AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.3.1.4

Chemical measurements

Past-paper questions

Tier	**Foundation**
Question groups	**30**
Available paper years	**2008–2025**

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.

4.3.1.4 Chemical measurements

Question 01

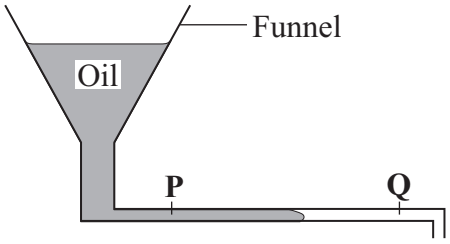
June 2008 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

Viscosity is the ease with which a liquid flows.

The more viscous an oil is, the more slowly it will flow.

A student compared the viscosity of four different oils, **W**, **X**, **Y** and **Z**, at different temperatures. He used the apparatus shown in the diagram.



First he used oil **W**.

- Oil **W** was heated to 20 °C and was then poured into the funnel.
- The time taken for oil **W** to flow from **P** to **Q** was recorded.
- The student repeated the procedure for oil **W** at temperatures of 30 °C, 40 °C and 50 °C.

The student then used oils **X**, **Y** and **Z** in the same way.

The results are shown in the table.

Oil	Time taken for the oil to travel between points P and Q in seconds			
	at 20 °C	at 30 °C	at 40 °C	at 50 °C
W	55	50	45	40
X	35	32	29	26
Y	85	75	80	55
Z	110	100	90	80

9A When testing oil **W** at the four temperatures shown, the dependent variable is . . .

1 the choice of oil.

2 the time the oil takes to travel between **P** and **Q**.

3 the temperature of the oil.

4 the distance between **P** and **Q**.

4.3.1.4 Chemical measurements

Question 01 · continued

9B A measurement that appears to be anomalous is for . . .

1 oil **W** at 40 °C.

2 oil **X** at 30 °C.

3 oil **Y** at 40 °C.

4 oil **Z** at 30 °C.

9C The most viscous oil is . . .

1 **W**

2 **X**

3 **Y**

4 **Z**

9D The accuracy of the results would be improved by . . .

1 using a wider range of temperatures.

2 repeating each procedure.

3 maintaining the apparatus at the same temperature as the oil.

4 using more oils.

END OF TEST

4.3.1.4 Chemical measurements

Question 02

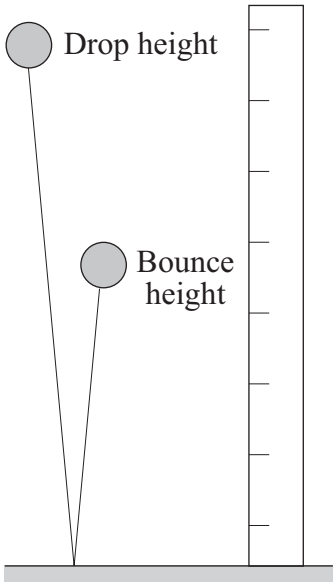
June 2009 | CHY1BP | Original Q6 | Legacy

QUESTION SIX

A student tested two balls; one ball was made from natural rubber and the other from a new polymer.

The student dropped the rubber ball from a measured height and recorded the height to which it bounced. The student did the experiment using different drop heights.

The student repeated the whole experiment using the polymer ball.



The results are shown in the table.

Drop height in cm	Rubber ball bounce height in cm	Polymer ball bounce height in cm
20	14	18
40	28	36
60	42	54
80	67	71
100	70	90

6A To improve the reliability of the results, the student could have . . .

1 repeated the test with balls made of different polymers.

2 repeated the experiment for each drop height several times.

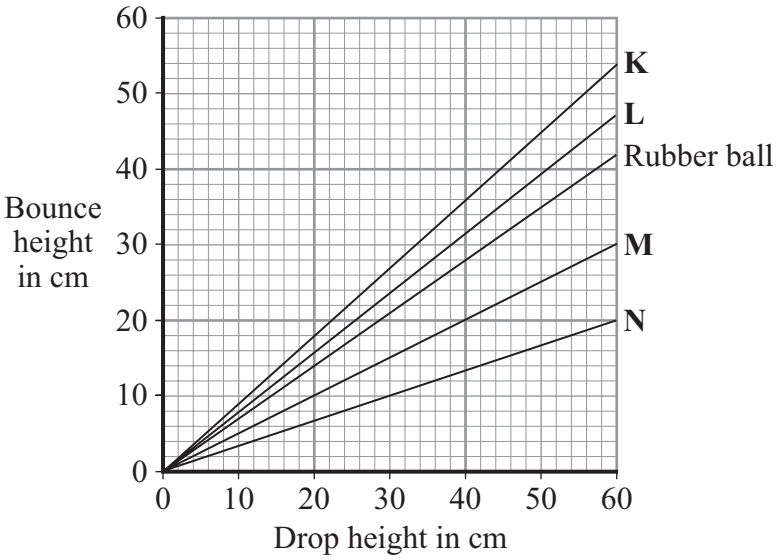
3 used a longer measuring instrument.

4 dropped the ball onto a harder surface.

4.3.1.4 Chemical measurements

Question 02 · continued

6B Which of the lines, **K**, **L**, **M** or **N**, on the graph, represents the polymer ball?



1 **K**

2 **L**

3 **M**

4 **N**

6C Which one of the following values **in the table** for the bounce height is clearly anomalous?

1 28 cm for the rubber ball

2 67 cm for the rubber ball

3 36 cm for the polymer ball

4 71 cm for the polymer ball

6D The results show that for each drop height . . .

1 the rubber ball will bounce higher than the polymer ball.

2 the polymer ball will bounce higher than the rubber ball.

3 the rubber ball will bounce higher as it warms up.

4 the rubber ball becomes less bouncy the more it is used.

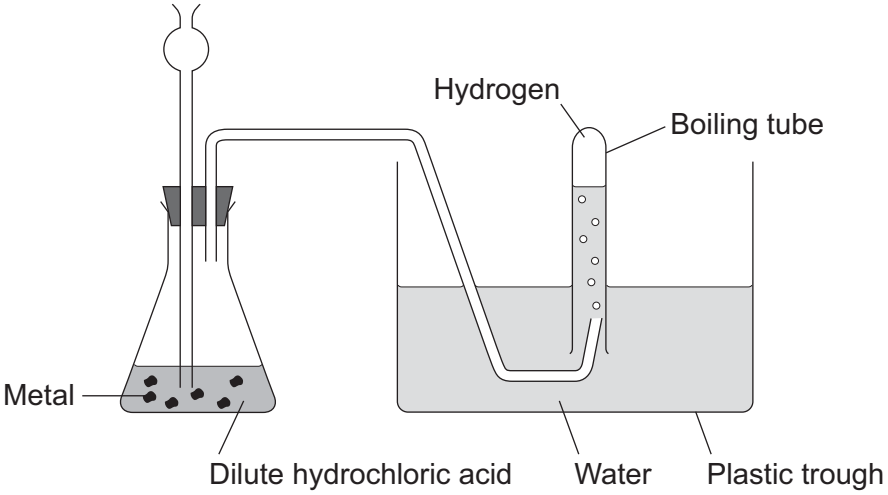
4.3.1.4 Chemical measurements

Question 03

June 2010 | CHY1AP | Original Q6 | Legacy

QUESTION SIX

Some students were trying to decide which one of the metals, **K**, **L**, **M** or **N**, was the most reactive. They set up the apparatus shown in the diagram.



Dilute hydrochloric acid was added to the metal **K**. Hydrogen was given off. The students recorded how long it took to fill the boiling tube with the hydrogen. They did the experiment twice more under exactly the same conditions.

They repeated the experiment, using equal-sized pieces of metals **L**, **M** and **N**.

The results are shown in the table.

	Time taken to fill the boiling tube with hydrogen in seconds		
Metal	**Experiment 1**	**Experiment 2**	**Experiment 3**
K	600	479	649
L	189	220	178
M	81	82	78
N	125	132	143

4.3.1.4 Chemical measurements

Question 03 · continued

6A To make it a fair test, the students made sure that the boiling tube was always completely filled with hydrogen before they recorded the time.

What else should they do to make it a fair test?

1 use a different acid for each metal

2 use the same volume of the acid for each test

3 replace the water in the plastic trough for each test

4 use different temperatures for each metal

6B Which metal was the most reactive?

1 metal **K**

2 metal **L**

3 metal **M**

4 metal **N**

6C Why did the students take more than one reading for each metal?

1 to make an error less likely

2 so that they could plot a graph

3 to make it easier to see the relationship between the two variables

4 to make it a fair test

6D Some of their results were anomalous.

Which of the following experiments should the students repeat?

