# Conservation of mass: supporting resources

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

**How to use the additional resources**

### Using the pause-and-think questions

Pause-and-think questions are supplied in two formats: a teacher version for ‘live’ questioning and a student version which can be used during independent study. The time stamps allow you to pause the video when presenting to a class, or learners to use for active revision.

The questions could also be used to support delivery of the experiment as a demonstration or class practical. Responses will help you to assess understanding and address misconceptions.

#### **Teacher version**

The questions are presented in a table and you can choose to use as many or as few questions as appropriate for your class and the learning objectives.

Some questions have two timestamps to allow you to adapt the questions for different classes or scenarios. Pause the videos at the earlier timestamp to ask a question before the answer is given, useful for revision or to challenge learners. Pause at the later timestamp to ask a question reflectively and assess whether learners

have understood what they have just heard or seen. This would be useful when introducing a topic, in a flipped learning scenario or when additional support and encouragement is needed.

Think about how you will ask for responses. Variation may help to increase engagement – students could write and hold up short answers; more complex questions could be discussed in groups.

Not all answers to questions are included in the video. Some of the questions will draw on prior learning or extend learners’ thinking beyond the video content.

#### **Student version**

The same questions are offered as a printable worksheet for learners. Use in situations where there is not a teacher present to guide discussion during the video, for example homework, revision or a remote learning environment.

## **Pause-and-think questions**

### Teacher version

|  |  |  |  |
| --- | --- | --- | --- |
| **Timestamp(s)** | | **Question Answer/discussion points** | |
| 00:00 | 00:30 | What do you think is meant by the term ‘conservation of mass’? Write a definition in your own words or share your ideas with the class. | See the separate Frayer model as an example of how to explore learners’ ideas about ‘conservation’ before showing the video. |
| 00:53 | | Write down or improve your definition.  Try to include the words ‘reactants’ and ‘products’. | Mass (or matter) cannot be created or destroyed during a chemical reaction. Products and reactants will have the same mass. |
| 01:12 | | How can you explain the conservation of mass when a liquid turns into a gas? Does steam have mass? What about oxygen gas? | Conservation of mass still applies even when there is a change in state. Gasses still contain the same number of atoms. |
| **01:29** | | **Reaction of magnesium and oxygen** | |
| 01:39 | 01:54 | What is the name of the white powder formed when magnesium reacts with oxygen? | Magnesium oxide |
| 02:06 | 02:11 | Why does the crucible need a loose fitting lid? | To ensure that oxygen can get in and the reaction can complete. |
| 02:13 | 02:20 | Why is the magnesium in a loose curl? | It needs to be curled to fit in the base of the crucible but only loosely so that oxygen can still get to the surface of the metal. |
| 02:32 | 02:43 | Record the mass of magnesium and the crucible in the results table. | 48.29 g  Draw or use one of the printable results tables provided. |
| 03:30 | 03:47 | Why do we need to carefully lift the lid? | To allow oxygen into the crucible.  To check that the reaction has completed. Carefully, to ensure that no product escapes. |
| 04:05 | 04:11 | Why is it important that we don’t lose any of the white powder? | Loss of the powder will reduce the final mass that we are trying to measure. |
| 04:23 | | Record the final mass of the crucible in the results table. | 48.36 g |
| Is the final mass more than or less than the starting mass? | The mass has increased. |
| **04:31** | | **Reaction of calcium carbonate with hydrochloric acid** | |
| 04:52 | | When filling the measuring cylinder you must bend down to observe it at eye-level. Why? | A parallax error will occur if you read the measuring cylinder from above or below the level it is filled to. The measuring cylinder must be stood on a flat surface. |
| 05:08 | | Record the mass of the marble chips and flask of acid in your results table. | 80.60 g |
| 05:14 | 05:23 | What are the products of a reaction between hydrochloric acid and calcium carbonate? Can you write a word and balanced symbol equation? | Calcium chloride (salt), water and carbon dioxide |
| 05:20 | 05:23 | What do the bubbles forming tell us? Can you name the product? How could you test to see if you are right? | A gas is being released. The gas is carbon dioxide. Test by bubbling the product through limewater using a bung and delivery tube. |

