

(Reactions of acids with metals, bases, and carbonates)

Q1.a) (2018)

0 5

A student investigated the mass of copper oxide produced by heating copper carbonate.

This is the method used.

1. Weigh an empty test tube.
2. Weigh 2.00 g of copper carbonate into the test tube.
3. Heat the copper carbonate until there appears to be no further change.
4. Re-weigh the test tube and copper oxide produced.
5. Subtract the mass of the empty tube to find the mass of copper oxide.
6. Repeat steps 1–5 twice.
7. Repeat steps 1–6 with different masses of copper carbonate.

Table 4 shows the student's results.

Table 4

Mass of copper carbonate in g	Mass of copper oxide in g			
	Trial 1	Trial 2	Trial 3	Mean
2.00	1.29	1.27	1.31	1.29
4.00	2.89	2.57	2.59	2.58
6.00	3.85	3.90	3.87	3.87
8.00	5.12	5.15	5.09	X
10.00	6.42	6.45	6.45	6.44

The equation for the reaction is:



Complete the sentence.

[1 mark]

The state symbol shows carbon dioxide is a _____.

Q1.b) (2018)

Why do the contents of the test tube lose mass in the investigation?

[1 mark]

Q1.c) (2018)

Calculate the mean mass **X** in **Table 4**.

[1 mark]

X = _____ g

Q1.d) (2018)

One of the results in **Table 4** is anomalous.

Which result is anomalous?

[1 mark]

Mass of copper carbonate _____ g Trial _____

Q1.e) (2018)

Suggest how the investigation could be improved to make sure the reaction is complete.

[2 marks]

Q2.a) (2018)

Another student repeated the investigation using magnesium carbonate instead of copper carbonate.

The word equation for the reaction is:

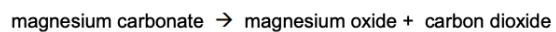
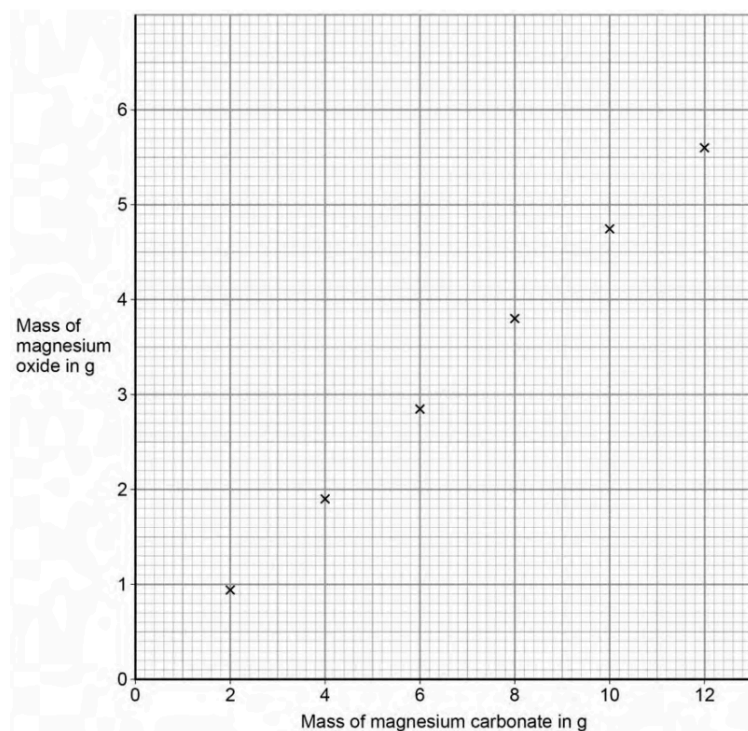


Figure 8 shows the results of the investigation.

Figure 8



Draw a line of best fit on **Figure 8**.

[1 mark]

Q2.b) (2018)

Determine the mass of magnesium oxide produced by 8.4 g of magnesium carbonate.

Use **Figure 8**.

[1 mark]

Mass = _____ g

Q2.c) (2018)

Calculate the mass of magnesium oxide produced when 168 g of magnesium carbonate is heated.