1 metal **K**, experiment 2

2 metal **L**, experiment 3

3 metal **M**, experiment 3

4 metal **N**, experiment 1

4.3.1.4 Chemical measurements

Question 04

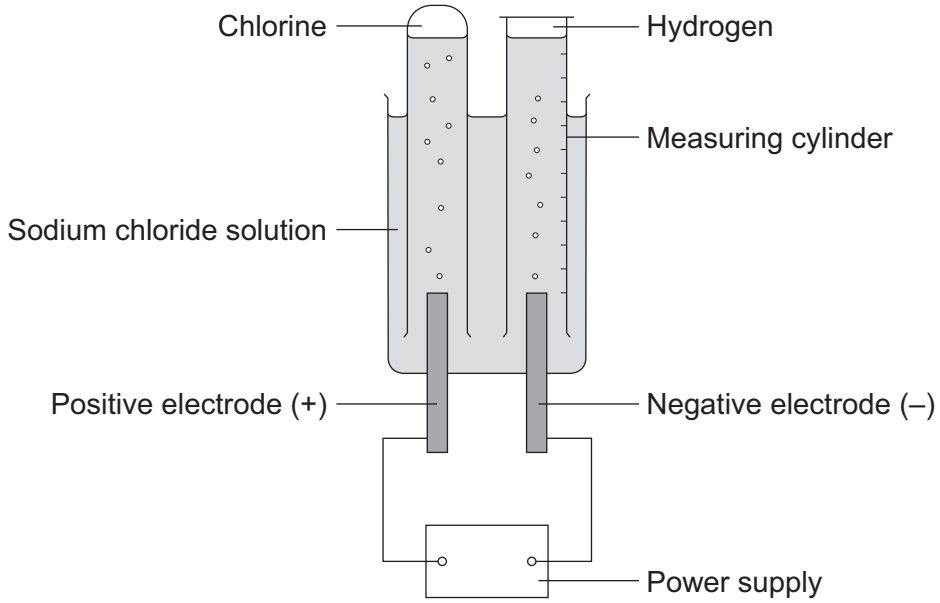
6 A student investigated the electrolysis of sodium chloride solution.

Five sodium chloride solutions were made. Each solution had a different concentration.

To make each solution the student:

- weighed the amount of sodium chloride needed
- dissolved it in water
- added more water until the total volume was one cubic decimetre (1 dm^3).

The solutions were placed one at a time in the apparatus shown below.



The student measured the volume of hydrogen gas produced in ten minutes.

The results are shown on the graph on the next page.

6 (a) Sodium chloride does not conduct electricity when it is solid.

Explain, in terms of ions, why sodium chloride solution conducts electricity.

.....

.....

(1 mark)

6 (b) Chlorine is produced at the positive electrode.

Why are chloride ions attracted to the positive electrode?

.....

(1 mark)

Question 6 continues on the next page

4.3.1.4 Chemical measurements

Question 04 · continued

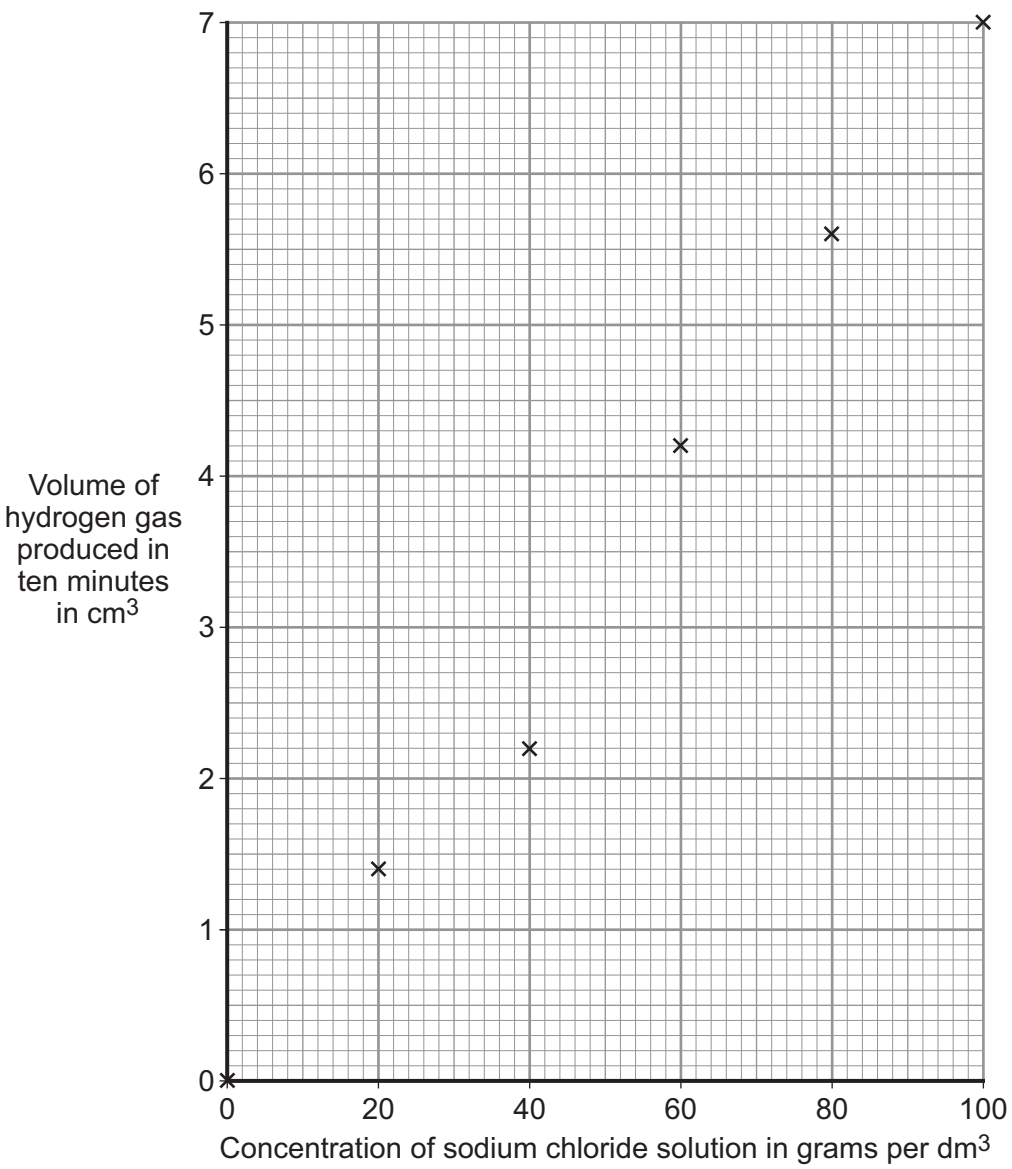
6 (c) The solution left at the end of each experiment contains sodium hydroxide.

Draw a ring around **one** number which could be the pH of this solution.

2 **5** **7** **13**

(1 mark)

6 (d) The results for the experiment on the previous page are shown on the graph.



4.3.1.4 Chemical measurements

Question 04 · continued

6 (d) (i) Draw a line of best fit on the graph.

(1 mark)

6 (d) (ii) The result for one concentration is anomalous.
Which result is anomalous?

The result at concentration ..... grams per dm^3

(1 mark)

6 (d) (iii) Suggest **two** possible causes of this anomalous result.

1 .....

.....

2 .....

.....

(2 marks)

6 (d) (iv) Suggest how the student could check the reliability of the results.

.....

.....

(1 mark)

6 (d) (v) How did an increase in the concentration of the sodium chloride solution affect the volume of hydrogen gas produced in ten minutes?

.....

.....

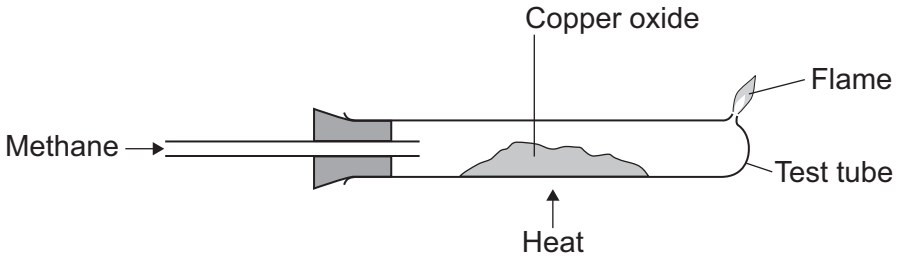
(1 mark)

9

4.3.1.4 Chemical measurements

Question 05

7 An experiment was done on the reaction of copper oxide (CuO) with methane (CH_4).



7 (a) The equation for this reaction is shown below.

$$4CuO(s) + CH_4(g) \rightarrow 4Cu(s) + 2H_2O(g) + CO_2(g)$$

The water and carbon dioxide produced escapes from the test tube.

Use information from the equation to explain why.

.....

(1 mark)

7 (b) (i) Calculate the relative formula mass (M_r) of copper oxide (CuO).

Relative atomic masses (A_r): O = 16; Cu = 64.

.....

.....

.....

Relative formula mass (M_r) = ...

(2 marks)

7 (b) (ii) Calculate the percentage of copper in copper oxide.

.....

.....

.....

Percentage of copper = ... %

(2 marks)

4.3.1.4 Chemical measurements

Question 05 · continued

7 (b) (iii) Calculate the mass of copper that could be made from 4.0 g of copper oxide.

.....

.....

Mass of copper = ... g

(1 mark)

7 (c) The experiment was done three times.
The mass of copper oxide used and the mass of copper made was measured each time.
The results are shown in the table.

	Experiment		
	1	**2**	**3**
Mass of copper oxide used in g	4.0	4.0	4.0
Mass of copper made in g	3.3	3.5	3.2

7 (c) (i) Calculate the mean mass of copper made in these experiments.

.....

.....

