# Identifying ions: supporting resources

This resource supports the practical video Identifying ions, available here: <rsc.li/3dhnn5B>

## 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 have been put into four sections: general questions, flame tests, testing for positive ions and testing for negative ions.

#### **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 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 remote learning.

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

### Teacher version

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Timestamp(s) Question Answer/discussion points** | | | | | |
| 00:22 | | What is the difference between qualitative analysis and quantitative analysis? Give examples of each. | Qualitative analysis is where we can only identify which ions or molecules are present in an unknown sample. Chemical tests are an example of qualitative analysis.  Quantitative analysis is where we can identify the amount of the substance present, eg the actual concentration of an ion. Titrations are an example of quantitative analysis. | | |
| 00:33 | 00:45 | What is an ion?  Describe how a positive and negative ion is formed. | A positively or negatively charged particle.  A positive ion is formed when a particle loses electrons.  A negative ion is formed when a particle gains electrons. | | |
| 01:12 | | What will we be looking for during the chemical tests?  How will you know if a test has a positive result? | Signs that a chemical change has taken place, eg colour change, formation of a gas, temperature change, formation of a solid or a precipitate.  Consider the observed result. If there is only one possible ion with this result  then the result will be positive, eg a blue precipitate with sodium hydroxide indicates the presence of the copper ion. However  if there are several possibilities, eg a white precipitate is formed with sodium hydroxide then you will need to do further tests until there is only one possible answer. | | |
| **Flame tests** | | | | | |
| 01:22 | 01:29 | What are flame tests used to identify? | Metal ions. | | |
| 01:57 | | Why can’t we use a dry splint for a flame test? | A dry splint itself will burn and affect the colour that we see. A soaked splint will not burn immediately so we will only see the flame colour associated with the metal ions initially. | | |
| 02:32 | | Why do we test distilled water first. What does this show? | This is a control. It shows that the distilled water that the splints were soaked in does not affect the flame colour. | | |
| 02:52 | 02:58 | Record the flame colour for lithium in the table provided. | Lithium | Li+ | crimson |
| 03:09 | 03:15 | Record the flame colour for potassium in the table provided. | Potassium | K+ | lilac |
| 03:30 | 03:42 | Record the flame colour for calcium in the table provided. | Calcium | Ca2+ | orange-red |
| 03:52 | 03:56 | Record the flame colour for copper in the table provided. | Copper | Cu2+ | green |
| 04:11 | 04:14 | Record the flame colour for copper in the table provided. | Sodium | Na+ | yellow-orange |

|  |  |  |  |
| --- | --- | --- | --- |
| 04:25 | | Check your results or, if you haven’t yet done so, record the flame colours in your results table. | Lithium Li+ crimson  Potassium K+ lilac Calcium Ca2+ orange-red Copper Cu2+ green  Sodium Na+ yellow-orange |
| *04:36* | | *Challenge: Suggest a reason why different metals have different flame colours.* | *They have different electronic configurations. For more information, see the links in the teacher notes.* |
| **Testing for positive ions** | | | |
| 04:55 | | What are the benefits of microscale chemistry? | Benefits include:   * sustainability * safety * more careful observations can be made   Read more about the benefits of microscale: rsc.li/2ZtlkTM. |
| 05:17 | | What colour is sodium hydroxide? | Colourless |
| 05:30 | | Name the ions present in sodium hydroxide solution. | Sodium ion, Na+  Hydroxide ion, OH-  (*also some H+ and OH- from the water*) |
| 05:47 | 06:00 | Name the green precipitate formed when sodium hydroxide is added to iron (ii) ions. | Iron(ii) hydroxide |
| 06:04 | 06:58 | Record the results shown with each metal ion in your results table. | Iron(ii) Fe2+ green precipitate Iron(iii) Fe3+ rust precipitate Copper(ii) Cu2+ blue precipitate Aluminium Al3+ white precipitate Calcium Ca2+ white precipitate  Magnesium Mg2+ white precipitate |
| 06:58 | | Name the products formed in the reactions and write the ionic equations. | Iron(iii) hydroxide  Fe3+(aq) + 3OH-(aq) → Fe(OH)3(s)  Copper(ii) hydroxide  Cu2+(aq) + 2OH-(aq) → Cu(OH)2(s)  Aluminium hydroxide  Al3+(aq) + 3OH-(aq) → Al(OH)3(s)  Calcium hydroxide  Ca2+(aq) + 2OH-(aq) → Ca(OH)2(s)  Magnesium hydroxide  Mg2+(aq) + 2OH-(aq) → Mg(OH)2(s) |
| 07:43 | | Describe the test for aluminium. What does a positive result look like? | Add excess sodium hydroxide to the white precipitate.  If the solid disappears then the aluminium ion is present. |
| 07:50 | | Both magnesium ions and calcium ions form a white precipitate with sodium hydroxide. Suggest a further test you could do to distinguish between the two metal ions. | Carry out a flame test. If an orange-red flame is observed then the calcium ion is present.  (Magnesium has no flame colour in a flame test.) |