Use your answer to Question 05.7

[2 marks]

Mass of magnesium oxide produced = _____ g

Q3. (2018)

All alkalis contain the same ion.

What is the formula of this ion?

[1 mark]

Tick **one** box.

H ⁺	☐
Na ⁺	☐
OH ⁻	☐
O ²⁻	☐

Q4.(2018)

Soluble salts are formed by reacting metal oxides with acids.

Give **one** other type of substance that can react with an acid to form a soluble salt.

[1 mark]

Q5. (2018)

Calcium nitrate contains the ions Ca²⁺ and NO₃⁻

Give the formula of calcium nitrate.

[1 mark]

Q6. (2019)

Calcium hydroxide solution reacts with an acid to form calcium chloride.

Complete the word equation for the reaction.

[2 marks]

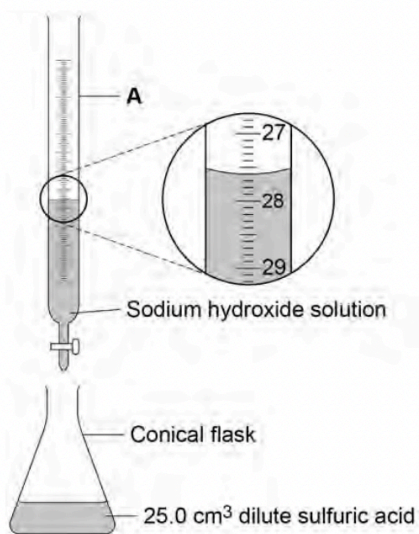
calcium hydroxide + _____ acid → calcium chloride + _____

Q7.a) (2019)

A student investigates the volume of sodium hydroxide solution that reacts with 25.0 cm³ of dilute sulfuric acid.

Figure 12 shows the apparatus the student uses.

Figure 12



Use Figure 12 to answer Questions 09.3 and 09.4

Name apparatus A.

[1 mark]

Q7.b) (2019)

What is the reading on apparatus A?

[1 mark]

_____ cm³

Q7.c) (2019)

Chemical Change

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The higher the concentration of a sample of dilute sulfuric acid, the greater the volume of sodium hydroxide needed to neutralise the acid.

The student tested two samples of dilute sulfuric acid, **P** and **Q**.

Describe how the student could use titrations to find which sample, **P** or **Q**, is more concentrated.

[6 marks]

Q8. (2020)

This question is about acids, bases and salts.

Zinc nitrate is a salt.

A student produces zinc nitrate using an acid and a base.

Which acid should the student use to produce zinc nitrate?

[1 mark]

Tick (✓) **one** box.

Hydrochloric acid

☐

Nitric acid

☐

Sulfuric acid

☐

Q9.(2020)

Which is a base the student could use to produce zinc nitrate?

[1 mark]

Tick (✓) **one** box.

Zinc chloride

☐

Zinc oxide

☐

Zinc sulfate

☐

Q10.a)(2021)

Chemical Change

<http://www.pcfgstudy.com>

A student investigated the reactivity of metals with hydrochloric acid.

This is the method used.

1. Measure 50 cm³ of hydrochloric acid into a polystyrene cup.
2. Measure the temperature of the hydrochloric acid.
3. Add one spatula of metal powder to the hydrochloric acid and stir.
4. Measure the highest temperature the mixture reaches.
5. Calculate the temperature increase for the reaction.
6. Repeat steps 1 to 5 three more times.
7. Repeat steps 1 to 6 with different metals.

Table 4 shows the student's results.

Table 4

Metal	Temperature increase in °C				Mean temperature increase in °C
	Trial 1	Trial 2	Trial 3	Trial 4	
Cobalt	6	7	5	9	7
Magnesium	54	50	37	55	X
Zinc	18	16	18	20	18

Calculate the mean temperature increase **X** for magnesium in **Table 4**.

Do **not** include the anomalous result in your calculation.

[2 marks]

X = _____ °C

Q10.b)(2021)

Determine the order of reactivity for the metals cobalt, magnesium and zinc.

Use **Table 4**.

[1 mark]

Most reactive _____

Least reactive _____

Q10.c)(2021)

The range of measurements either side of the mean shows the uncertainty in the mean temperature increase.