Mean mass of copper made = ... g

(1 mark)

7 (c) (ii) Suggest how the results of these experiments could be made more precise.

.....

.....

(1 mark)

7 (c) (iii) The three experiments gave slightly different results for the mass of copper made.
This was caused by experimental error.

Suggest **two** causes of experimental error in these experiments.

1 .....

.....

2 .....

.....

(2 marks)

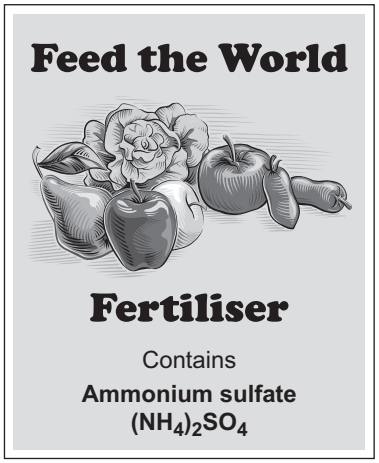
10

4.3.1.4 Chemical measurements

Question 06

June 2011 | CHY3F | Original Q3 | Legacy

3 Ammonium sulfate is an artificial fertiliser.



3 (a) A student tested this fertiliser to prove that it contained ammonium ions and sulfate ions.

Draw a ring around the correct answer to complete each sentence.

3 (a) (i) Test for ammonium ions (NH_4^+).

The student added [sodium chloride solution / sodium hydroxide solution / dilute sulfuric acid] to the fertiliser.

A gas called ammonia was produced.

Ammonia turns damp litmus paper [blue. / green. / red.]

(2 marks)

3 (a) (ii) Test for sulfate ions (SO_4^{2-}).

The student added [barium chloride / silver nitrate / sodium chloride] solution to a solution of the fertiliser.

A [blue / red / white] precipitate was formed.

(2 marks)

3 (b) Ammonium sulfate is made by reacting sulfuric acid with ammonia solution.

Sulfuric acid is a *strong* acid.

Draw a ring around the correct answer to complete the sentence.

The word *strong* means that the acid is

- difficult to break.
- very concentrated.
- fully ionised in water.

(1 mark)

3 (c) Use the information about acids in the table to help you answer these questions.

Name of chemical	Ions produced in aqueous solution		pH	Universal Indicator added
Ethanoic acid	H^+	CH_3COO^-	5	Goes orange
Sulfuric acid	H^+	SO_4^{2-}	1	Goes red

Draw a ring around the correct answer to complete each sentence.

3 (c) (i) Sulfuric acid and ethanoic acid are both acids because they contain

- CH_3COO^- ions.
- H^+ ions.
- SO_4^{2-} ions.

(1 mark)

3 (c) (ii) Sulfuric acid is a stronger acid than ethanoic acid.

The pH of stronger acids is

- higher than
- lower than
- the same as

the pH of weaker acids.

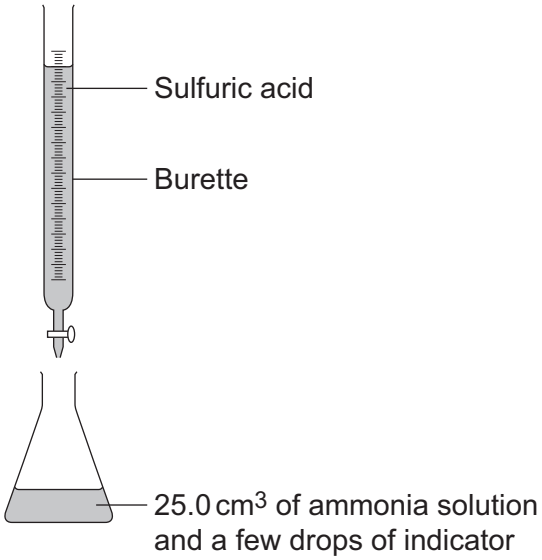
(1 mark)

4.3.1.4 Chemical measurements

Question 06 · continued

3 (d) The volume of sulfuric acid that reacts with 25.0 cm^3 of ammonia solution can be found by titration.

The diagram shows the apparatus used for the titration.



A student did the titration five times and recorded the following results.

Titration	1	2	3	4	5
Volume of acid added in cm^3	13.3	13.9	13.2	13.1	13.2

3 (d) (i) How did the student know when enough sulfuric acid had been added to neutralise the ammonia solution?

.....

.....

(1 mark)

3 (d) (ii) The student did **not** use one of the results because it was anomalous.

Which result was anomalous? .....

(1 mark)

3 (d) (iii) Use the **other** four results to calculate the mean volume of sulfuric acid that reacted with the ammonia.

.....

.....

Mean volume = ... cm^3

(1 mark)

10

4.3.1.4 Chemical measurements

Question 07

June 2012 | CH2FP | Original Q1 | Legacy

1 (a) The symbol equation for the decomposition of hydrogen peroxide is:

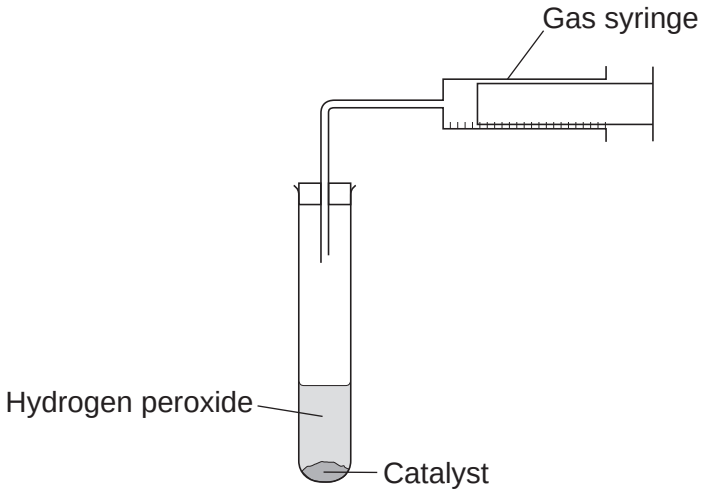
$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Complete the word equation for the decomposition of hydrogen peroxide.

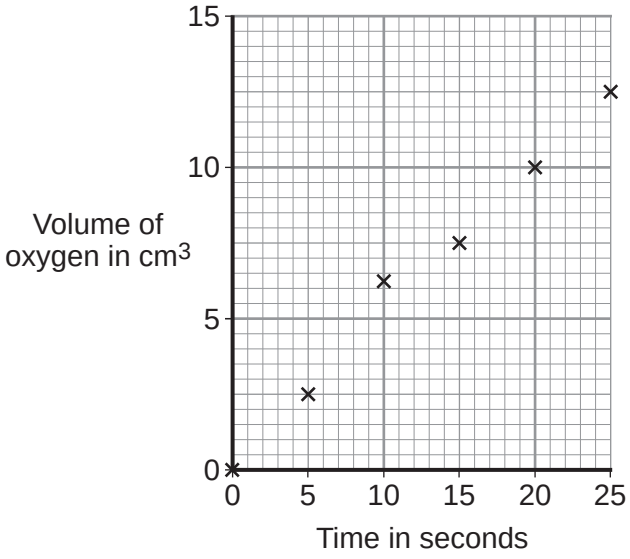
Hydrogen peroxide → ..... + ...

(1 mark)

1 (b) A student did an experiment to see how quickly hydrogen peroxide decomposes.
The student used the apparatus shown below to measure the volume of oxygen.



1 (b) (i) Draw a straight line of best fit to complete the graph.



(1 mark)

4.3.1.4 Chemical measurements

Question 07 · continued

1 (b) (ii) Draw a circle around the anomalous point on the graph.

(1 mark)

1 (b) (iii) What is the volume of oxygen given off after 15 seconds? ..... cm^3

(1 mark)

1 (b) (iv) How did the volume of oxygen change between 0 and 25 seconds?

.....

(1 mark)

1 (c) The student wanted to make the reaction faster.

Draw a ring around the correct answer to complete each sentence.

1 (c) (i) To make the reaction faster, the temperature should be

higher.

lower.

the same.

(1 mark)

1 (c) (ii) To make the reaction faster, the hydrogen peroxide should be

more dilute.

more concentrated.

the same.

(1 mark)

Question 1 continues on the next page

4.3.1.4 Chemical measurements

Question 07 · continued

1 (d) The diagram represents the bonding in oxygen.

O=O

Draw a ring around the correct answer to complete each sentence.

1 (d) (i) When two oxygen atoms bond, the atoms [share / transfer / delocalise] electrons.

(1 mark)

1 (d) (ii) The oxygen atoms are joined by [ionic / metallic / covalent] bonds.

(1 mark)

1 (d) (iii) Oxygen is made of [simple molecules. / a giant lattice. / macromolecules.]

(1 mark)

1 (e) When hydrogen peroxide decomposes water is produced.
Which **two** statements in the table explain why water is a liquid at room temperature?

Tick (✓) the **two** statements.

Statement	Tick (✓)
Water has a boiling point of 100 °C.	
Water is made of ions.	
Water has a melting point lower than room temperature.	
Water has a giant covalent structure.	

(2 marks)

12

4.3.1.4 Chemical measurements

Question 08

June 2014 | CH1FP | Original Q3 | Legacy

3 Limestone is used for statues and buildings.

Limestone contains calcium carbonate ($CaCO_3$).