|  |  |  |  |
| --- | --- | --- | --- |
| **Testing for negative ions** | | | |
| 08:28 | | Why do you think that the limewater is put into a separate test tube at the start of the carbonate test? | The lime water is to test the gas being produced. If it was mixed with the original solution you may not be able to observe any colour change taking place. |
| 08:34 | | What does limewater test for? | Carbon dioxide. |
| 09:10 | | Why does the gas not escape the test tube to the surroundings? | Carbon dioxide is more dense than air. Therefore most of it remains in the test tube because diffusion will be slow. |
| 09:29 | 09:33 | What has happened to the limewater?  Name the gas being produced. | The limewater has gone cloudy.  Carbon dioxide gas is being produced. |
| 09:37 | 09:43 | What is the test for carbonate ions? What does a positive result look like? | Add hydrochloric acid and test any gas being produced by bubbling it through limewater. If the limewater goes cloudy it is a carbonate. |
| 09:37 | 09:50 | Write a word and symbol equation for the reaction of sodium carbonate with hydrochloric acid.  What type of reaction is this? | Sodium carbonate + hydrochloric acid →  Sodium chloride + water + carbon dioxide  Na2CO3(aq) + 2HCl(aq) → 2NaCl(aq) + H2O(l)  + CO2(g)  A neutralisation reaction. |
| 10:00 | 10:10 | Why do you think dilute acid is added at the start of the sulfate test? | To remove any ions that might interfere with a positive result. |
| 10:25 | 10:28 | Write a word and symbol equation for the reaction of sodium sulfate with barium chloride.  What type of reaction is this? | Sodium sulfate + barium chloride → sodium  chloride + barium sulfate  Na2SO4(aq) + BaCl2(aq) → 2NaCl(aq) +  BaSO4(s)  A double displacement reaction. |
| 10:25 | 10:34 | What is the test for sulfate ions? What does a positive result look like? | Add a few drops of hydrochloric acid and barium chloride to the sample. If a white precipitate forms then a sulfate is present. |
| 10:40 | 10:46 | Write the symbols for the halide ions in your results table:  Chloride Bromide Iodide | Cl-  Br-  I- |
| 11:03 | | What was added to the test tube to test for the presence of halides? | Nitric acid and sliver nitrate solution. |
| 11:28 | 11:47 | Record the results in your results table. | Cl- white precipitate is formed Br- cream precipitate is formed I- yellow precipitate is formed |
| 11:40 | | Write the ionic equations for the formation of silver bromide and silver iodide. | Br-(aq) + Ag+(aq) → AgBr(s)  I-(aq) + Ag+(aq) → AgI(s) |
| 12:08 | 12:15 | Unknown solution B, shown in the video, is blue.  What test would you use to confirm the identity of the positive ion? | Since the solution is blue, I would suspect that a copper ion was present so I would do either the sodium hydroxide test or the flame test first. |

## **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**

00:22 What is the difference between qualitative analysis and quantitative analysis?

00:33 What is an ion?