Complete the sentence.

Use **Table 4**.

[1 mark]

The mean temperature increase for zinc is $18 \pm$ _____ °C

Q10.d)(2021)

What type of variable is the volume of hydrochloric acid in this investigation?

[1 mark]

Tick (✓) **one** box.

Control

☐

Dependent

☐

Independent

☐

Q10.e)(2021)

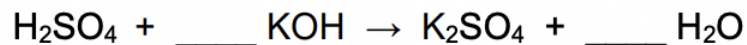
Suggest **one** way of improving **step 3** in the method to give results which are more repeatable.

[1 mark]

Q11. (2021)

Balance the equation for the reaction between sulfuric acid and potassium hydroxide.

[1 mark]

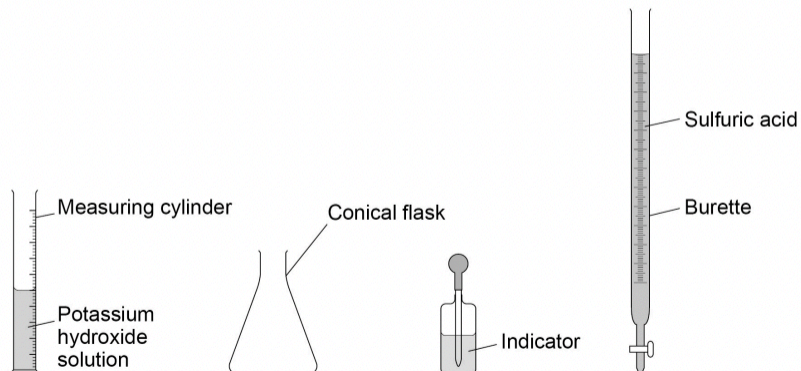


Q12.a)(2021)

A student does a titration to find the volume of sulfuric acid that reacts with 25 cm³ of potassium hydroxide solution.

Figure 7 shows the equipment used.

Figure 7



The 25 cm³ of potassium hydroxide solution is measured with the measuring cylinder.

Which piece of equipment could the student use to measure the 25 cm³ of potassium hydroxide solution more accurately?

[1 mark]

Tick (✓) **one** box.

Beaker

☐

Evaporating basin

☐

Pipette

☐

Test tube

☐

Q12.b)(2021)

Describe how the student would use the equipment in **Figure 7** to complete the titration.

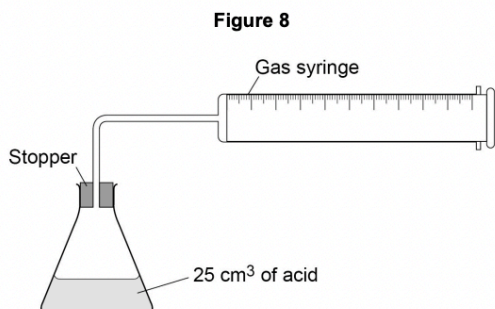
[5 marks]

Q13.a) (2021)

This question is about metal carbonates.

A student investigated the reaction of copper carbonate with an acid.

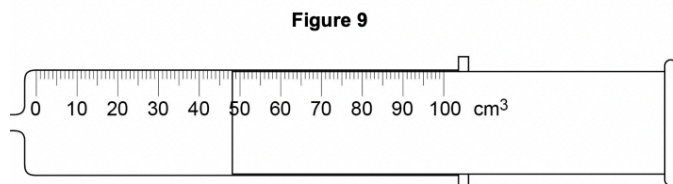
Figure 8 shows the apparatus.



This is the method used.

1. Pour 25 cm³ of the acid into a conical flask.
2. Weigh 0.10 g of copper carbonate.
3. Remove the stopper and add the copper carbonate to the flask.
4. Quickly replace the stopper.
5. Record the maximum volume of gas collected in the gas syringe.
6. Repeat steps 1 to 5 with different masses of copper carbonate.

Figure 9 shows the gas syringe during the experiment.



What is the reading on the gas syringe?

