AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.4.2.4

The pH scale and neutralisation

Past-paper questions

Tier	**Foundation**
Question groups	**7**
Available paper years	**2018–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

5.4.2.4 The pH scale and neutralisation

Question 01

June 2018 | 8464/C/1F | Original Q3

0 3 This question is about acids and bases.

0 3 . 1 Which ion is found in all acids?

[1 mark]

Tick **one** box.

Cl^- ☐ H^+ ☐ Na^+ ☐ OH^- ☐

0 3 . 2 Zinc nitrate can be produced by reacting an acid and a metal oxide.

Name the acid and the metal oxide used to produce zinc nitrate.

[2 marks]

Acid _____

Metal oxide _____

0 3 . 3 In an equation, zinc nitrate is written as $Zn(NO_3)_2(aq)$.

What does (aq) mean?

[1 mark]

Tick **one** box.

Dissolved in water ☐

Insoluble ☐

Not all reacted ☐

Reactant ☐

0 3 . 4 The pH of a solution is 8

Some hydrochloric acid is added to the solution.

Suggest the pH of the solution after mixing.

[1 mark]

pH = _____

5.4.2.4 The pH scale and neutralisation

Question 01 · continued

0 3 . 5 **Table 2** shows the solubility of three solids in water at room temperature.

Table 2

Solid	The mass of the solid that dissolves in 100 cm^3 of water
Phosphorus oxide	50 g
Silicon dioxide	0 g
Sodium hydroxide	100 g

A teacher labelled these three solids **A**, **B** and **C**.

She gave a student the information shown in **Table 3**

Table 3

Solid	Observation when added to water	pH of the solid in water
A	colourless solution	14
B	colourless solution	2
C	solid does not dissolve	7

Describe a method that could be used to identify each of the three solids **A**, **B** and **C**.

You must use an indicator in the method.

Use information in **Table 2** and **Table 3**

[4 marks]

9

5.4.2.4 The pH scale and neutralisation

Question 02

June 2019 | 8464/C/1F | Original Q7

0 7 This question is about salts.

Ammonium nitrate solution is produced when ammonia gas reacts with nitric acid.

0 7 . 1 Give the state symbol for ammonium nitrate solution.

[1 mark]

_____

0 7 . 2 What is the formula of nitric acid?

[1 mark]

Tick (✓) **one** box.

HCl ☐

HNO_3 ☐

H_2SO_4 ☐

NH_4OH ☐

0 7 . 3 Ammonia gas dissolves in water to produce ammonia solution.

Ammonia solution contains hydroxide ions, OH^-

A student adds universal indicator to solutions of nitric acid and ammonia.

What colour is observed in each solution?

[2 marks]

Colour in nitric acid _____

Colour in ammonia solution _____

5.4.2.4 The pH scale and neutralisation

Question 02 · continued June 2019 | 8464/C/1F | Original Q7

0 7 . 4 The student gradually added nitric acid to ammonia solution.

Which row, **A**, **B**, **C** or **D**, shows the change in pH as the nitric acid is added until in excess?

[1 mark]

Tick (✓) **one** box.

	pH of ammonia solution at start	pH after addition of excess nitric acid	
A	10	7	☐
B	2	10	☐
C	7	1	☐
D	10	2	☐

0 7 . 5 Calculate the percentage by mass of oxygen in ammonium nitrate (NH_4NO_3).

Relative atomic masses (A_r): H = 1 N = 14 O = 16

Relative formula mass (M_r): NH_4NO_3 = 80

[3 marks]

Percentage by mass of oxygen = _____ %

Question 7 continues on the next page

5.4.2.4 The pH scale and neutralisation

Question 02 · continued

0 7 . 6 Describe a method to investigate how the temperature changes when different masses of ammonium nitrate are dissolved in water.

You do **not** need to write about safety precautions.

[6 marks]

14

5.4.2.4 The pH scale and neutralisation

Question 03

November 2020 | 8464/C/1F | Original Q1

0 1 This question is about acids and bases.

0 1 . 1 What is the pH of sulfuric acid?

[1 mark]

Tick (✓) **one** box.

1 ☐ 7 ☐ 14 ☐

0 1 . 2 An acid reacts with zinc to produce zinc chloride and hydrogen.

