# Conservation of mass: supporting resources

### This resource supports the practical video Conservation of mass, available here: [**rsc.li/373X3aW**](rsc.li/373X3aW)

### Using the follow-up worksheet

The follow up worksheet for this video develops mathematical skills and brings together other aspects of quantitative chemistry. There are two differentiated versions.

The support sheet is presented in a table format which helps to break down the stages of each calculation into smaller steps and appears less daunting for learners than a long list of questions. Guidance on how to structure the calculations are given in faded text to further support learners.

The challenge sheet is laid out linearly and includes an additional task which approaches calculations with molar values.

The questions in this follow up activity concentrate on the reaction of magnesium and oxygen. Learners could be further challenged to write their own questions and mark scheme based on the reaction of calcium carbonate with hydrochloric acid.

## **Follow-up worksheet: calculations (support)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1. Write a balanced symbol equation for the following reaction: | | | | | |
| magnesium + oxygen → magnesium oxide  Mg + O2 → MgO | | | | | |
| 2. What is the atomic mass of Mg? |  | 3. What is the relative formula mass of O2? | 16 x 2 = | 4. What is the relative formula mass of MgO? | 24 + 16 = |
| 5. What is the mass of magnesium that would react with 1 g of oxygen? | | | (2 x RAM of Mg) / RFM of O2  ( 2 x ) ÷ =  g | | |
| 6. What is the mass of magnesium oxide that would be produced from 1 g of oxygen? | | | (2 x RFM of MgO) / RFM of O2  ( 2 x ) ÷ =  g | | |
| A magnesium strip was heated in a crucible over a Bunsen flame. The total mass of the crucible and magnesium before was 48.29 g. The total mass of the crucible and magnesium oxide after was 48.36 g. | | | | | |
| **Change in mass (g) = total mass after (g) – total mass before (g)** | | | | | |
| 7. What is the change in mass? | | - =  g | 8. What is the mass of oxygen that combined with magnesium in this reaction? | | g |
| 9. What is the mass of a magnesium strip that would have completely reacted to produce that change in mass? | | | | | |
| Mass of Mg that would react with 1 g of O2 (Q5) x mass of O2 (Q8)  x =  = g | | | | | |
| 10. What is the mass of magnesium oxide that would be produced from 0.07 g of oxygen? | | | | | |
| Mass of MgO that would be produced from 1 g of O2 (Q6) x mass of O2 (Q8)  x =  = g | | | Or alternatively, mass of Mg strip calculated in Q9 + mass of oxygen (Q8)  + =  = g | | |
| The actual mass of the magnesium strip that was added to the crucible was 0.13 g. | | | | | |
| 11. What should the theoretical change in mass have been? | (RFM of O2 / 2 x RAM of Mg) x actual mass of Mg =  ( ÷ ) x  =  = g | 12. What should the theoretical yield of magnesium oxide have been? | (RFM of MgO / RAM of Mg) x actual mass of Mg =  ( ÷ ) x  =  = g | 13. Was the actual change in mass smaller or larger than the theoretical  change in mass? |  |
| 14. How can you account for the difference between the actual and the theoretical change? | | | | | |
|  | | | | | |

## **Follow-up worksheet: calculations (challenge)**

### Part one: reacting masses approach

1. Write a balanced symbol equation for the following reaction:

magnesium + oxygen → magnesium oxide

1. What is the atomic mass of Mg?
2. What is the relative formula mass of O2?
3. What is the relative formula mass of MgO?
4. What is the mass of magnesium that would react with 1 g of oxygen?
5. What is the mass of magnesium oxide that would be produced from 1 g of oxygen?

A magnesium strip was heated in a crucible over a Bunsen flame. The total mass of the crucible and magnesium before was 48.29 g. The total mass of the crucible and magnesium oxide after was 48.36 g.

1. What is the change in mass?
2. What is the mass of oxygen that combined with magnesium in this reaction?
3. What is the mass of a magnesium strip that would have completely reacted to produce that change in mass?
4. What is the mass of magnesium oxide that would be produced from 0.07 g of oxygen?

The actual mass of the magnesium strip that was added to the crucible was 0.13 g.

1. What should the theoretical change in mass have been?
2. What should the theoretical yield of magnesium oxide have been?
3. Was the actual change in mass smaller or larger than the theoretical change in mass that you calculated?
4. How might you account for the difference between the actual and the theoretical change?

### Part two: mole calculations

*Remember: number of moles = mass (g) / relative formula mass*

1. In part one you worked out the mass of oxygen that combined with magnesium by calculating the change in mass (Q7 and Q8).

How many moles of oxygen is this equal to?

1. What is the mass of 0.4 moles of magnesium oxide?

What is the mass of magnesium required to produce 0.4 moles of MgO?