[1 mark]

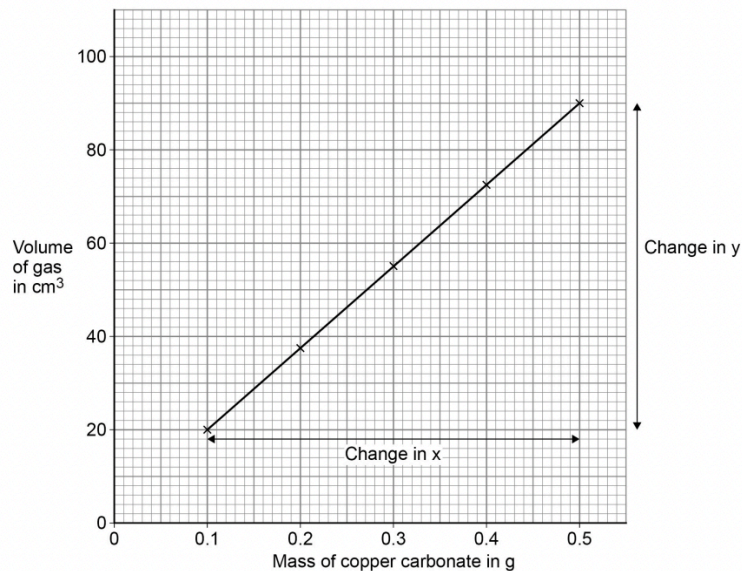
_____ cm³

Q13.b) (2021)

The student plotted the results on a graph.

Figure 10 shows the student's graph.

Figure 10



Determine the gradient of the line of best fit.

You should:

- calculate the values of the change in y and the change in x
- calculate the gradient of the line of best fit.

[4 marks]

Change in y = _____ cm³

Change in x = _____ g

Gradient _____

Gradient = _____ cm³/g

Q13.c) (2021)

Copper chloride was produced in the reaction.

Which acid reacts with copper carbonate to produce copper chloride?

[1 mark]

Tick (✓) **one** box.

Hydrochloric acid

☐

Nitric acid

☐

Sulfuric acid

☐

Q13.d) (2021)

Chemical Change

<http://www.pcfgstudy.com>

The reaction between copper carbonate and the acid produced a gas.

What was the gas?

[1 mark]

Tick (✓) **one** box.

Carbon dioxide

☐

Chlorine

☐

Hydrogen

☐

Oxygen

☐

Q13.e) (2021)

A different student produced a pure, dry sample of copper chloride using the same reaction.

This is the method used.

1. Add excess copper carbonate to the acid.
2. Filter the mixture.
3. Heat the solution gently until crystals start to form.
4. Leave for 24 hours.
5. Remove the crystals.
6. Rinse with water and dry the crystals.

Why was the solution heated gently in **step 3**?

[1 mark]

Tick (✓) **one** box.

To evaporate acid

☐

To evaporate copper carbonate

☐

To evaporate water

☐

Q13.f) (2021)

How should the solution be heated gently in **step 3**?

[1 mark]

Q14.(2022)

A metal oxide reacts with an acid to produce zinc sulfate and water.

Name the metal oxide and the acid used in this reaction.

[2 marks]

Name of metal oxide _____

Name of acid _____

Q15.(2022)

A student reacts an acid with an alkali in a titration.

What is the type of reaction when an acid reacts with an alkali?

[1 mark]

Tick (✓) **one** box.

Combustion

☐

Decomposition

☐

Neutralisation

☐

Q16.(2022)

Figure 5 shows a piece of equipment used to measure the volume of the acid in the titration.

Figure 5



What is the name of this piece of equipment?

[1 mark]

Tick (✓) **one** box.

Burette

☐

Pipette

☐

Syringe

☐

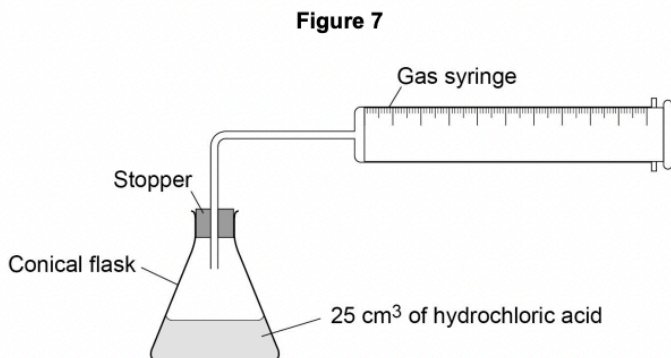
Tube

☐

Q17.a)(2022)

A student investigated the reaction of magnesium with hydrochloric acid.