|  |  |  |  |
| --- | --- | --- | --- |
| 05:27 | | What is meant by ‘the reaction completes’? | One of the reactants is completely used up so the reaction ends. |
| 05:36 | | There are some marble chips still visible in the beaker. What does this tell us about the reactants? | The calcium carbonate is in ‘excess’. The hydrochloric acid has all reacted. |
| 05:39 | | How might the reaction have been different if we had used larger marble chips? | Larger chips of the same mass would have a smaller surface area to volume ratio.  This would give a slower rate of reaction. The final mass should still be the same but it would take longer for the reaction to complete. |
|  | | Alternative: How might the reaction have been different if we had used powdered CaCO3?  Less chips? More chips? | These would affect the rate of reaction but not the final change in mass. |
| 05:44 | | Record the final mass in the results table. | 80.13 g |
| Is the final mass more than or less than the starting mass? | The mass has decreased. |
| **05:48** | | **Calculating the change in mass** |  |
| 06:00 | | Complete the results table by calculating the change in mass (pause with equation on screen). | 48.36 – 48.29 = +0.07  80.13 – 80.60 = -0.49 |
| 06:06 | 06:15 | What does a positive/negative change in mass mean? | A positive change in mass means that we have observed an increase in mass. A negative change in mass means that we have observed a decrease in mass. |
| 07:00 | | Add state symbols to the symbol equation. | 2Mg(s) + O2(g) → 2MgO(s) |
| 07:18 | | Add state symbols to the symbol equation. | CaCO3(s) + 2HCl(aq) → CaCl2(aq) + CO2(g) + H2O(l) |
| 08:11 | | Why does the sealed bag have the same mass before and after the reaction? | Because the closed system prevents the carbon dioxide from being lost to the surroundings. The mass of the gas is still included in the total mass of the sealed bag. |
| 08:11 | | What would happen if the bag was opened? | The carbon dioxide gas would escape to the surroundings and the mass would decrease. |
| 08:30 | | Please see the separate resource for a structure strip and suggested response to the following long-answer question: | |
| *A student has a conical flask containing 200 cm3 of hydrogen peroxide.*  *They added the catalyst manganese oxide which speeds up the decomposition of hydrogen peroxide to water and oxygen. At the end of the reaction they observed that the mass of water produced was less than the mass of hydrogen peroxide they started with.*  *The student is concerned that the law of conservation of mass does not work.*  *Explain how conservation of mass can still be applied even when there is an observed change in mass.* | |

**Pause-and-think questions**

### Student version

Pause the video at the time stated to test or revise your knowledge of these practical experiments.

**Time Question**

00:30 What does the word ‘conservation’ mean?

00:30 What do you think is meant by the term ‘conservation of mass’? Write a definition in your own words.

00:53 Improve your definition. Try to include the words ‘reactants’ and ‘products’.

01:39 What is the name of the white powder formed when magnesium reacts with oxygen?

02:11 Why does the crucible need a loose fitting lid?

02:20 Why is the magnesium in a loose curl?

03:47 Why do we need to carefully lift the lid?

04:11 Why is it important that we don’t lose any of the white powder?

04:23 Is the final mass more than or less than the starting mass?

04:52 When filling the measuring cylinder you must stand with it at eye-level. Why?

05:14 What are the products of a reaction between hydrochloric acid and calcium carbonate?

Can you write a word and balanced symbol equation for this reaction?

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+ → + +

05:20 What do the bubbles forming tell us?

Can you name the product?

05:27 What is meant by ‘the reaction completes’?

05:36 There are some marble chips still visible in the beaker. What does this tell us about the reactants?

05:39 How might the reaction have been different if we had used larger marble chips?

05:44 Is the final mass more or less than the starting mass?

06:00 Complete the results table:

|  |  |  |  |
| --- | --- | --- | --- |
| **reaction** | **total mass before (g)** | **total mass after (g)** | **change in mass (g)** |
| magnesium and oxygen | 48.29 | 48.36 |  |
| calcium carbonate and hydrochloric acid | 80.60 | 80.13 |  |

change in mass (g) = total mass after (g) – total mass before (g)

06:06 What does a positive or negative change in mass mean?

07:00 Add state symbols to the symbol equation: 2Mg + O2 → 2MgO

07:18 Add state symbols to the symbol equation:

CaCO3 + 2HCl → CaCl2 + CO2 + H2O

08:11 Why does the sealed bag have the same mass before and after the reaction?

What would happen to the mass if the bag was now opened?

08:30 Now try writing a longer answer to this question using the structure strips: A student has a conical flask containing 200 cm3 of hydrogen peroxide.

They added the catalyst manganese oxide which speeds up the decomposition of hydrogen peroxide to water and oxygen. At the end of the reaction they observed that the mass of water produced was less than the mass of hydrogen peroxide they started with.

The student is concerned that the law of conservation of mass does not work.

Explain how conservation of mass can still be applied even when there is an observed change in mass.