Which acid reacts with zinc to produce zinc chloride?

[1 mark]

Tick (✓) **one** box.

Hydrochloric acid ☐

Nitric acid ☐

Sulfuric acid ☐

0 1 . 3 What type of substance is zinc chloride?

[1 mark]

Tick (✓) **one** box.

Alkali ☐ Base ☐ Salt ☐

5.4.2.4 The pH scale and neutralisation

Question 03 · continued

0 1 . 4 An alkali is a base in solution.

Which compound is an alkali?

[1 mark]

Tick (✓) **one** box.

Sodium hydroxide ☐

Sodium nitrate ☐

Sodium sulfate ☐

0 1 . 5 The formula of the copper ion is Cu^{2+}

The formula of the oxide ion is O^{2-}

What is the formula of copper oxide?

[1 mark]

Tick (✓) **one** box.

Cu_2O_2 ☐ CuO_2 ☐ CuO ☐

Question 1 continues on the next page

5.4.2.4 The pH scale and neutralisation

Question 03 · continued

A student reacts an acid with copper oxide.

0 1 . 6 The reaction between the acid and copper oxide is very slow at room temperature.

How could the student speed up the reaction?

[1 mark]

0 1 . 7 Complete the sentence to show how the student makes sure that **all** the acid reacts.

Choose the answer from the box.

[1 mark]

in excess	**in solution**	**molten**	**soluble**

The student adds copper oxide to the acid until the

copper oxide is _____.

5.4.2.4 The pH scale and neutralisation

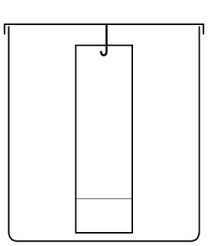
Question 03 · continued

0 1 . 8 The student filters the unreacted copper oxide from the solution.

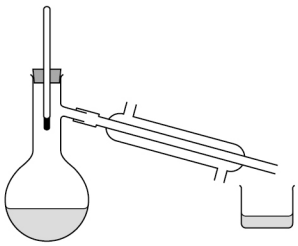
Which apparatus does the student use?

[1 mark]

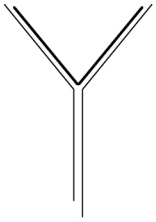
Tick (✓) **one** box.



☐



☐



☐



☐

0 1 . 9 What process is used to produce crystals of a salt from a salt solution?

[1 mark]

_____

_____

9

5.4.2.4 The pH scale and neutralisation

Question 04

November 2021 | 8464/C/1F | Original Q7

0 7 Acids react to produce salts.

Universal indicator is added to water and then nitric acid is added to the mixture.

0 7 . 1 Give the colour change when nitric acid is added to the mixture of universal indicator and water.

[1 mark]

Tick (✓) **one** box.

- Blue to red ☐
- Green to purple ☐
- Green to red ☐
- Red to purple ☐

0 7 . 2 What happens to the pH of water when nitric acid is added?

[1 mark]

Tick (✓) **one** box.

- Decreases ☐
- Stays the same ☐
- Increases ☐

0 7 . 3 What is the state symbol for nitric acid?

[1 mark]

_____

5.4.2.4 The pH scale and neutralisation

Question 04 · continued

Zinc carbonate reacts with nitric acid.

The word equation for the reaction is:

zinc carbonate (white solid) + nitric acid → zinc nitrate (colourless solution) + water + carbon dioxide

0 7 . 4 Give **two** observations that would be made when zinc carbonate is added to nitric acid until the zinc carbonate is in excess.

[2 marks]

1 _____

_____

2 _____

_____

0 7 . 5 The formula of the zinc ion is Zn^{2+}

The formula of the nitrate ion is NO_3^-

What is the formula for zinc nitrate?

[1 mark]

Tick (✓) **one** box.

- $ZnNO_3$ ☐
- $Zn(NO_3)_2$ ☐
- Zn_2NO_3 ☐
- $Zn_2(NO_3)_2$ ☐

Question 7 continues on the next page

5.4.2.4 The pH scale and neutralisation

Question 04 · continued

0 7 . 6 Acids react with insoluble metal oxides to produce salts.

Plan a method to produce a pure, dry sample of the soluble salt copper chloride from an acid and a metal oxide.