3 (a) **Figure 2** shows a limestone quarry.

Figure 2



3 (a) (i) Suggest **one** problem quarrying limestone will cause for people living nearby.

[1 mark]

.....

.....

3 (a) (ii) Suggest **one** benefit of quarrying limestone for people living nearby.

[1 mark]

.....

.....

3 (a) (iii) Why are limestone statues and buildings damaged by rain?

[1 mark]

.....

.....

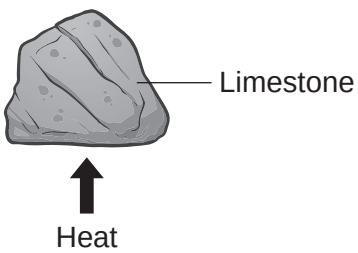
Question 3 continues on the next page

4.3.1.4 Chemical measurements

Question 08 · continued

3 (b) A student investigated what happens when limestone is heated, as shown in **Figure 3**.

Figure 3



This is the method the student used:

- measure the mass of limestone before heating
- measure the mass of solid product after heating
- repeat the experiment two more times.

The student's results are shown in **Table 2**.

Table 2

	Experiment 1	Experiment 2	Experiment 3
Mass of limestone before heating in g	5.0	5.0	5.0
Mass of solid product after heating in g	3.6	3.4	3.8
Mass lost in g	1.4	1.6	

3 (b) (i) Calculate the mass lost in experiment **3**.

[1 mark]

.....

.....

Mass lost = ... g

3 (b) (ii) Calculate the mean mass lost in the three experiments.

[1 mark]

.....

.....

Mean mass lost = ... g

4.3.1.4 Chemical measurements

Question 08 · continued

3 (b) (iii) Suggest **one** reason why the mass lost was **not** the same for the three experiments.

[1 mark]

.....

.....

3 (c) The word equation for the reaction when calcium carbonate is heated is:

calcium carbonate ⟶ calcium oxide + carbon dioxide

3 (c) (i) Complete the sentence.

[1 mark]

The reaction when calcium carbonate is heated is called

thermal ..... .

3 (c) (ii) Heating 5.0 g of calcium carbonate produces 2.8 g of calcium oxide.

Calculate the mass of carbon dioxide produced.

[1 mark]

.....

.....

Mass of carbon dioxide = ... g

3 (c) (iii) Describe how to test a gas to show that it is carbon dioxide.

[2 marks]

Test .....

.....

Result .....

.....

10

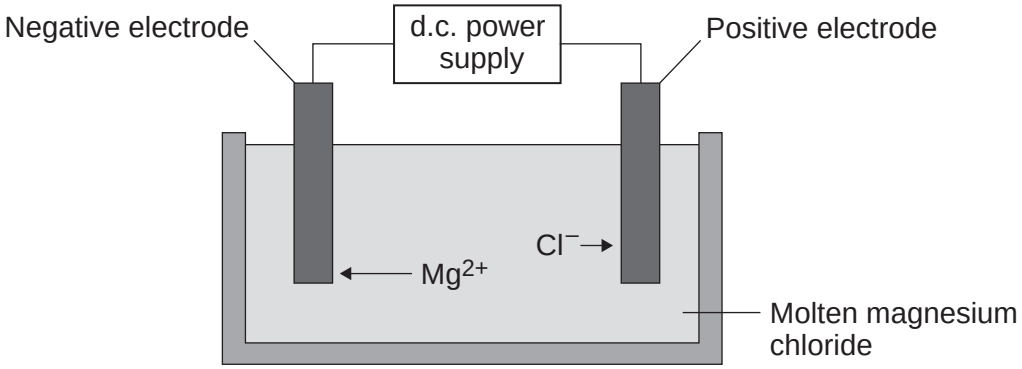
4.3.1.4 Chemical measurements

Question 09

5 Some students investigated reactions to produce magnesium.

5 (a) The students used electrolysis to produce magnesium from magnesium chloride, as shown in **Figure 7**.

Figure 7



5 (a) (i) Magnesium chloride contains magnesium ions and chloride ions.

Why does solid magnesium chloride **not** conduct electricity?

[1 mark]

.....

.....

5 (a) (ii) One of the products of the electrolysis of molten magnesium chloride is magnesium.

Name the other product.

[1 mark]

.....

5 (a) (iii) Why do magnesium ions (Mg^{2+}) move to the negative electrode?

[1 mark]

.....

.....

4.3.1.4 Chemical measurements

Question 09 · continued

5 (a) (iv) At the negative electrode, the magnesium ions (Mg^{2+}) gain electrons to become magnesium atoms.

How many electrons does each magnesium ion gain?

[1 mark]

.....

5 (b) The students did the experiment four times and weighed the magnesium produced.

Table 1 shows their results.

Table 1

Experiment	Mass of magnesium produced in grams
1	1.13
2	0.63
3	1.11
4	1.09

5 (b) (i) There is an anomalous result.

Suggest **one** possible reason for the anomalous result.

[1 mark]

.....

.....

5 (b) (ii) Calculate the mean mass of magnesium produced, taking account of the anomalous result.

[2 marks]

.....

.....

.....

Mean mass = ... g

4.3.1.4 Chemical measurements

Question 09 · continued

5 (c) The formula of magnesium chloride is $MgCl_2$

The relative formula mass of magnesium chloride is 95.

The relative atomic mass of magnesium is 24.

5 (c) (i) Use the equation to calculate the percentage mass of magnesium in magnesium chloride.

$$\text{Percentage mass of magnesium} = \frac{\text{mass of magnesium}}{\text{mass of magnesium chloride}} \times 100\%$$

[2 marks]

.....

.....

.....

Percentage mass of magnesium in magnesium chloride = ... %

5 (c) (ii) Draw a ring around the relative mass of chlorine in $MgCl_2$

[1 mark]

71 **95** **119**

4.3.1.4 Chemical measurements

Question 09 · continued

5 (d) Magnesium is also produced from the reaction of magnesium oxide with silicon.

5 (d) (i) The equation for the reaction is:

$$2\ MgO(s) + Si(s) \rightleftharpoons SiO_2(s) + 2\ Mg(s)$$

What is the meaning of this symbol $\rightleftharpoons$?

Draw a ring around the correct answer.

[1 mark]

neutralisation reaction **precipitation reaction** **reversible reaction**

5 (d) (ii) The forward reaction is endothermic.

Draw a ring around the correct answer to complete the sentence.

[1 mark]

In an endothermic reaction the temperature of the surroundings

decreases.

increases.

stays the same.

12

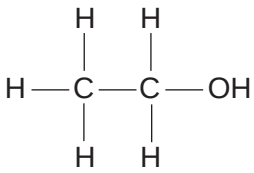
4.3.1.4 Chemical measurements

Question 10

June 2014 | CH3FP | Original Q8 | Legacy

8 (a) The structure of an alcohol is shown in **Figure 10**.

Figure 10



8 (a) (i) Draw a circle around the functional group in the structure of the alcohol.

[1 mark]

8 (a) (ii) What is the chemical name of this alcohol?

[1 mark]

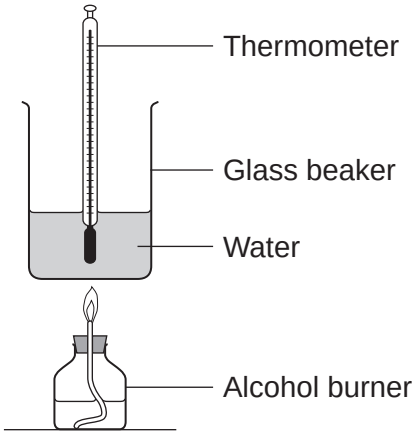
.....

8 (b) Alcohols are used as fuels.

A student plans an experiment to find the energy released per gram of alcohol burned.

The student uses the apparatus shown in **Figure 11**.

Figure 11



8 (b) (i) Suggest **two** ways that this apparatus could be improved to obtain accurate results.

[2 marks]

.....

.....

.....

.....

4.3.1.4 Chemical measurements

Question 10 · continued

8 (b) (ii) In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Describe how the student should do this experiment.

You should include any measurements the student should make.

Do **not** describe any improvements to the apparatus.

Do **not** describe how to do any calculations.

[6 marks]

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Extra space .....

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10

4.3.1.4 Chemical measurements

Question 11

June 2015 | CH1FP | Original Q5 | Legacy

5 Limestone is used to make many different materials.

5 (a) Heating limestone produces calcium oxide and carbon dioxide.

Complete the sentences.

5 (a) (i) The main compound in limestone is calcium ..... .

[1 mark]

5 (a) (ii) The reaction to produce calcium oxide from limestone is thermal ..... .

[1 mark]

5 (a) (iii) Calcium hydroxide is produced when calcium oxide reacts with ..... .

[1 mark]

5 (a) (iv) Calcium hydroxide is used to neutralise acids because it is an ..... .

[1 mark]

Question 5 continues on the next page

Question 11 · continued

5 (b) Cement is made from limestone and clay.

