# Reactivity series of metals: supporting resources

This resource supports the practical video Reactivity series of metals, available here: [rsc.li/3baSTPO](file:///C:\Users\ryderk\Downloads\rsc.li\3baSTPO)

## 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.

##### **Teacher version**

The questions are presented in a table and you can choose to use as many 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 – learners could write and hold up short answers; more complex questions could be discussed in groups.

Not all of the questions will be answered directly as part of the video. Some of the questions will draw on prior learning or will be used to 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 remote learning.

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

#### Teacher version

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| **Timestamp(s)** | | **Question** | **Answer/discussion points** |
| 00:16 | 00:22 | What property does a metal need to have to make a hot water pipe? | Does not rust. Note that the word rust is associated with iron only and we use the word corrode to describe the process with other metals. |
| 00:26 | 00:30 | What property does a metal need to have to make a food can? | Inert (unreactive) so it doesn't react with the food. |
| **00:36** | | **Reaction of alkali metals with water** |  |
| 00:57 | 01:01 | What is the name of the group 1 metals? | The alkali metals. |
| 01:26 | 01:30 | Why is lithium stored in oil? | So it doesn't react with oxygen or moisture in the air. |
| 02:00 | 02:02 | What do you see when you cut lithium with a knife? | A shiny surface. |
| 02:03 | 02:07 | Why does the shiny surface not last long? | Reacts quickly in air – we can say that it tarnishes in air. |
| 02:07 | | What does this suggest we are going to find about the reactivity of lithium compared to other metals? | It suggests that lithium is more reactive to start with than other metals. |
| 02:17 | 02:30 | Write down three observations of lithium in water. | Floats and moves slowly around on the surface of the water (note that these two statements are usually the same mark).  Fizzes (effervescence).  Solid lithium disappears/gets smaller. |
| 02:47 | 02:56 | Why does universal indicator go purple after the reaction has finished? | We are making a soluble alkali solution called lithium hydroxide containing OH- ions. |
| 03:02 | 03:07 | Write a word equation followed by a symbol equation for the reaction of lithium and water. | Lithium + water → lithium hydroxide  + hydrogen  2Li(s) + 2H2O(l) → 2LiOH(aq) + H2(g) |
| 03:28 | 03:33 | What is the difference between cutting lithium and sodium? | It is easier to cut sodium, sodium is a softer metal. |
| 03:44 | | The newly cut surface of sodium goes duller more quickly in air than lithium. What does this suggest we are going to find about the reactivity of sodium compared to lithium? | It suggests sodium will be more reactive than lithium as it reacts more quickly with air. |
| 04:00 | 04:08 | Write down three observations of sodium in water. | Floats and moves quickly across the water. Fizzes (effervescence).  Melts into a ball.  Solid metal disappears.  (*Melts into a ball will usually be a different mark to solid metal disappears.*) |
| 04:15 | 04:19 | Identify three things from the observations that suggest sodium is more reactive  than lithium. | Moves more quickly across the water. Fizzes more vigorously.  Melts into a ball. |
| 04:23 | 04:29 | Give two similarities between the reactions of sodium and lithium with water. | Both fizzed.  Both metals floated and moved across the surface.  Both metals ‘disappeared’. |

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| 04:36 | 04:43 | The universal indicator turns purple. Name the alkaline solution that has been produced. | Sodium hydroxide, an alkaline solution. |
| 04:46 | 04:51 | Write a word equation followed by a symbol equation for the reaction of sodium and water. | Sodium + water → sodium hydroxide  + hydrogen  2Na(s) + 2H2O(l) → 2NaOH(aq) + H2(g) |
| 05:11 | 05:16 | How does cutting potassium compare with sodium and lithium? | It is much easier, because it is much softer. |
| 05:47 | 06:16 | Write down three observations for potassium with water. Put a star against two observations that show it is the most reactive alkali metal. | Floats and moves *very quickly*\* across the water.  Fizzes (effervescence).  *Self-ignites with lilac flame*.\* Potassium disappears. |
| 06:22 | 06:25 | What is the name of the alkali solution that turns the universal indicator purple? | Potassium hydroxide solution. |
| 06:29 | 06:38 | Write a word equation followed by a symbol equation for the reaction of potassium and water. | potassium + water → potassium hydroxide  + hydrogen  2K(s) + 2H2O(l) → 2KOH(aq) + H2(g) |
| 06:38 | | What gas is given off in all three reactions described and how would you test for it? | Hydrogen. A lit splint gives a squeaky pop. |
| 06:38 | 06:43 | What is the pattern for the reactivity of the alkali metals going down the group? | Reactivity increases. |
| **06:49** | | **Reactivity of metals with acid** |  |
| 07:05 | | Why are these reactions described as exothermic? | Heat energy released to the surroundings. |
| 07:12 | 07:15 | Why is an insulated cup used? | To reduce heat loss. |
| 07:40 | | Why is the presenter bending down to look at the measuring cylinder? | So that she has the meniscus at eye level (and doesn’t introduce parallax error). |
| 07.48 | 07:56 | You are measuring temperature *change*, so what must you make sure you measure? | Starting temperature (and maximum temperature reached). |
| 07:56 | | Identify the independent variable. Identify the dependent variable. | Type of metal.  Temperature *change* (must write the word change). |
| 07:59 | | Record the starting temperature in your results table. | 19.5 °C |
| 08:05 | | Why do you add a lid (with a hole in)? | To stop heat loss (by convection or evaporation). (The hole is for the thermometer, but is not important for answering a question about heat loss.) |
| 08:17 | 08:23 | Record the final temperature in your table.  Calculate the temperature change. | 27.0 °C  7.5 °C |
| 08:49 | 08:55 | Identify 3 control variables (for a fair test). | Same volume of acid.  Same concentration of acid. Same mass of metal. |
| 09:05 | 09:10 | Complete your results table. | Use your own results or wait until the second time stamp to use the example results from the video. |
| 09:10 | | Calculate the change in temperature. | Zinc – 7.5 °C Magnesium – 51.0 °C Copper – 0.0 °C  Iron – 4.0 °C |

