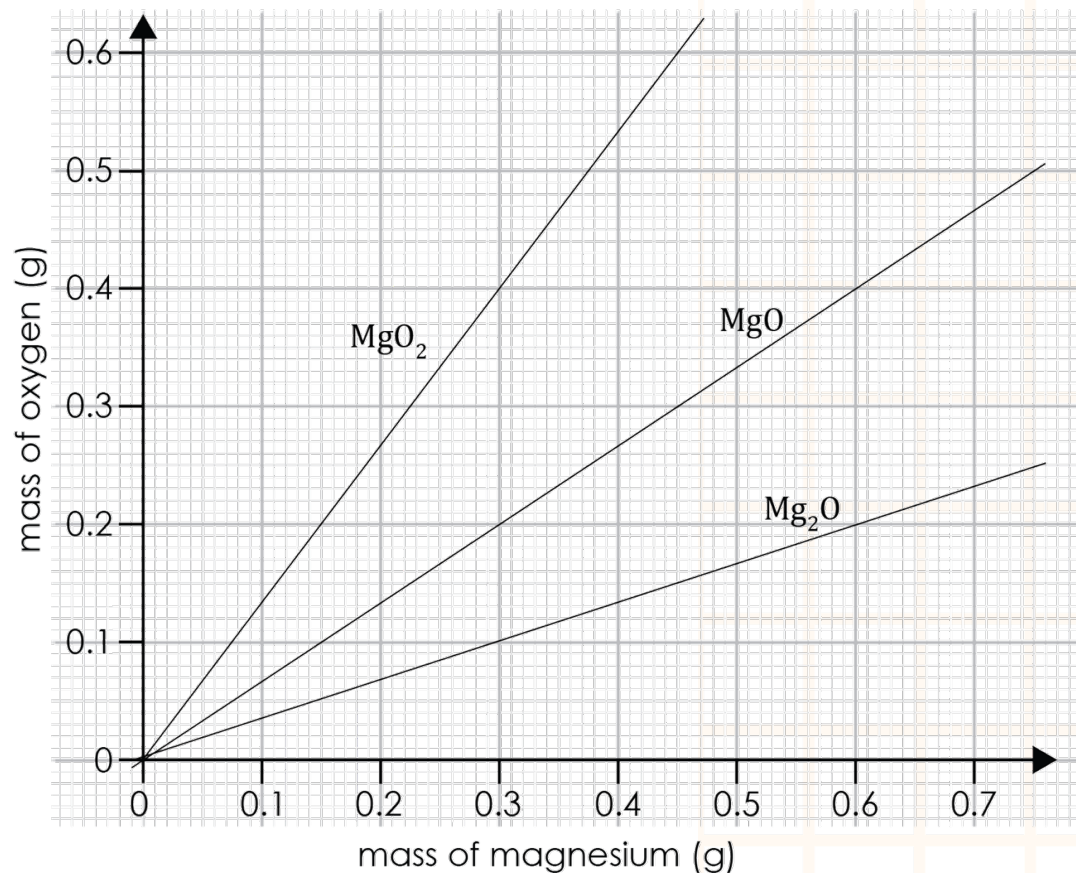| Group	Mass of magnesium (g)	Mass of oxygen (g)
Group 1		
Group 2		
Group 3		
Group 4		
Group 5		
Group 6		
Group 7		
Group 8		
Group 9		
Group 10		

Finding the formula of magnesium oxide

Method two: graphical method

Plot all the class data onto the graph opposite.

Draw a straight line of best fit.

Compare this to the pre-drawn lines on the graph.

Learning objectives

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Have you met all of the learning objectives?