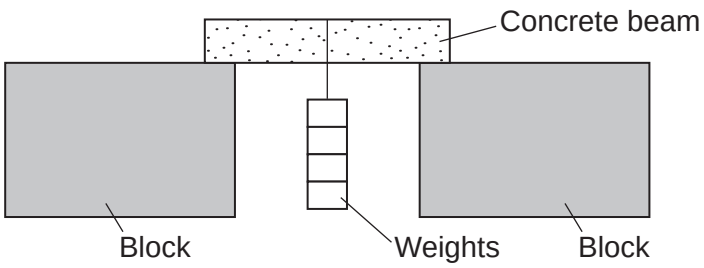
Concrete is made by mixing cement with water, sand and aggregate (small pieces of rock).

A group of students did an investigation on the amount of aggregate needed to make the strongest concrete beam.

The students used this method:

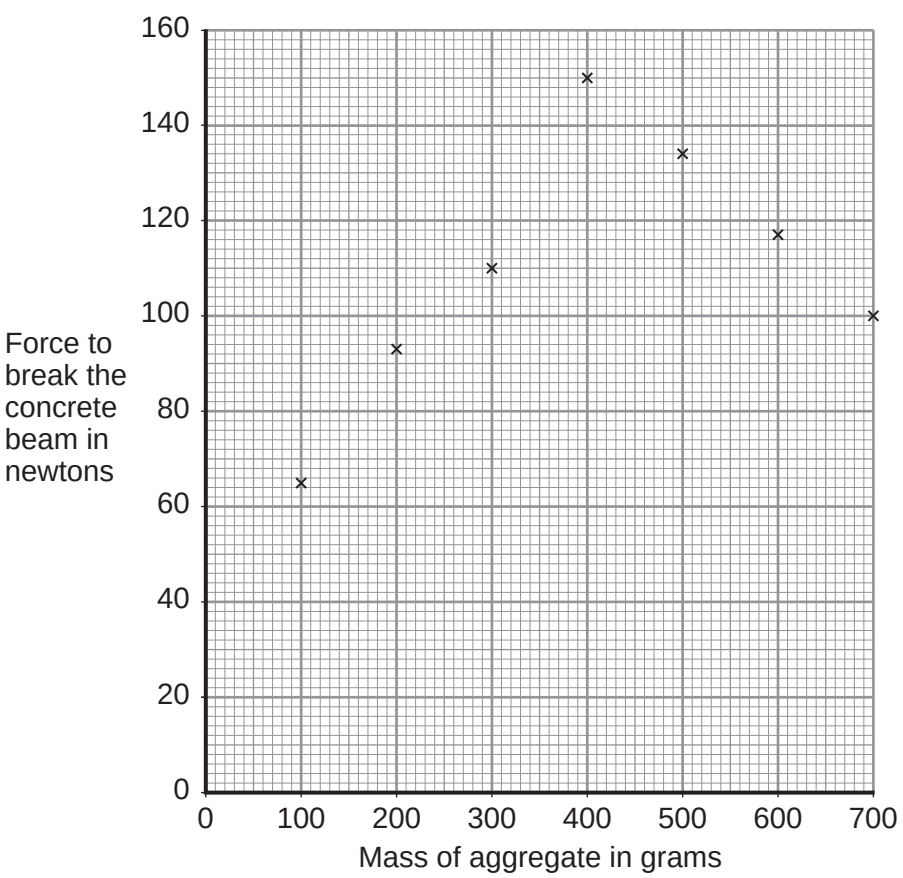
- use the same mass of cement and the same mass of sand but change the mass of aggregate to make seven different concrete mixtures
- use the different concrete mixtures to make beams of the same size
- add weights, as shown in **Figure 7**, until the concrete beam breaks.

Figure 7



The students' results are plotted on the graph in **Figure 8**.

Figure 8



Question 11 · continued

5 (b) (i) One of the points is anomalous.

Complete the graph in **Figure 8** by drawing **two** straight lines of best fit.

[2 marks]

5 (b) (ii) Describe **one** way the students could improve the method so that their results are more accurate for each graph point.

[2 marks]

.....

.....

.....

.....

5 (b) (iii) What force is needed to break a concrete beam containing no aggregate?

Show your working on the graph.

[2 marks]

Force = ... newtons

5 (b) (iv) One of the students concluded that:

'The force needed to break a concrete beam increases as the mass of aggregate increases.'

The student's conclusion is **not completely** correct. Use values from the graph to explain why.

[3 marks]

.....

.....

.....

.....

.....

.....

13

4.3.1.4 Chemical measurements

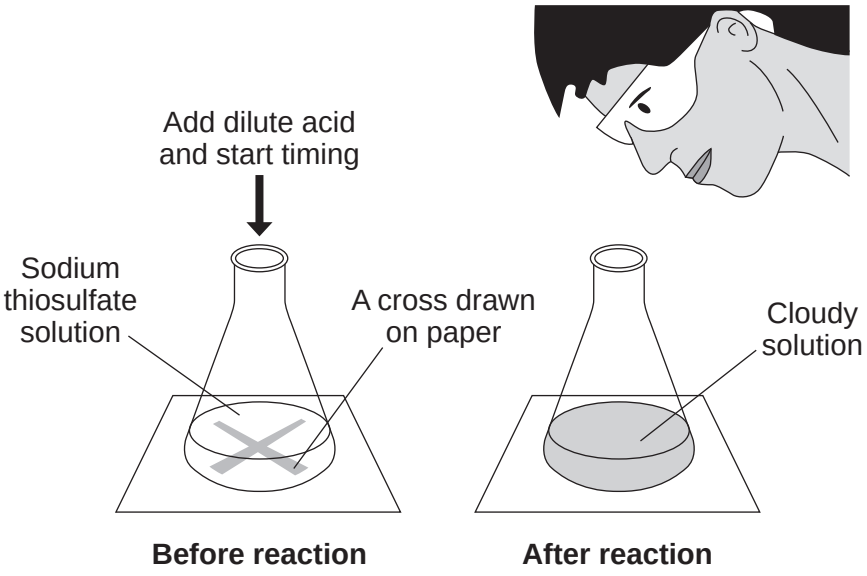
Question 12

June 2016 | CH2FP | Original Q4 | Legacy

4 A student investigated the effect of temperature on the rate of a reaction.

Figure 9 shows an experiment.

Figure 9



The student:

- put 50 cm^3 sodium thiosulfate solution into a conical flask
- heated the sodium thiosulfate solution to the required temperature
- put the flask on a cross drawn on a piece of paper
- added 5 cm^3 dilute hydrochloric acid and started a stopclock
- stopped the stopclock when the cross could no longer be seen
- repeated the experiment at different temperatures.

Question 12 · continued

The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

sodium thiosulfate	hydrochloric acid	sodium chloride	water	sulfur dioxide	sulfur

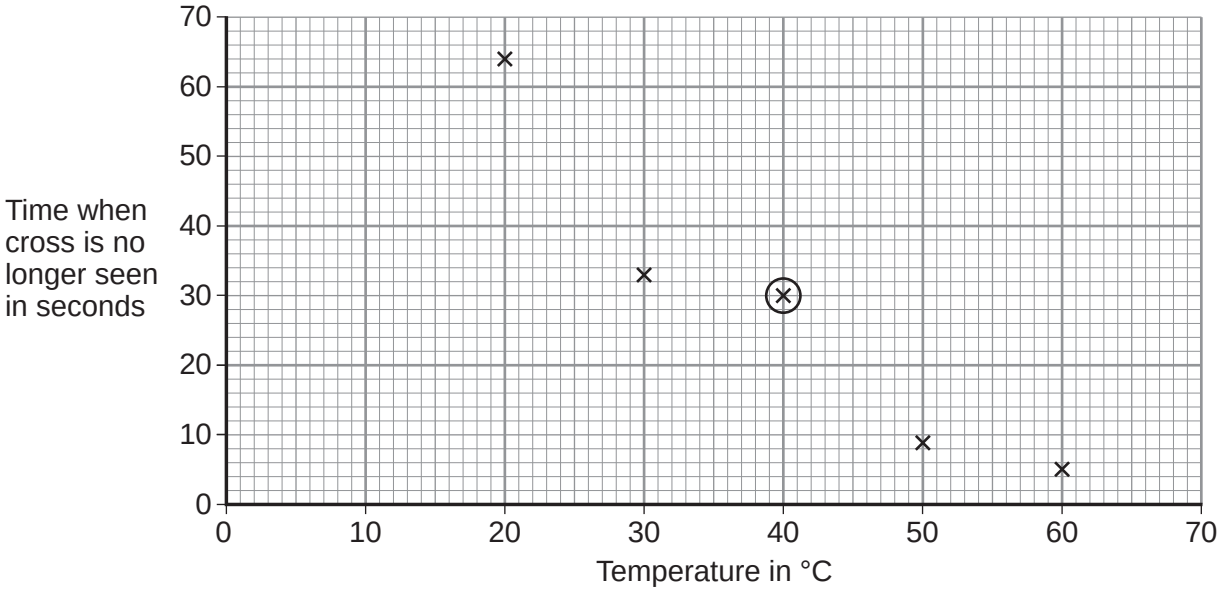
4 (a) Which product is a gas?

[1 mark]

_____

4 (b) **Figure 10** shows the results of this experiment at five different temperatures. The circled result point is anomalous.

Figure 10



4 (b) (i) Draw a line of best fit on **Figure 10** to show how the reaction time varied with reaction temperature.

[1 mark]

4 (b) (ii) Give a possible reason for the anomalous result at 40 °C.