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| 09:14 | | Check your answers (if using the sample results from the video).  Why is the temperature change given to 1 decimal place? | Learners will have different answers if using their own results. Discuss the reason for any variation – room temperature, amount of metal powder used, efficacy of insulation, errors in procedure etc.  Because the measurement on the thermometer was taken to the nearest 0.5 °C. The answer shows the level of accuracy in the measurements taken. |
| 09:18 | 09:28 | Using your results put the metals in order of reactivity.  How are you going to do this? | Mg > Zn > Fe > Cu  The metal with the highest temperature rise is the most reactive. |
| 09:38 | 09:44 | Recall the general equation for a reaction between a metal and an acid.  What is the common name of the salts produced when using hydrochloric acid? | Metal + acid → a salt + hydrogen  *(A common way of remembering this is MASH.)*  Chlorides. |
| 10:01 | 10:06 | What gas is formed?  How do you know? | Hydrogen.  A lit splint gave a squeaky pop. |
| 10:17 | 10:22 | Write the word and chemical equations. | Magnesium + hydrochloric acid → magnesium chloride + hydrogen Mg(s) + 2HCl(aq) → MgCl2(aq) + H2(g)  Zinc + hydrochloric acid → zinc chloride +  hydrogen  Zn(s) + 2HCl(aq) → ZnCl2(aq) + H2(g)  Iron + hydrochloric acid → iron chloride +  hydrogen  Fe(s) + 2HCl(aq) → FeCl2(aq) + H2(g) |
| 10:22 | 10:28 | Why didn’t we write an equation for the reaction of copper with hydrochloric acid? | There was no reaction. |
| **10:35** | | **Metal displacement reactions** |  |
| 10:50 | 10:57 | Think back to the metal and acid experiment. Why would it be difficult to put copper in order of reactivity? | It does not react with water or acid. Therefore, you can't work out if it is more or less reactive than any other metal that also does not react with water and acid. |
| 11:02 | 11:07 | What does displacement mean? | A more reactive metal displaces a less reactive metal from its compound.  Use the Frayer model in the resources pack to explore this key term further. |
| 11:19 | | Why is the microscale version better for the environment? | Harmful chemicals. Less volume will be less harmful. Less volume will be easier to dispose of safely. |
| 12:49 | 12:52 | Why did you not need to add magnesium to magnesium sulfate, zinc to zinc sulfate or copper to copper sulfate? | A metal does not displace itself. |
| 13.04 | 13:17 | Write down observations in a results table. | A darker metal has appeared on the surface in column 1 row 2 and 3 and in column 2 row 3. The CuSO4 solution has changed colour. The appearance of bubbles also indicate that a reaction is taking place. |
| 13:25 | | Summarise the reactions that occurred with:   * magnesium * zinc * copper | Mg reacted with two other metal salts ZnSO4 and CuSO4.  Zn reacted with one other metal salt CuSO4.  Cu did not react. |

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| 13:48 | 14:22 | Use the information above to put Mg, Zn and Cu order of reactivity. | The order of reactivity is (from the most reactive) Mg, Zn, Cu. |
| 14:22 | 14:31 | Write word and symbol equations for the three reactions described above. | Magnesium + zinc sulfate → magnesium  sulfate + zinc  Mg(s) + ZnSO4(aq) → MgSO4(aq) + Zn(s)  Magnesium + copper(ii) sulfate →  magnesium sulfate + copper  Mg(s) + CuSO4(aq) → MgSO4(aq) + Cu(s)  Zinc + copper(ii) sulfate → zinc sulfate + copper  Zn(s) + CuSO4(aq) → ZnSO4(aq) + Cu(s) |
| 14:36 | | What is a redox reaction? | A reaction where oxidation and reduction are both taking place. |
| 14:36 | 14:42 | Complete the sentence:  The more reactive metal is and the less reactive metal is . | oxidised reduced |
| 14:50 | 15:17 | Using the reactions that have taken place, determine the order of reactivity and order the metals from most reactive to least reactive. | potassium sodium lithium magnesium zinc  iron  copper |
| 15:30 | | Now try writing a longer answer to this question using the structure strips:  A student has a sample of an unknown metal solid, labelled ‘metal *x*’. The sample is shiny in appearance and grey in colour.  Describe two different experiments that the student could carry out to place metal *x* in the reactivity series. Describe the reactions that would take place and the expected results if metal *x* is more reactive than copper but less reactive than iron.  Suggest an identity for metal *x*. | |

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## **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**

00:16 Give one property that a metal should have in order to make a hot water pipe.