Describe how a positive and negative ion are formed.

01:12 What will we be looking for during the chemical tests?

How will you know if a test has a positive result?

**Flame tests**

01:22 What are flame tests used to identify?

02:32 Why do we test distilled water first? What does this show?

Record the symbol and flame colours for each metal ion in the table below:

|  |  |  |
| --- | --- | --- |
| **Metal ion** | **Symbol** | **Observation: flame colour** |
| Lithium |  |  |
| Potassium |  |  |
| Calcium |  |  |
| Copper |  |  |
| Sodium |  |  |

02:58 Lithium.

03:09 Potassium.

03:30 Calcium.

03:52 Copper.

04:11 Sodium.

**Testing for positive ions**

05:17 What colour is sodium hydroxide?

05:30 Name the ions present in sodium hydroxide solutions.

05:47 Name the green precipitate formed when sodium hydroxide is added to iron (ii) ions

06:04 Record the results shown with each metal ion in the results table below:

|  |  |  |  |
| --- | --- | --- | --- |
| **Positive ion** | **Symbol** | **Observation when added to sodium hydroxide solution** | **Observation with excess sodium hydroxide solution** |
| Iron(ii) |  |  |  |
| Iron(iii) |  |  |  |
| Copper(ii) |  |  |  |
| Aluminium |  |  |  |
| Calcium |  |  |  |
| Magnesium |  |  |  |

06:58 Name the products formed in the reactions and complete the ionic equations: Iron(iii) hydroxide: Fe3+(aq) + 3OH-(aq) →

Copper(ii) hydroxide: + 2OH-(aq) →

: Al3+(aq) + 3OH-(aq) →

: Ca2+(aq) + →

Magnesium hydroxide: + →

07:43 Describe the test for aluminium. What does a positive test look like?

07:50 Both magnesium ions and calcium ions form a white precipitate with sodium hydroxide. Suggest a further test you could do to distinguish between the two metal ions.

**Testing for negative ions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Negative ion** | **Symbol** | **Test** | **Observation** |
| Carbonate |  |  |  |
| Sulfate |  |  |  |

08:28 Why do you think that the limewater is put into a separate test tube at the start of the carbonate test?

08:34 What does limewater test for?

09:29 What has happened to the limewater?

09:33 Name the gas produced.

09:37 Complete the word and symbol equation:

Sodium carbonate + hydrochloric acid → + +

Na2CO3(aq) + → + H2O(l) +

What type of reaction is this?

09:43 Complete the table above with the test and positive result for carbonate ions. 09:58 Why do you think dilute acid is added at the start of the sulfate test?

10:25 Complete the table above with the test and positive result for sulfate ions. 10:25 Complete the word and symbol equation:

Sodium sulfate + barium chloride → +

Na2SO4(aq) + BaCl2(aq) → +

10:28 What type of reaction is this?

10:38 Add the symbols for the halide ions to the results table below. 11:28 Record the results for the halide tests in the results table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Negative ion** | | **Symbol** | **Test** | **Observation** |
| Halide | Chloride |  |  |  |
| Bromide |  |  |
| Iodide |  |  |

11:40 Write the ionic equations for the formation of silver bromide and silver iodide.

+ →

+ →

12:08 Unknown solution B is blue. Which metal ion would you expect it to contain? Which test would you do use to confirm you prediction?

10:25 Complete the table above with the test and positive result for sulfate ions. 10:25 Complete the word and symbol equation:

Sodium sulfate + barium chloride → +

Na2SO4(aq) + BaCl2(aq) → +

10:28 What type of reaction is this?

10:38 Add the symbols for the halide ions to the results table below. 11:28 Record the results for the halide tests in the results table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Negative ion** | | **Symbol** | **Test** | **Observation** |
| Halide | Chloride |  |  |  |
| Bromide |  |  |
| Iodide |  |  |

11:40 Write the ionic equations for the formation of silver bromide and silver iodide.

+ →

+ →

12:08 Unknown solution B is blue. Which metal ion would you expect it to contain? Which test would you do use to confirm you prediction?