[1 mark]

_____

_____

Question 4 continues on the next page

4.3.1.4 Chemical measurements

Question 12 · continued

4 (b) (iii) The reaction at 20 °C produced 0.32 g of sulfur in 64 seconds.

Calculate the rate of the reaction at 20 °C using the equation:

$$\text{Rate of reaction} = \frac{\text{mass of sulfur}}{\text{time}}$$

[2 marks]

Rate of reaction = _____ grams per second

4 (b) (iv) Give **two** reasons why the rate of the reaction increases as the temperature increases.

[2 marks]

Tick (✓) **two** boxes.

- The particles move faster. ☐
- The particles collide less often. ☐
- All the particles have the same energy. ☐
- The particles collide with more energy. ☐
- The number of particles increases. ☐

4 (b) (v) Use the correct answer from the box to complete the sentence.

[1 mark]

activation	collision	exothermic

The minimum amount of energy particles must have to react is called

the _____ energy.

8

4.3.1.4 Chemical measurements

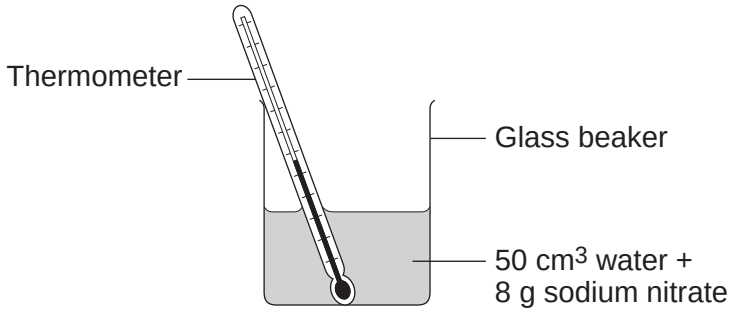
Question 13

5 This question is about temperature changes.

5 (a) A student investigated the temperature change when 8 g of sodium nitrate dissolves in 50 cm^3 of water.

Figure 11 shows the apparatus the student used.

Figure 11



The student did the experiment five times.
Table 2 shows the results.

Table 2

Experiment	Decrease in temperature of water in °C
1	5.9
2	5.7
3	7.2
4	5.6
5	5.8

4.3.1.4 Chemical measurements

Question 13 · continued

5 (a) (i) Calculate the mean decrease in temperature.
Do not use the anomalous result in your calculation.

[2 marks]

Mean decrease in temperature = _____ °C

5 (a) (ii) Suggest **one** change in the apparatus in **Figure 11** which would improve the accuracy of the results.
Give a reason for your answer.

[2 marks]

Question 5 continues on the next page

4.3.1.4 Chemical measurements

Question 13 · continued

5 (b) The student investigated the temperature change when different masses of sodium carbonate were added to 50 cm^3 of water at 20 °C.

Table 3 shows the results.

Table 3

Mass of sodium carbonate in g	Final temperature of solution in °C
2.0	21.5
4.0	23.0
6.0	24.5
8.0	26.0
10.0	26.6
12.0	26.6
14.0	26.6

Describe the relationship between the mass of sodium carbonate added and the final temperature of the solution.

Use values from **Table 3** in your answer.

[3 marks]

7

4.3.1.4 Chemical measurements

Question 14

June 2016 | CH3FP | Original Q3 | Legacy

3 This question is about energy changes in chemical reactions.

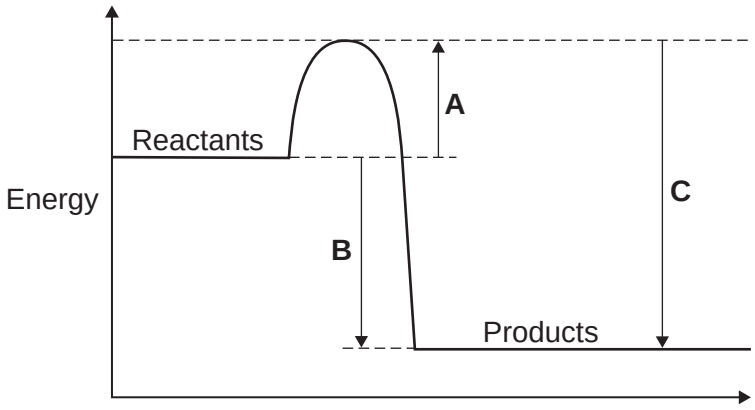
3 (a) Complete the word equation for the combustion of hydrogen.

[1 mark]

hydrogen + oxygen ⟶ _____

3 (b) **Figure 3** shows a simple energy level diagram.

Figure 3



3 (b) (i) Which arrow, **A**, **B** or **C**, shows the activation energy?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

3 (b) (ii) What type of reaction is shown by the energy level diagram in **Figure 3**?
Give a reason for your answer.

[2 marks]

Type of reaction _____

Reason _____

_____

4.3.1.4 Chemical measurements

Question 14 · continued

3 (b) (iii) For a reaction, the value of **A** is 1370 kJ and **C** is 3230 kJ.
Calculate the value of **B**.

[1 mark]

_____

_____

B = _____ kJ

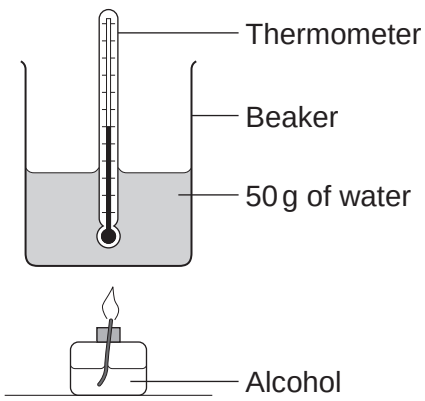
Question 3 continues on the next page

Question 14 · continued

3 (c) Alcohols are used as fuels.

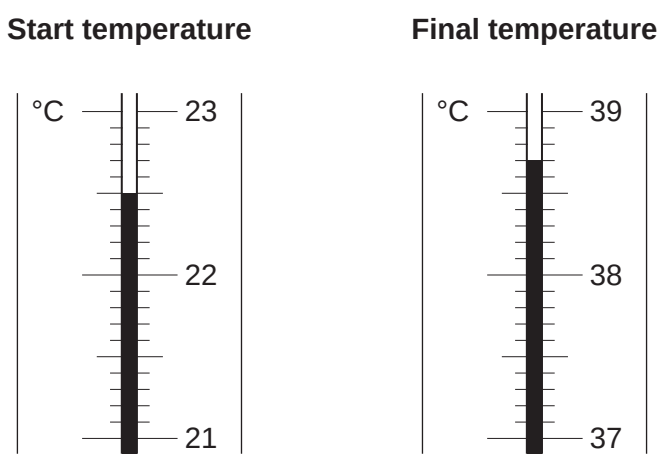
A group of students investigated the amount of energy released when different alcohols are burned.
The students used the apparatus shown in **Figure 4**.

Figure 4



3 (c) (i) **Figure 5** shows the start temperature and the final temperature of the water.

Figure 5



Write the start temperature and the final temperature of the water in **Table 1**.
Work out the increase in temperature to complete **Table 1**.

[3 marks]

Table 1

Start temperature of the water in °C	
Final temperature of the water in °C	
Increase in temperature in °C	

4.3.1.4 Chemical measurements

Question 14 · continued

3 (c) (ii) The students worked out the heat energy released by burning 1 g of each alcohol. The students used the equation:

Heat energy released = m × 4.2 × increase in temperature

Look at **Figure 4**. What is the value of m?

[1 mark]

m = _____ g

3 (c) (iii) **Table 2** shows the students' results.

Table 2

Name of alcohol	Number of carbon atoms in one molecule of alcohol	Heat energy released when 1 g of alcohol is burned in kJ
Methanol	1	11.4
Ethanol	2	14.5
Propanol	3	20.1
Butanol	4	16.8
Pentanol	5	17.2

Which value of heat energy released is anomalous?

[1 mark]

_____

3 (c) (iv) Look at **Table 2**.
What is the relationship between the number of carbon atoms in one molecule of alcohol and the heat energy released when 1 g of the alcohol is burned?

[1 mark]

_____

_____

Question 3 continues on the next page

4.3.1.4 Chemical measurements

Question 14 · continued

3 (c) (v) The value in a data book for the amount of heat energy released when 1 g of butanol is burned completely is 36.2 kJ.

Suggest **two** reasons why the students' result for butanol is lower than the data book value.

[2 marks]

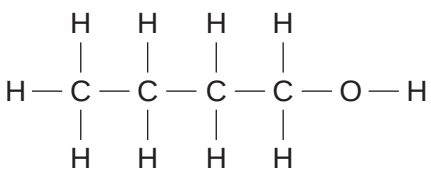
1 _____

_____

2 _____

_____

3 (c) (vi) The displayed structure of butanol is:



What is the functional group of the alcohol?

[1 mark]

Tick (✓) **one** box.

— C — C ☐

— C — H ☐

— O — H ☐

14

4.3.1.4 Chemical measurements

Question 15

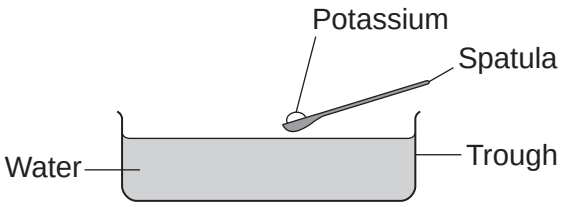
June 2017 | CH3FP | Original Q4 | Legacy

4 This question is about potassium and its compounds.

4 (a) Potassium reacts with water.