00:26 Give one property that a metal should have in order to make a food can.

**Reaction of metals with water**

00:57 What is the name of the group 1 metals?

01:26 Why are all the group 1 metals stored in oil?

02:07 Explain what you see when you cut an alkali metal. Why does it not last long?

02:18 Fill in the chart below for your observations of the alkali metals in water.

|  |  |
| --- | --- |
| **alkali metal** | **observation in water** |
| Lithium |  |
| Sodium |  |
| Potassium |  |

06:16 List two similarities in the observations for the reactions of the alkali metals with water.

1.

2.

06:16 List two differences for the reaction of potassium with water compared to sodium and lithium.

1.

2.

06:25 Why does the universal indicator go purple after the reaction of each of the alkali metals in water?

06:38 Complete the word and symbol equations for the reaction of lithium, sodium and potassium with water.

Lithium + water → +

2Li(s) + 2H2O(l) → +

Sodium + → +

2Na(s) + 2H2O(l) → +

Potassium + water → +

+ → +

06:43 Put lithium, sodium and potassium in order of reactivity – most reactive first.

> > Describe the trend in reactivity of the group 1 metals.

**Reaction of metals with acid**

07:05 Why are metal reactions with acid described as exothermic reactions?

07:15 How do you minimise heat loss during the reaction between metals and acid?

07:56 Identify the independent variable in a reaction of different metals with acid.

Identify the dependent variable in the exothermic reaction of different metals with acid.

07:59 Read the temperature and complete the table.

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| --- | --- | --- | --- |
|  | **Temperature °C** | | |
| **Metal** | **Initial** | **Final** | **Change** |
| Zinc |  |  |  |

08:49 Identify three control variables in this experiment for a fair test.

1.

2.

3.

09:10 Fill in the results chart for the reaction of magnesium, zinc, iron and copper with acid.

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| --- | --- | --- | --- | --- |
|  | | **Temperature °C** | | |
| **Metal** | **Observation with acid** | **Initial** | **Final** | **Change** |
| Zinc |  |  |  |  |
| Magnesium |  |  |  |  |
| Copper |  |  |  |  |
| Iron |  |  |  |  |

09:28 What is the order of reactivity of magnesium, zinc, copper, iron putting the most reactive first?

> > >

09:38 The acid used in this experiment is hydrochloric acid. What is the name of the salts that will be produced?

10:06 The gas given off is hydrogen. What is the test for this gas?

10:17 Write a word and symbol equation for the reaction of zinc, iron and magnesium with acid.

Magnesium + hydrochloric acid → +

+ → +

Zinc + hydrochloric acid → +

+ → +

Iron + hydrochloric acid → +

+ → +

10:22 Why don’t we write an equation for the reaction of copper with hydrochloric acid?

**Metal displacement reactions**

11:02 Define displacement.

12:49 Why do you not add magnesium to magnesium sulfate?

13:04 Complete the table with a tick or a cross to indicate where a reaction has taken place.

|  |  |  |  |
| --- | --- | --- | --- |
| **Metal**  **Metal salt solution** | **Magnesium** | **Zinc** | **Copper** |
| Magnesium sulfate |  |  |  |
| Zinc sulfate |  |  |  |
| Copper(ii) sulfate |  |  |  |

13:48 Write down the order of reactivity of magnesium, zinc and copper with the most reactive first.

> >   
14:22 Write the word and symbol equations for the three reactions.

14:36 These reactions are redox equations. Define a redox reaction.

14:36 Complete the sentences using **reduced** and **oxidised**.

The more reactive metal is and the less reactive metal is

.

14:50 Using all the results from the three experiments of metals with water, acid and displacement, put the following metals in order of reactivity with the most reactive first: zinc, lithium, iron, copper, potassium, magnesium, sodium.

Most reactive

Least reactive

15:30 Now try writing a longer answer to this question using the structure strips:

A student has a sample of an unknown metal solid, labelled ‘metal *x*’. The sample is shiny in appearance and grey in colour.

Describe two different experiments that the student could carry out to place metal *x* in the reactivity series. Describe the reactions that would take place and the expected results if metal *x* is more reactive than copper but less reactive than iron.

Suggest an identity for metal *x*.

***This question has a structure strip. Find more resources to support you here rsc.li/3baSTPO.***