(HT) Strong and Weak Acids

Answer the questions below.

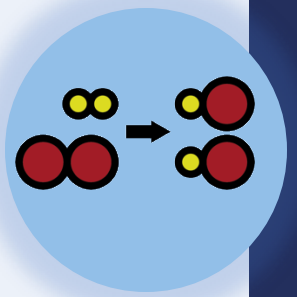
1. State the chemical formula for hydrochloric acid.
   HCl
2. State the chemical formula for sulfuric acid.
   H_2SO_4
3. State the pH range of acids.
   Less than 7
4. Calculate the relative formula mass of nitric acid (HNO_3).
   1+14+(3x16) = 63
5. Calculate the percentage by mass of hydrogen in nitric acid.

$$\textbf{Percentage by mass} = \frac{\textbf{mass of element}}{\textit{mass of compound}} \times 100$$

$$\textbf{Percentage by mass} = \frac{1}{63} \times 100$$

$$\textbf{Percentage by mass} = 1.59\ \%$$

Do Now



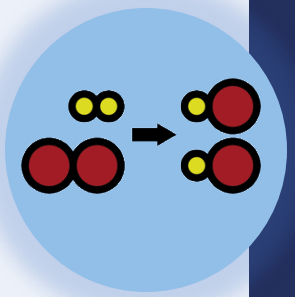
(HT) Strong and Weak Acids

Do Now:

1. State the chemical formula for hydrochloric acid.
2. State the chemical formula for sulfuric acid.
3. State the pH range of acids.
4. Calculate the relative formula mass of nitric acid (HNO_3).
5. Calculate the percentage by mass of hydrogen in nitric acid.

Drill:

1. Name the salt that would be produced in a reaction between hydrochloric acid and copper oxide.
2. Name the salt that would be produced in a reaction between nitric acid and calcium hydroxide.
3. Name the salt that would be produced in a reaction between sulfuric acid and lithium carbonate.



Do Now

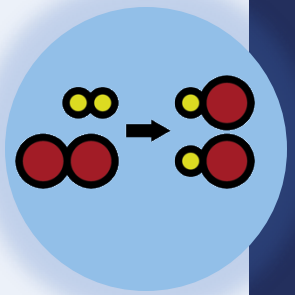
(HT) Strong and Weak Acids

Read Now:

When a solute dissolves in a solvent, a solution is formed. Acids in solution are another example of a solute being dissolved in a solvent. The concentration of the solution is a measure of how much solute is present per unit volume. A concentrated solution has lots of solute per unit volume and a dilute solution has much less solute per unit volume. The concentration of an acid affects its pH, but pH is also affected by the strength of an acid. A strong acid, such as hydrochloric acid, is one which fully dissociates into ions solution. This means that in solution, it splits completely into H^+ and Cl^- ions. A weak acid, such as ethanoic acid, is one which does not fully dissociate into ions in solution.

1. Define a solution.
2. Explain the difference between a concentrated and a dilute solution.
3. Explain what is meant by a strong acid.
4. Give an example of a strong acid.
5. Explain what is meant by a weak acid.
6. Give an example of a weak acid.

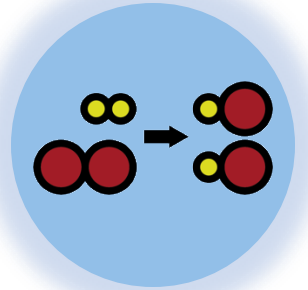
Do Now



(HT) Strong and Weak Acids

C4.3.14

Science Mastery

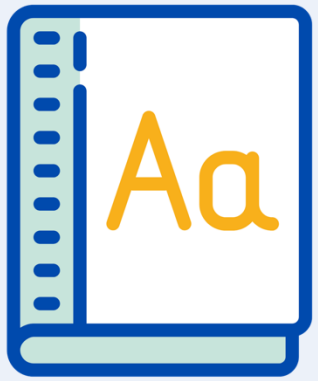


Lesson Objectives

Following this lesson, students will be able to:

- Explain the difference between a strong acid and weak acid
- Explain the factors that affect pH of an acid
- Explain the difference between strength and concentration

Key Words:

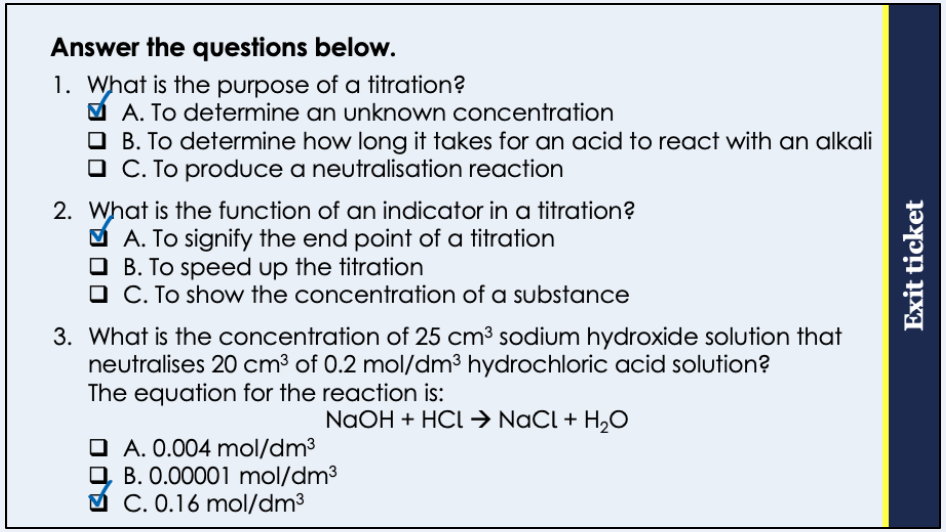


acid	**strong**	**weak**	**concentrated**
dilute	**ionise**	**dissociate**	

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the **pre-unit quiz**.

- The teacher should customise this slide as needed, to facilitate
  - **reteach**, **explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.



Answer the questions below.

1. What is the purpose of a titration?
   - ☑ A. To determine an unknown concentration
   - ☐ B. To determine how long it takes for an acid to react with an alkali
   - ☐ C. To produce a neutralisation reaction
2. What is the function of an indicator in a titration?
   - ☑ A. To signify the end point of a titration
   - ☐ B. To speed up the titration
   - ☐ C. To show the concentration of a substance
3. What is the concentration of 25 cm^3 sodium hydroxide solution that neutralises 20 cm^3 of 0.2 mol/dm^3 hydrochloric acid solution?
   The equation for the reaction is:
   $NaOH + HCl \rightarrow NaCl + H_2O$
   - ☐ A. 0.004 mol/dm^3
   - ☐ B. 0.00001 mol/dm^3
   - ☑ C. 0.16 mol/dm^3

Exit ticket

Fix-it

pH

Higher Tier only

What is **pH** actually a measure of?

pH denotes 'potential of hydrogen' so is a measure of the **hydrogen ion concentration** in a solution.

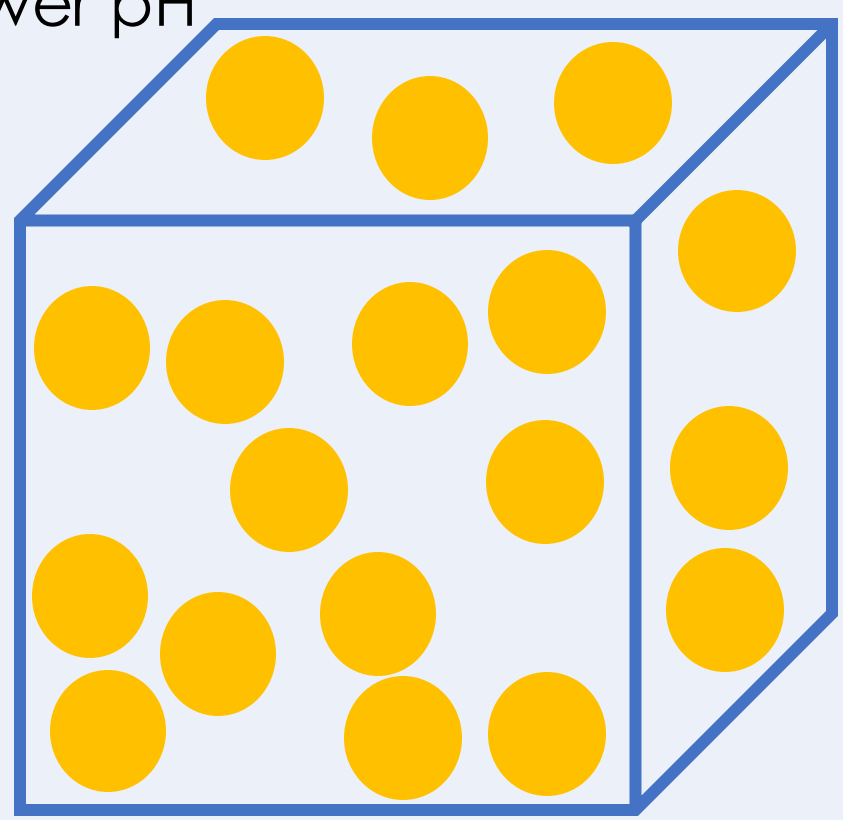
All acids produce **hydrogen ions (H^+)** in aqueous solutions.