Figure 5 shows potassium being added to water.

Figure 5



The word equation for the reaction is:

potassium + water ⟶ potassium hydroxide + hydrogen

Give **two** observations that can be seen when potassium is added to water.

[2 marks]

Question 4 continues on the next page

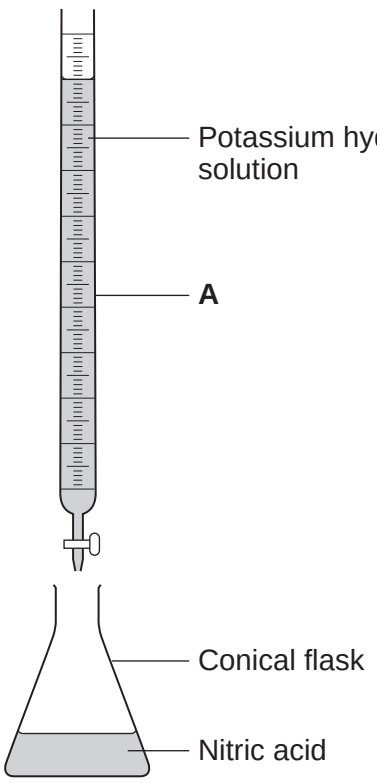
4.3.1.4 Chemical measurements

Question 15 · continued

4 (b) Potassium hydroxide solution is used in titrations.

A student used the apparatus in **Figure 6** to do a titration to find the concentration of some nitric acid.

Figure 6



4 (b) (i) Name the piece of apparatus labelled **A**.

[1 mark]

_____

4 (b) (ii) What should the student add to the nitric acid before starting the titration?

[1 mark]

_____

4.3.1.4 Chemical measurements

Question 15 · continued

4 (b) (iii) Describe how the student could use the apparatus in **Figure 6** to complete the titration.

[3 marks]

4 (b) (iv) The student did the titration four times.

Give **one** variable the student should keep the same for each titration.

[1 mark]

Question 4 continues on the next page

4.3.1.4 Chemical measurements

Question 15 · continued

4 (c) **Table 2** shows the student's results.

Table 2

	Volume of potassium hydroxide solution used in cm^3
Titration 1	23.8
Titration 2	18.2
Titration 3	19.0
Titration 4	18.6
Mean value	

4 (c) (i) Calculate the mean volume of potassium hydroxide solution used.

Do not use any anomalous results in your calculation.

[2 marks]

Mean volume of potassium hydroxide solution used = _____ cm^3

4.3.1.4 Chemical measurements

Question 15 · continued

4 (c) (ii) A second student repeated the experiment and recorded the results in **Table 3**.

Table 3

	Volume of potassium hydroxide solution used in cm^3
Titration 1	24
Titration 2	18

Look at **Table 2** and **Table 3**.

Suggest **two** improvements the second student could make to obtain results that are more accurate.

[2 marks]

_____

_____

_____

_____

12

4.3.1.4 Chemical measurements

Question 16

June 2018 | 8462/1F | Original Q5

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:

$$CuCO_3(s) \rightarrow CuO(s) + CO_2(g)$$

0 5 . 1 Complete the sentence.

[1 mark]

The state symbol shows carbon dioxide is a _____.

4.3.1.4 Chemical measurements

Question 16 · continued

0 5 . 2 Why do the contents of the test tube lose mass in the investigation?

[1 mark]

0 5 . 3 Calculate the mean mass **X** in **Table 4**.

[1 mark]

X = _____ g

0 5 . 4 One of the results in **Table 4** is anomalous.

Which result is anomalous?

[1 mark]

Mass of copper carbonate _____ g Trial _____

0 5 . 5 Suggest how the investigation could be improved to make sure the reaction is complete.

[2 marks]

Question 16 · continued

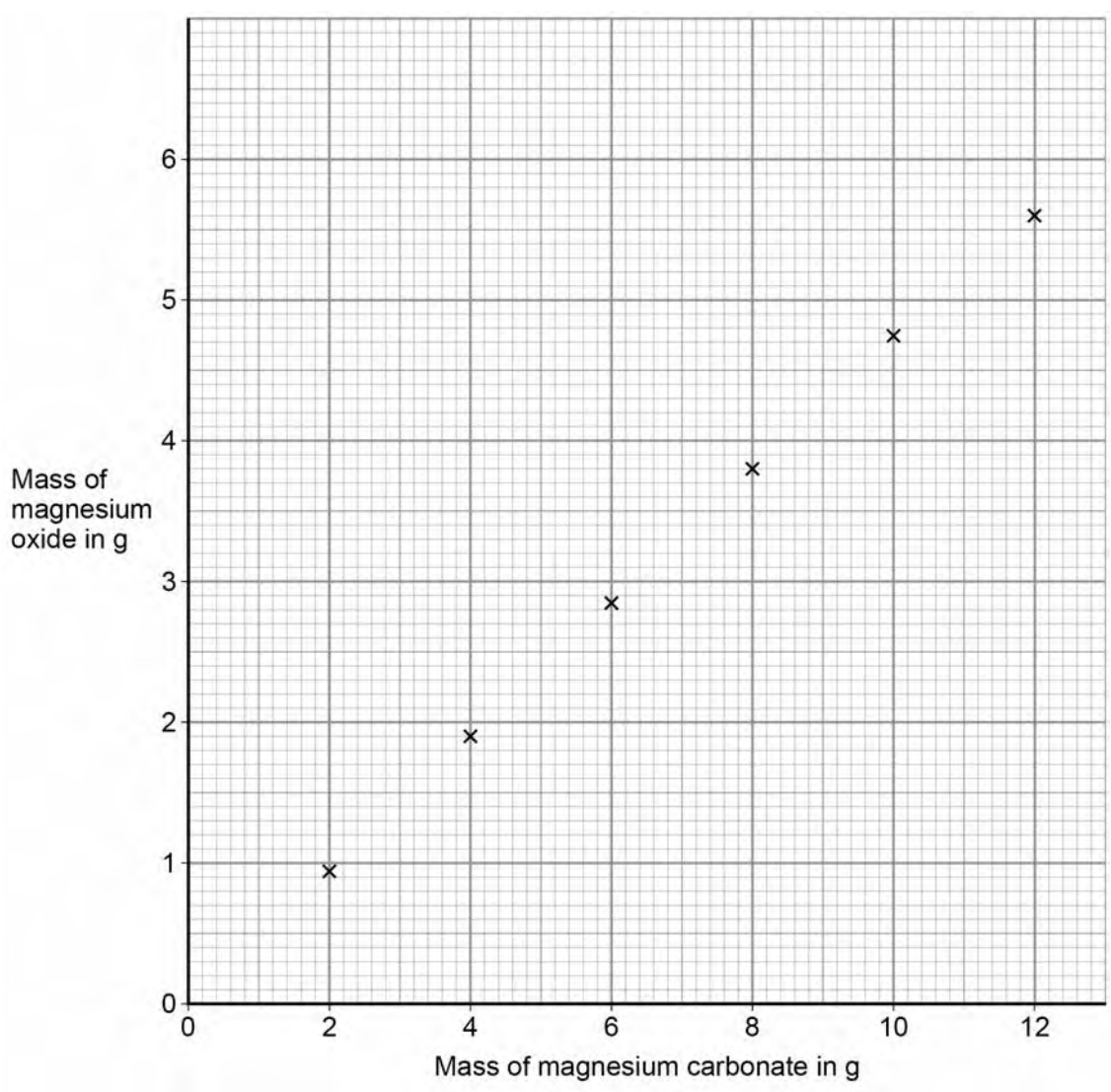
Another student repeated the investigation using magnesium carbonate instead of copper carbonate.

The word equation for the reaction is:

magnesium carbonate → magnesium oxide + carbon dioxide

Figure 8 shows the results of the investigation.

Figure 8



4.3.1.4 Chemical measurements

Question 16 · continued

0 5 . 6 Draw a line of best fit on **Figure 8**.

[1 mark]

0 5 . 7 Determine the mass of magnesium oxide produced by 8.4 g of magnesium carbonate.

Use **Figure 8**.

[1 mark]

Mass = _____ g

0 5 . 8 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

4.3.1.4 Chemical measurements

Question 17

June 2018 | 8462/2F | Original Q7

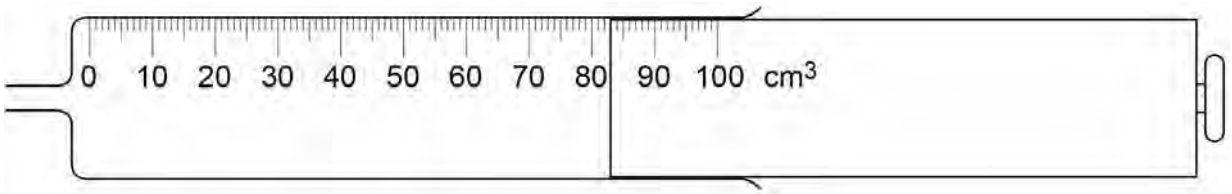
0 7 A student investigated how concentration affects the rate of reaction between magnesium and hydrochloric acid.