[6 marks]

12

5.4.2.4 The pH scale and neutralisation

Question 05

June 2022 | 8464/C/1F | Original Q5

0 5 This question is about salts.

Green copper carbonate and sulfuric acid can be used to produce blue copper sulfate crystals.

0 5 . 1 **Excess** copper carbonate is added to sulfuric acid.

Give **three** observations you would make.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

0 5 . 2 How can the excess copper carbonate be removed?

[1 mark]

_____

_____

0 5 . 3 The pH of the solution changes during the reaction.

What is the pH of the solution at the end of the reaction?

[1 mark]

pH = _____

0 5 . 4 Copper carbonate and sulfuric acid react to produce copper sulfate.

What type of reaction is this?

[1 mark]

_____

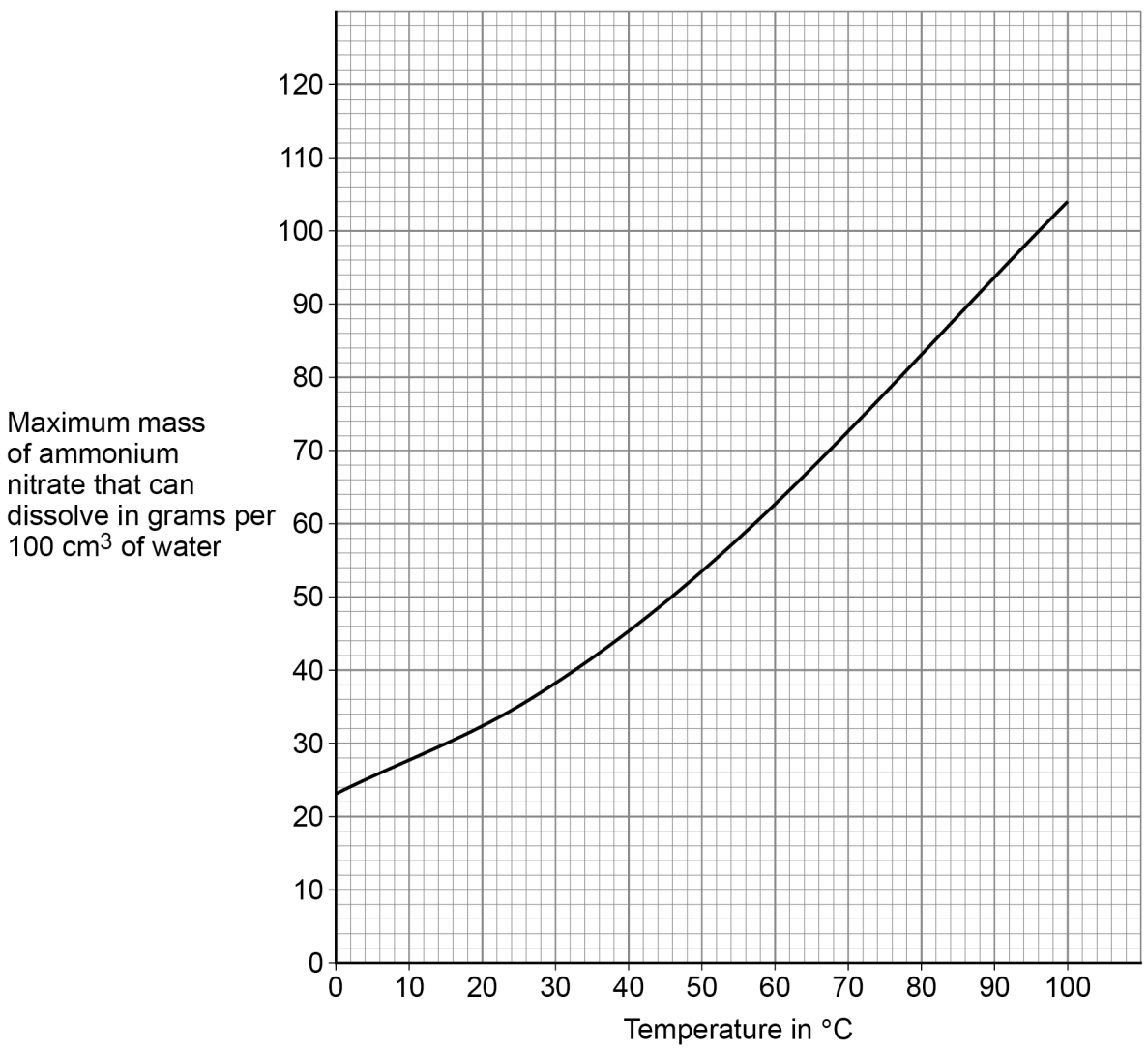
5.4.2.4 The pH scale and neutralisation

Question 05 · continued

0 5 . 5 Ammonium nitrate is a salt.