Figure 7 shows the apparatus used.



This is the method used.

1. Set up the apparatus as shown in **Figure 7**.
2. Cut 10 mm of magnesium ribbon.
3. Remove the stopper.
4. Add the magnesium ribbon to the conical flask.
5. Replace the stopper as quickly as possible.
6. Record the final reading on the gas syringe when the reaction has stopped.
7. Repeat steps 1 to 6 three more times.
8. Repeat steps 1 to 7 with different lengths of magnesium ribbon.

Which gas is produced when magnesium reacts with hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

Carbon dioxide

☐

Chlorine

☐

Hydrogen

☐

Oxygen

☐

Q17.b)(2022)

What was the independent variable in the investigation?

[1 mark]

Q17.c)(2022)

Give **one** control variable in the investigation.

[1 mark]

Q18.a)(2022)

Table 5 shows the results for one length of magnesium ribbon.

Table 5

	Trial 1	Trial 2	Trial 3	Trial 4
Volume of gas produced in cm ³	19	36	37	32

One of the results was anomalous.

Which trial in **Table 5** gave an anomalous result?

[1 mark]

Trial _____

Q18.b)(2022)

Suggest **one** reason for the anomalous result in **Table 5**.

[1 mark]

Q19.a) (2022)

Table 6 shows the mean volume of gas produced for each length of magnesium ribbon.

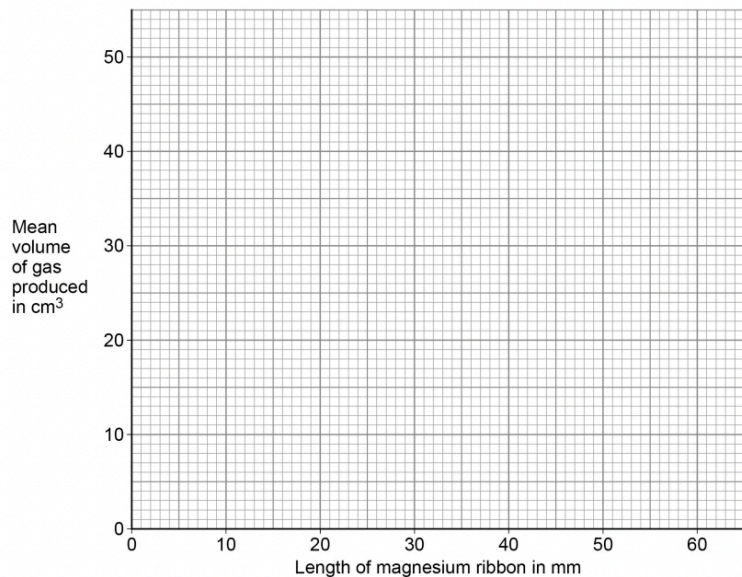
Table 6

Length of magnesium ribbon in mm	10	20	30	40	50	60
Mean volume of gas produced in cm ³	7	14	21	28	35	42

Plot the data from **Table 6** on **Figure 8**.

Draw a line of best fit.

[3 marks]

Figure 8

Q19.b) (2022)

Complete the sentence.

[1 mark]

As the length of the magnesium ribbon increases, the mean volume of gas produced

_____.

Q20.a)(2023)

Chemical Change

<http://www.pcfgstudy.com>

A student determined the reacting volumes of hydrochloric acid and sodium hydroxide solution by titration.

This is the method used.

1. Measure 25.0 cm^3 of the sodium hydroxide solution.
2. Add the sodium hydroxide solution to a conical flask.
3. Add 3 drops of indicator to the sodium hydroxide solution.
4. Add the hydrochloric acid drop by drop until the indicator changes colour.
5. Record the volume of the hydrochloric acid added.
6. Repeat steps 1 to 5 three more times.