pH of an acid is affected by:

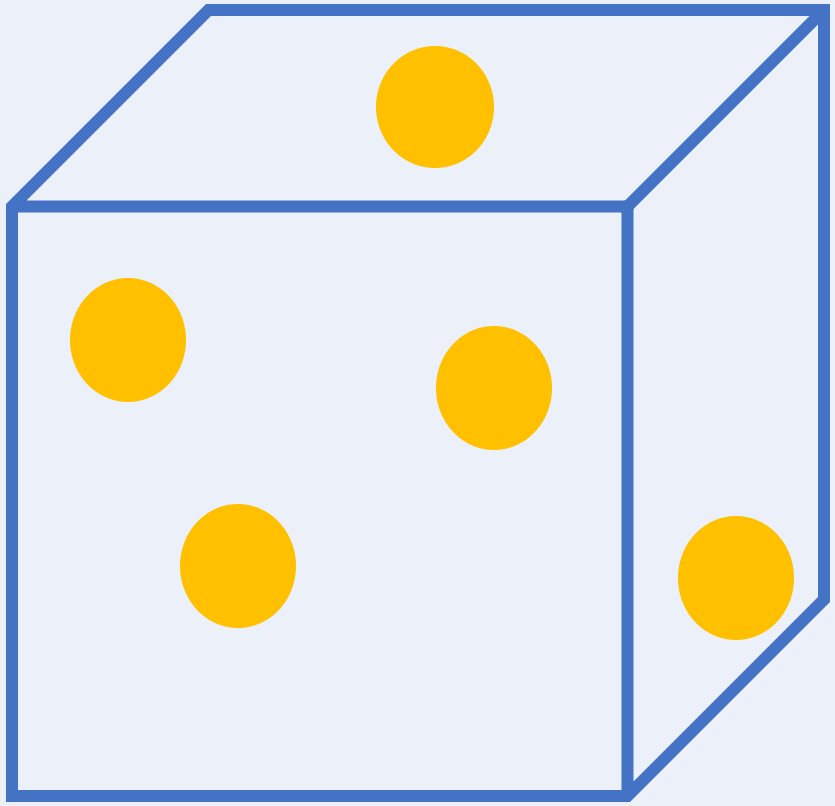
- Concentration of an acid
- Strength of an acid

pH and Concentration

- Higher concentration of acid molecules
- Greater concentration of hydrogen (H^+) ions
- Lower pH