1. The actual mass of the magnesium strip used in part 1 was given as 0.13 g. If the length of this strip was 8 cm, what length of magnesium strip would you need to make 0.4 moles of MgO?

## **Follow-up worksheet: calculations (support / challenge part one) ANSWERS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1. Write a balanced symbol equation for the following reaction: | | | | | |
| magnesium + oxygen → magnesium oxide  **2**Mg + O2 → **2**MgO | | | | | |
| 2. What is the atomic mass of Mg? | **24** | 3. What is the relative formula mass of O2? | **16 x 2 =**  **32** | 4. What is the relative formula mass of MgO? | **24 + 16 =**  **40** |
| 5. What is the mass of magnesium that would react with 1 g of oxygen?  (RAM of Mg / RFM of O2) | | | **(2 x RAM of Mg) / RFM of O2 (2x24)/32 = 0.6857**  **= 1.50 g** | | |
| 6. What is the mass of magnesium oxide that would be produced from 1 g of oxygen? | | | **(2 x RFM of MgO) / RFM of O2 (2 x 40)/32 = 2.5**  **= 2.50 g** | | |
| A magnesium strip was heated in a crucible over a Bunsen flame. The total mass of the crucible and magnesium before was 48.29 g. The total mass of the crucible and magnesium oxide after was 48.36 g. | | | | | |
| **Change in mass (g) = total mass after (g) – total mass before (g)** | | | | | |
| 7. What is the change in mass? | | **48.36 - 48.29 =**  **0.07 g** | 8. What is the mass of oxygen that combined with magnesium in this reaction? | | **0.07 g** |
| 9. What is the mass of a magnesium strip that would have completely reacted to produce that change in mass? | | | | | |
| **Mass of Mg that would react with 1 g of O2 (Q5) x mass of O2 (Q8) 1.5 x 0.07 = 0.105**  **= 0.11 g** | | | | | |
| 10. What is the mass of magnesium oxide that would be produced from 0.07 g of oxygen? | | | | | |
| **Mass of MgO that would be produced from 1 g of O2 (Q6) x mass of O2 (Q8)**  **2.50 x 0.07 = 0.175**  **= 0.18 g** | | | **Or alternatively,**  **answer to mass of Mg strip calculated in Q9**  **+ mass of oxygen (Q8) 0.11 + 0.07 = 0.18 g** | | |
| The actual mass of the magnesium strip that was added to the crucible was 0.13 g. | | | | | |
| 11. What should the theoretical change in mass have been?\* | **RFM of O2 / RAM of Mg =**  **32/48 = 0.67**  **0.67 x 0.13 =**  **0.0871**  **= 0.09 g**\* | 12. What should the theoretical yield of magnesium oxide have been? | **RFM of MgO / RAM of Mg =**  **80/48 = 1.67**  **1.67 x 0.13 =**  **0.2171**  **= 0.22 g** | 13. Was the actual change in mass smaller or larger than the theoretical  change in mass? | **0.07<0.09**  **smaller** |
| 14. How can you account for the difference between the actual and the theoretical change? | | | | | |
| * **Some of the product may have been lost to the surroundings when the crucible lid was lifted to let in the oxygen** * **The reaction may not have gone to completion (some of the magnesium may not have fully reacted).** | | | | | |

\*Note: learners using the challenge sheet may take a different approach to arrive at this answer

### Part two: mole calculations

*Remember: number of moles = mass (g) / relative formula mass*

1. In part one you worked out the mass of oxygen that combined with magnesium by calculating the change in mass (Q7 and Q8).

How many moles of oxygen is this equal to?

##### Number of moles = mass (g) / relative formula mass

##### = 0.07 / 32

##### = 0.0021875

##### = 0.0022 mol

1. What is the mass of 0.4 moles of magnesium oxide?

##### mass = number of moles x relative formula mass

##### = 0.4 x 40

##### = 16.0 g

1. What is the mass of magnesium required to produce 0.4 moles of MgO?

##### Method 1

##### From the equation 2 moles of Mg produces 2 moles of MgO Therefore 0.4 moles of Mg produces 0.4 moles of MgO Mass of Mg = moles x RFM = 0.4 x 24 = 9.6 g

##### Method 2

##### To produce 1 g:

##### Amount of magnesium = RAM of magnesium / RFM of magnesium oxide

##### = 24 / 40 = 0.6 g

##### To produce 16.0 g:

##### 0.6 x 16.0 = 9.6 g

1. The actual mass of the magnesium strip used in part 1 was given as 0.13 g. If the length of this strip was 8 cm, what length of magnesium strip would you need to make 0.4 moles of MgO?

##### 8 cm = 0.13 g

##### 0.08 m = 0.13 g

##### Metres per gram: 0.08 / 0.13 = 0.62 m/g

##### 0.62 x 9.6 = 5.95 m