Which piece of equipment should be used to measure 25.0 cm^3 of the sodium hydroxide solution in step 1?

[1 mark]

Tick (✓) **one** box.

Beaker

☐

Pipette

☐

Ruler

☐

Q20.b)(2023)

Which piece of equipment should be used to add the hydrochloric acid drop by drop in step 4?

[1 mark]

Tick (✓) **one** box.

Balance

☐

Burette

☐

Measuring cylinder

☐

Q21.(2023)

Name **two** other substances that can each be reacted with a dilute acid to make zinc chloride.

Do **not** refer to zinc carbonate in your answer.

[2 marks]

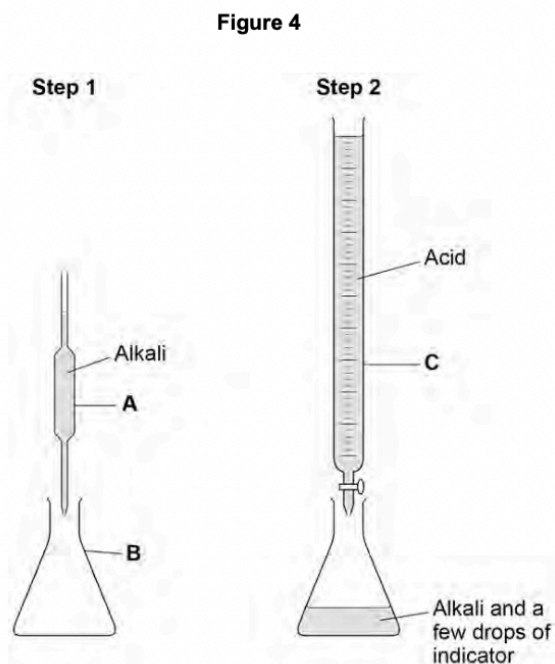
1 _____

2 _____

Q22.a)(2024)

A titration measures the volumes of an acid and an alkali that neutralise each other.

Figure 4 shows the apparatus used.



Name the pieces of equipment labelled **A**, **B** and **C** in **Figure 4**.

Choose answers from the box.

[3 marks]

beaker	burette	conical flask
measuring cylinder	pipette	test tube

A _____

B _____

C _____

Q22.b)(2024)

In **Step 2** in **Figure 4** the acid is added to the alkali until the solution is neutralised.

The volume of acid added is then read from equipment **C**.

Name a suitable indicator for use in **Step 2** of the titration.

[1 mark]

Q22.c)(2024)

Give **one** observation that shows the alkali is neutralised.

[1 mark]

Q22.d)(2024)

Give **two** ways to make sure that the volume of acid added is accurate.

[2 marks]

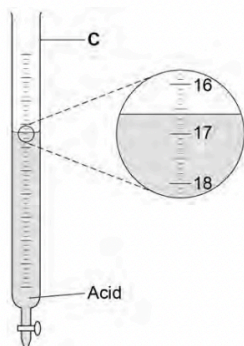
1

2

Q22.e)(2024)

Figure 5 shows the reading on equipment C at the end of Step 2.

Figure 5



What is the reading on equipment C in Figure 5?

[1 mark]

Tick (✓) **one** box.16.4 cm³☐16.6 cm³☐17.4 cm³☐17.6 cm³☐

Q22.f)(2024)

Chemical Change

<http://www.pcfgstudy.com>

A student did a different titration.

Table 1 shows the results.

Table 1

	Trial 1	Trial 2	Trial 3
Volume of acid added in cm ³	25.3	23.7	23.6

Which **two** results should be used to calculate the mean volume of acid added?

[1 mark]

Tick (✓) **one** box.

Trial 1 and Trial 2

☐

Trial 1 and Trial 3

☐

Trial 2 and Trial 3

☐

Q22.g)(2024)

A salt is produced when an acid neutralises an alkali.

Barium chloride is a salt containing the ions Ba²⁺ and Cl⁻

What is the formula of barium chloride?

[1 mark]

Tick (✓) **one** box.

BaCl

☐

BaCl₂

☐

Ba₂Cl

☐

Ba₂Cl₂

☐