High concentration



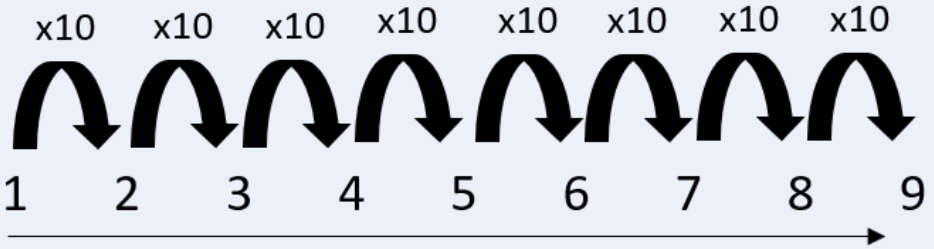
Low concentration

Unusual scales

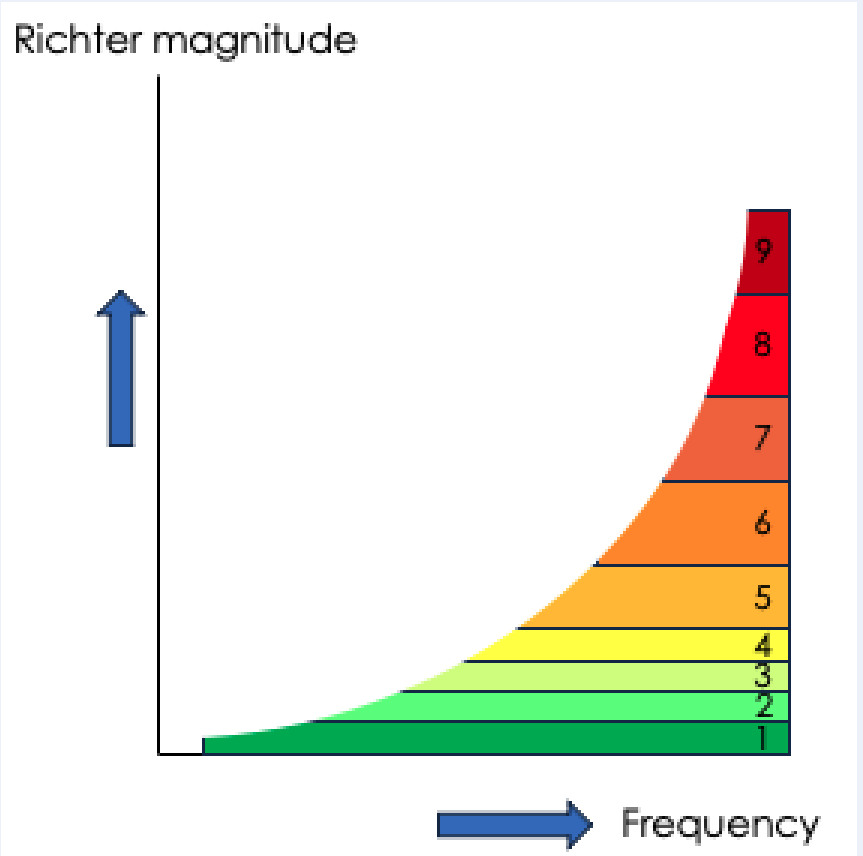
Scientists describe the **magnitude (strength)** of an earthquake using the **Richter Scale**.

This scale of numbers is unusual because an **earthquake that measures 2 on the scale is not double the magnitude of an earthquake measuring 1**.

It is **10 times** the magnitude.