Figure 13 shows the maximum mass of ammonium nitrate that can dissolve in 100 cm^3 of water at different temperatures.

Figure 13



5.4.2.4 The pH scale and neutralisation

Question 05 · continued

A student adds ammonium nitrate to water at 80 °C until no more dissolves.

The student cools 100 cm^3 of this solution of ammonium nitrate from 80 °C to 20 °C to produce crystals of ammonium nitrate.

Determine the mass of ammonium nitrate that crystallises on cooling 100 cm^3 of this solution from 80 °C to 20 °C

[3 marks]

Mass = _____ g

9

5.4.2.4 The pH scale and neutralisation

Question 06

June 2023 | 8464/C/1F | Original Q6

0 6 This question is about carbon dioxide.

Carbon dioxide is soluble in water and forms an acidic solution.

0 6 . 1 Which ion makes the solution acidic?

[1 mark]

_____

0 6 . 2 Name an indicator that could be used to test if the solution is acidic.

Give the result of the test.

[2 marks]

Indicator _____

Result _____

_____

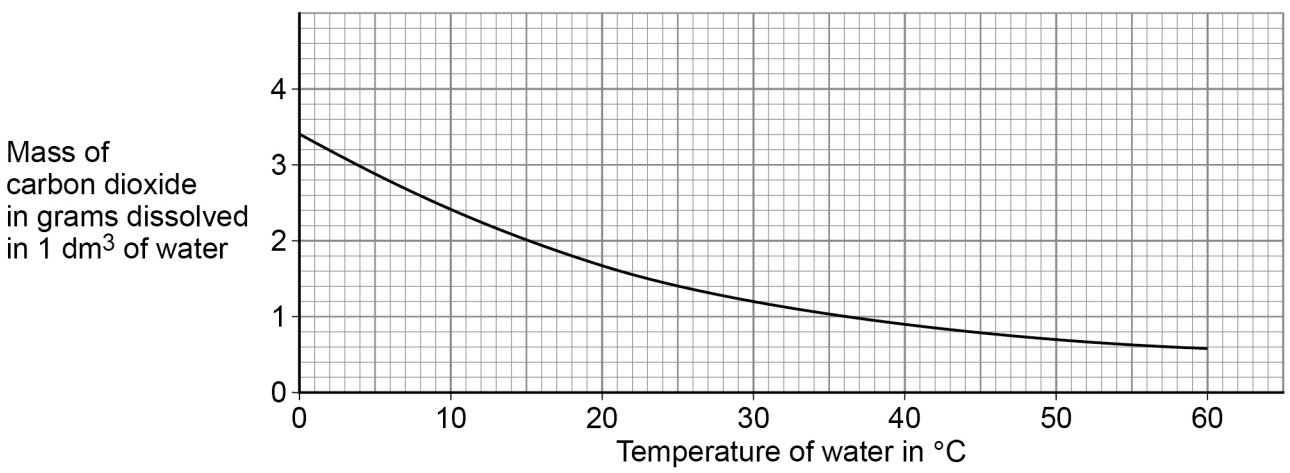
Question 6 continues on the next page

5.4.2.4 The pH scale and neutralisation

Question 06 · continued

Figure 14 shows the mass of carbon dioxide that will dissolve in 1 dm^3 of water at different temperatures.

Figure 14



0 6 . 3 How does the solubility of carbon dioxide change as the temperature of the water increases?

[1 mark]

Tick (✓) **one** box.

The solubility decreases ☐

The solubility does not change ☐

The solubility increases ☐

5.4.2.4 The pH scale and neutralisation

Question 06 · continued

0 6 . 4 Carbon dioxide dissolves in water to form an acidic solution.

How does the pH of the solution change as the temperature of the water increases?

Use **Figure 14**.