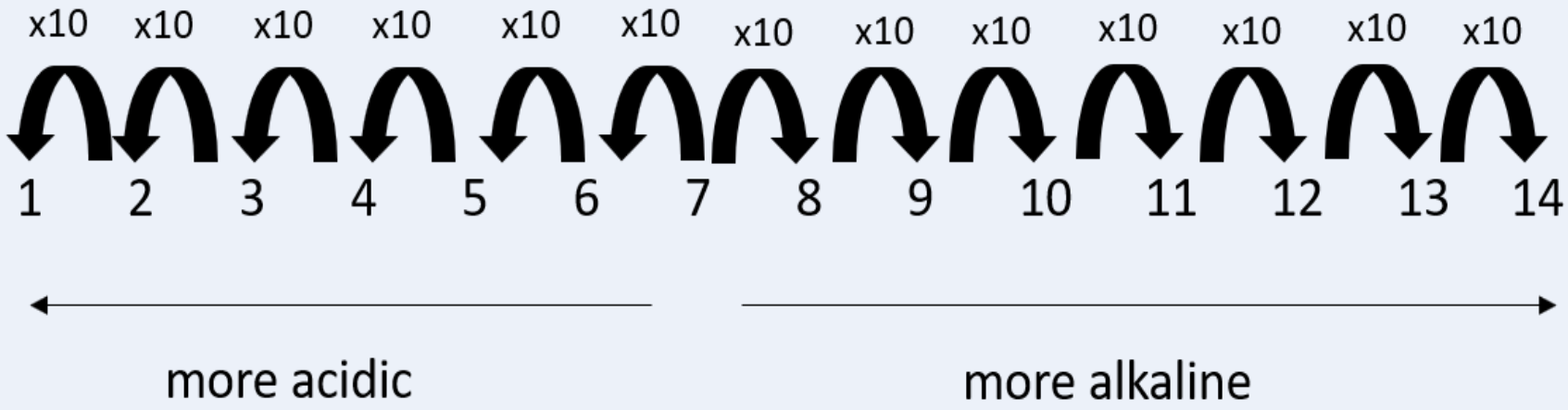


Increasing magnitude of earthquake



Unusual scales

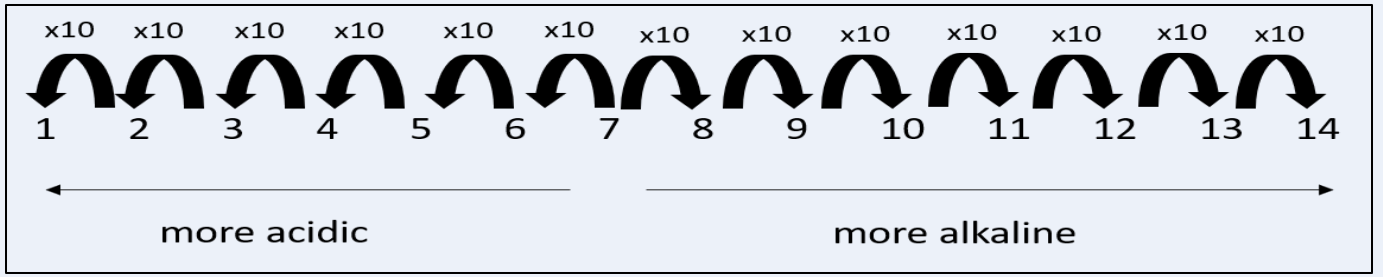
Magnitude of pH is also described in the same way:



How does the acidity of Solution A (pH 4) and B (pH 5) compare?

Solution A is 10x more acidic than solution B

Comparing pH



1. How does the hydrogen ion concentration of Solution X and Y compare?
   a. Y has twice the hydrogen ion concentration of X
   b. Y has 10 times the hydrogen ion concentration of X
   c. X has 10 times the hydrogen ion concentration of Y

solution X
pH 2

2. How does the hydrogen ion concentration of Solution X and Z compare?
   a. X has 1000 times the hydrogen ion concentration of Z
   b. Z has 1000 times the hydrogen ion concentration of X
   c. X has three times the hydrogen ion concentration of Z

solution Y
pH 1

3. How does the hydrogen ion concentration of Solution Y compare with Z?
   a. Y has four times the hydrogen ion concentration of Z
   b. Z has 10 000 times the hydrogen ion concentration of Y
   c. Y has 10 000 times the hydrogen ion concentration Z

solution Z
pH 5

Check for understanding

pH and Strength

Higher Tier only

A **strong** acid is one which **fully dissociates** in solution.

This means that it breaks up into its ions, including hydrogen ions.

Strong acids are:
- Hydrochloric acid
- Sulfuric acid
- Nitric acid

We can represent what happens to strong acids in solutions:

$$HCl\ (aq) \rightarrow H^{+}\ (aq) + Cl^{-}\ (aq)$$

Weak Acids

Higher Tier only

A **weak** acid is one which **partially dissociates** in solution.

This means that not all the acid molecules break up into ions.

Weak acids are:
- Ethanoic acid
- Citric acid
- Carbonic acid

We can represent what happens to weak acids in solutions:

$$CH_3COOH\ (aq) \rightleftharpoons H^+\ (aq) + CH_3COO^-\ (aq)$$

H^+ ions and concentration

A sample of hydrochloric acid solution has a concentration of 1×10^{-3} mol/dm^3. The sample has a pH of 2.

Is hydrochloric acid a strong acid or a weak acid?

A strong acid. It fully dissociates into H^+ and Cl^- ions in solution.

If the sample is diluted to a concentration of 1×10^{-5} mol/dm^3, what happens to its pH?

The concentration of H+ ions decreases by a factor of 100. This means it has decreased by a factor of 10, then another factor of 10.
For each factor of 10 decrease, pH increases by 1 unit.

The new sample has increased by 2 pH units, so the new pH is pH 4.

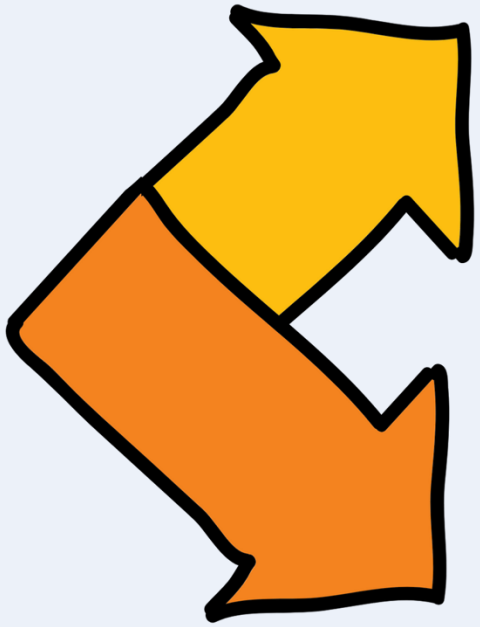
How would the sample have been diluted?
By adding more solvent, so there is a smaller amount of solute per unit volume.

Is this correct?

If they have the same concentration, hydrochloric acid will have a higher pH than ethanoic acid.

Talk Task

Can you explain the difference between these two terms?

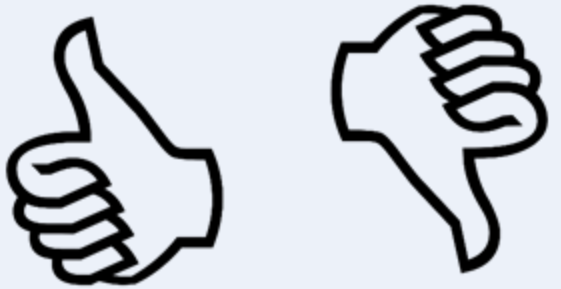


A strong acid

A concentrated acid

Talk Task

True or false?



1. A strong acid has a high pH **False**
2. A strong acid dissociates fully in solution **True**
3. Ethanoic acid is a strong acid **False**
4. Concentration does not affect pH **False**
5. If two acids have the same concentration, the stronger acid will have a lower pH **True**

Check for understanding

Explaining pH difference

A scientist has two samples of acids:
2 mol/dm^3 hydrochloric acid
1 mol/dm^3 ethanoic acid

Which is the stronger acid?

Hydrochloric acid. Ethanoic acid is a weak acid.

Which is the more concentrated acid?

Hydrochloric acid. It has a greater amount of solute (number of moles) per unit volume.

Which would have the lower pH?

Hydrochloric acid. It is the stronger acid and is more concentrated, so the concentration of H^+ ions in solution will be much greater.

Talk Task

Drill

1. Define a strong acid.
2. Give an example of a strong acid.
3. Define a weak acid.
4. Give an example of a weak acid.
5. State the pH range of acids.
6. Name the ion found in all acids.
7. Explain what it means for an acid to dissociate.

Check for understanding

Drill answers

1. An acid that completely dissociates into ions in solution.
2. Hydrochloric acid, nitric acid, sulfuric acid
3. An acid that does not completely dissociate into ions in solution.
4. Ethanoic acid.
5. Less than 7 (1-6)
6. H^+
7. The acid breaks up into its ions.

Check for understanding

Answer the questions below.

1. What is a strong acid?
   - ❑ A. An acid that contains lots of solute per unit volume
   - ❑ B. An acid that has lots of H+ ions
   - ☑ C. An acid that fully dissociates in solution

2. Which of these is <u>not</u> a strong acid?
   - ❑ A. Hydrochloric acid
   - ❑ B. Sulfuric acid
   - ☑ C. Ethanoic acid

3. Which of these will have the lowest pH?
   - ❑ A. 1 mol/dm^3 ethanoic acid
   - ❑ B. 1 mol/dm^3 hydrochloric acid
   - ☑ C. 2 mol/dm^3 hydrochloric acid

Exit ticket

Feedback

Lesson C4.3.14	
What was good about this lesson?	What can we do to improve this lesson?

Send us your feedback by clicking this link
or by emailing sciencemastery@arkonline.org
Thank you!