[1 mark]

Tick (✓) **one** box.

pH of the solution decreases ☐

pH of the solution does not change ☐

pH of the solution increases ☐

Calcium carbonate reacts with hydrochloric acid to produce carbon dioxide.

The equation for the reaction is:

$$CaCO_3(s) + 2\,HCl(aq) \longrightarrow CaCl_2(aq) + CO_2(g) + H_2O(\mathbf{x})$$

0 6 . 5 What is the state symbol (**x**) in the equation?

[1 mark]

Tick (✓) **one** box.

(aq) ☐ (g) ☐ (l) ☐ (s) ☐

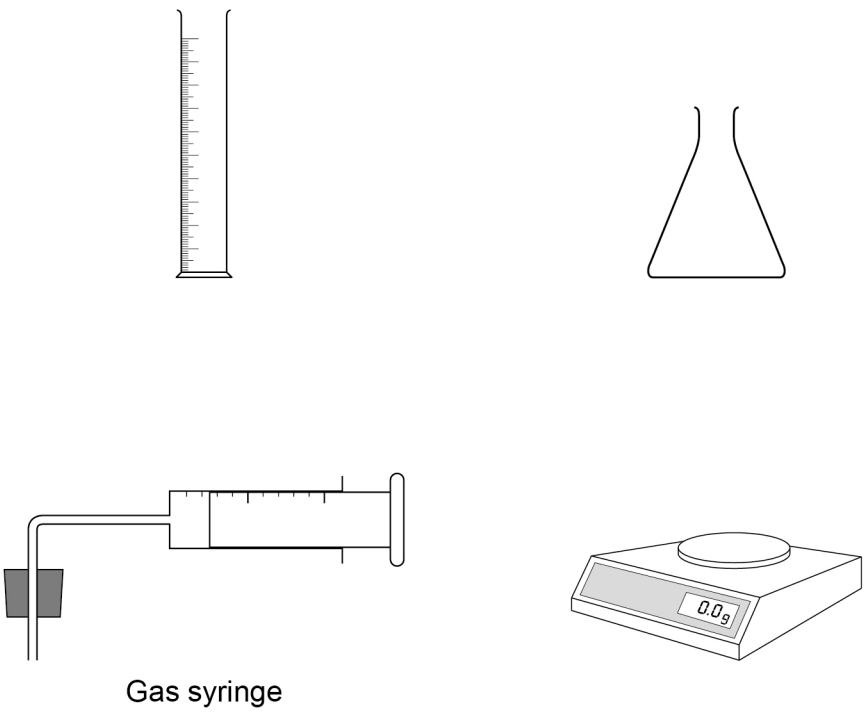
Question 6 continues on the next page

5.4.2.4 The pH scale and neutralisation

Question 06 · continued

0 6 . 6 **Figure 15** shows equipment a student used for an investigation.

Figure 15



Gas syringe

5.4.2.4 The pH scale and neutralisation

Question 06 · continued

The student investigated the volume of carbon dioxide produced when different masses of calcium carbonate react with hydrochloric acid.

Describe a method the student could use.

[6 marks]

12

5.4.2.4 The pH scale and neutralisation

Question 07

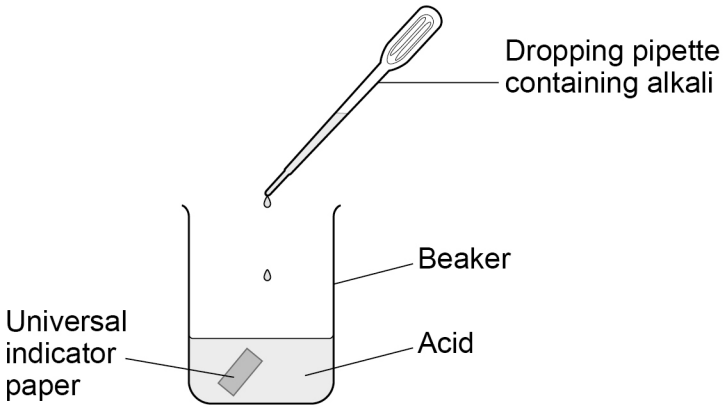
June 2025 | 8464/C/1F | Original Q5

0 5 This question is about acids.

A student investigated the volume of an alkali needed to react completely with 25 cm^3 of an acid.

Figure 10 shows the apparatus.

Figure 10



This is the method used.

1. Add 25 cm^3 of the acid to a beaker.

2. Add a piece of universal indicator paper to the acid.

3. Add the alkali drop by drop to the acid until the universal indicator paper changes colour to green.

4. Record the number of drops of alkali added.

0 5 . 1 The method does **not** give an accurate volume of alkali needed to react completely with the acid.

Suggest **two** improvements to the method.

[2 marks]

1 _____

_____

2 _____

_____

5.4.2.4 The pH scale and neutralisation

Question 07 · continued

0 5 . 2 What is the pH of the solution when the universal indicator paper turns green?

[1 mark]

Tick (✓) **one** box.

1 ☐ 5 ☐ 7 ☐ 9 ☐

0 5 . 3 What name is given to the reaction between an acid and an alkali?

[1 mark]

Tick (✓) **one** box.

Combustion ☐

Displacement ☐

Neutralisation ☐

0 5 . 4 Which ion do all acids contain?

[1 mark]

Tick (✓) **one** box.

Cl^- ☐ H^+ ☐ Na^+ ☐

0 5 . 5 Name the acid that reacts with sodium hydroxide to produce sodium nitrate.

[1 mark]

_____

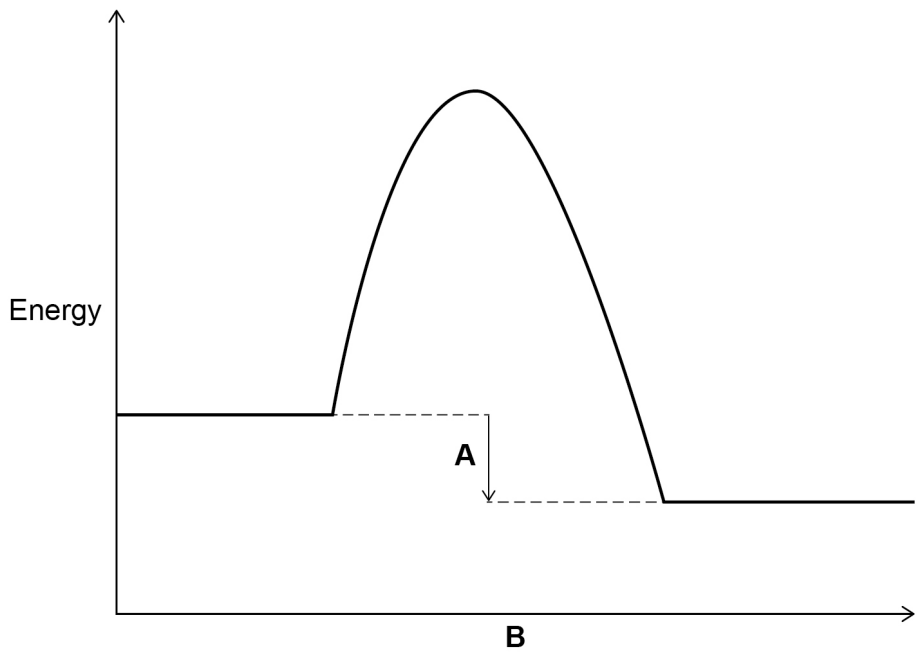
Question 5 continues on the next page

5.4.2.4 The pH scale and neutralisation

Question 07 · continued

0 5 . 6 **Figure 11** shows a reaction profile for the reaction between an acid and an alkali.

Figure 11



What do labels **A** and **B** represent on **Figure 11**?

Choose the answers from the box.

[2 marks]

activation energy	**overall energy change**	**products**
progress of reaction	**reactants**	

A _____

B _____

5.4.2.4 The pH scale and neutralisation

Question 07 · continued June 2025 | 8464/C/1F | Original Q5

Acids also react with insoluble solid substances to produce salt solutions.

0 5 . 7 When making a salt solution, excess solid is added to the acid.

Draw the apparatus used to separate the excess solid from the salt solution by filtration.

The apparatus should collect:

- the excess solid
- the salt solution.

[2 marks]

0 5 . 8 Solid **X** reacts with hydrochloric acid to produce zinc chloride and hydrogen gas.

Name solid **X**.

[1 mark]

11