This is the method used.

1. Place hydrochloric acid in a conical flask.
2. Add magnesium powder.
3. Collect the gas produced in a gas syringe.
4. Measure the volume of gas every 40 seconds for 160 seconds.
5. Repeat steps 1–4 three more times.
6. Repeat steps 1–5 with hydrochloric acid of a higher concentration.

0 7 . 1 **Figure 5** shows a gas syringe.

Figure 5



What is the volume of gas in the syringe?

[1 mark]

Volume = _____ cm^3

0 7 . 2 Which **two** variables should the student keep the same to make the investigation a fair test?

[2 marks]

Tick **two** boxes.

- Concentration of hydrochloric acid ☐
- Mass of magnesium powder ☐
- Temperature of hydrochloric acid ☐
- Time for reaction to end ☐
- Volume of gas collected ☐

Question 17 · continued

Table 5 shows the student's results for the experiment with hydrochloric acid of a lower concentration.

Table 5

Time in seconds	Volume of gas collected in cm^3				
	Test 1	Test 2	Test 3	Test 4	Mean
0	0	0	0	0	0
40	46	30	47	49	**X**
80	78	83	83	82	82
120	98	94	96	95	96
160	100	100	100	100	100

0 7 . 3 Calculate mean value **X** in **Table 5**.

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

Give your answer to 2 significant figures.

[2 marks]

X = _____ cm^3

4.3.1.4 Chemical measurements

Question 17 · continued

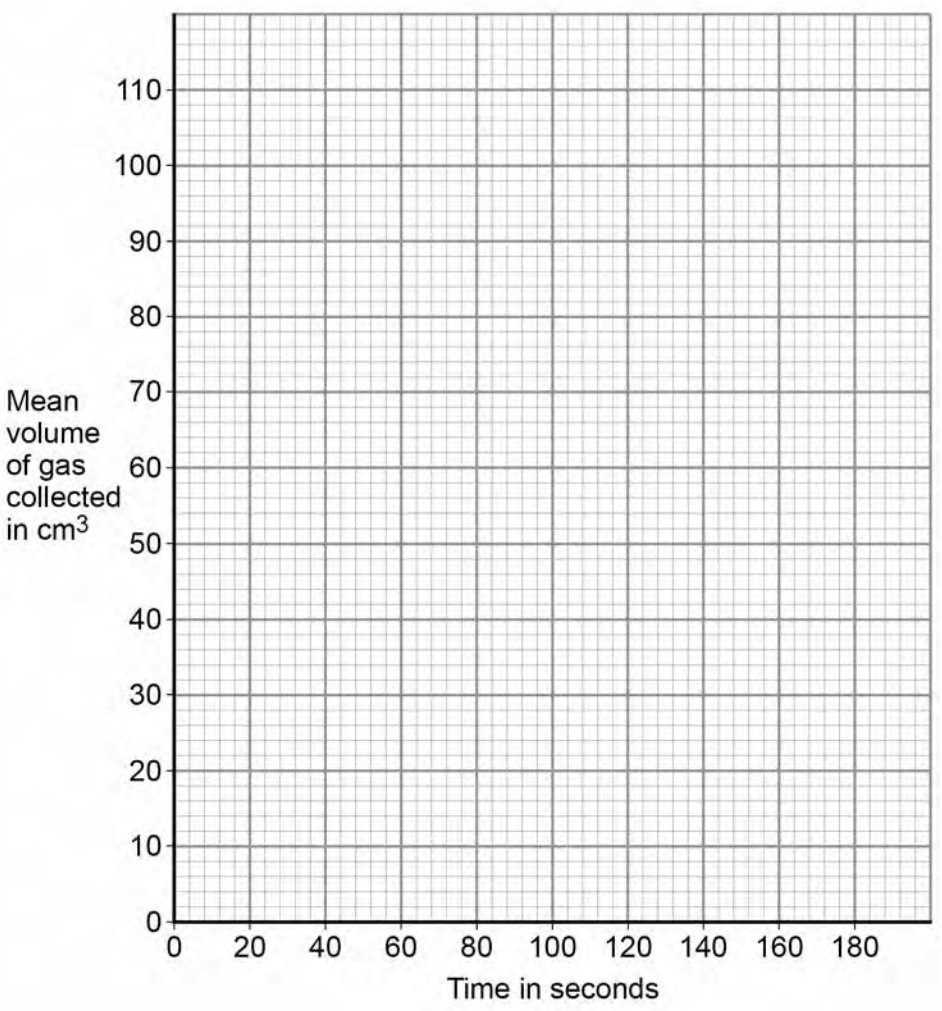
0 7 . 4 Plot the data from **Table 5** on **Figure 6**.

You should include your answer to Question **07.3**.

You do **not** need to draw a line of best fit.

[2 marks]

Figure 6



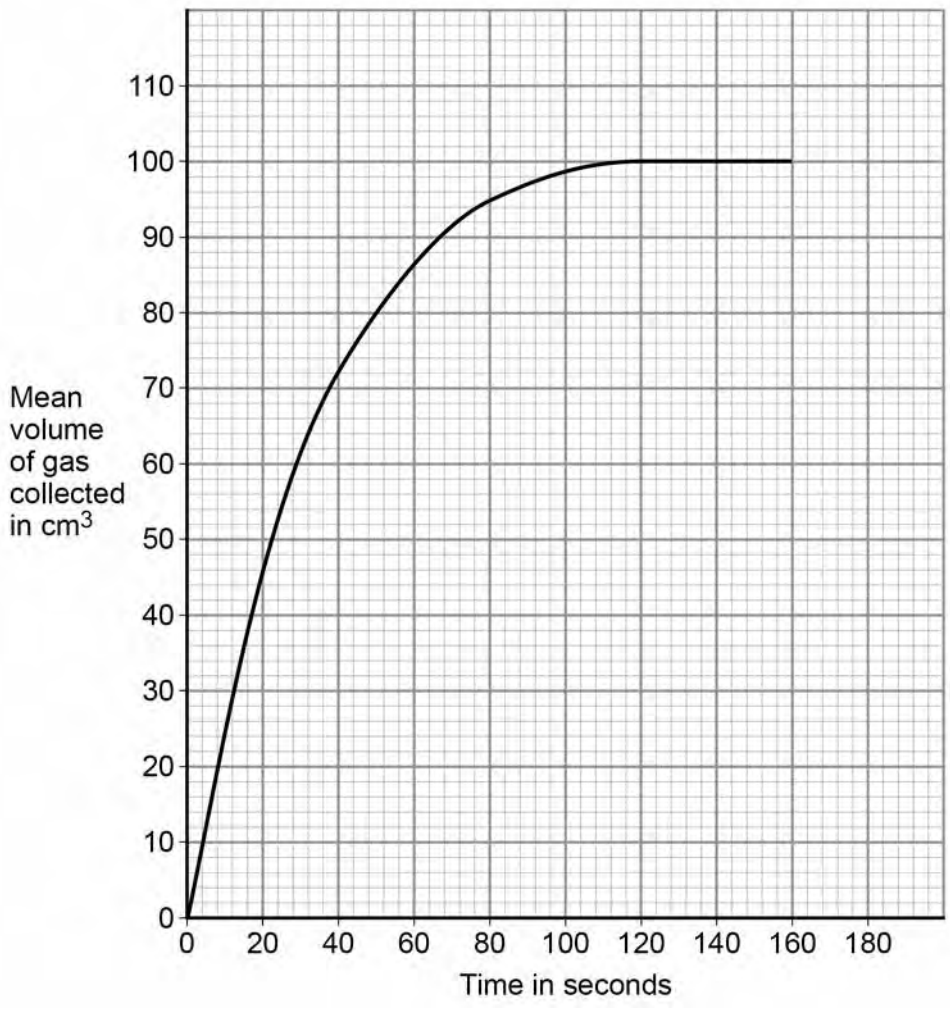
Question 7 continues on the next page

4.3.1.4 Chemical measurements

Question 17 · continued

Figure 7 shows results of the experiment with the hydrochloric acid of a higher concentration.

Figure 7



0 7 . 5 Calculate the mean rate of reaction between 0 and 50 seconds.

Use **Figure 7** and the equation:

$$\text{mean rate of reaction} = \frac{\text{mean volume of gas collected}}{\text{time taken}}$$

[2 marks]

Mean rate of reaction = _____ cm^3/s

4.3.1.4 Chemical measurements

Question 17 · continued

0 7 . 6 Describe how the **rate of reaction** changes between 0 and 160 seconds.

Use **Figure 7**.

[3 marks]

0 7 . 7 The student concludes that the rate of reaction is greater when the concentration of hydrochloric acid is higher.

Why is the rate of reaction greater when the concentration of hydrochloric acid is higher?

[2 marks]

Tick **two** boxes.

- The particles are moving faster ☐
- The particles have more energy ☐
- The surface area of magnesium is smaller ☐
- There are more particle collisions each second ☐
- There are more particles in the same volume ☐

Question 7 continues on the next page

4.3.1.4 Chemical measurements

Question 17 · continued

0 7 . 8 The student tests the gas produced by bubbling it through limewater.

No change is seen in the limewater.

Give **one** conclusion the student can make about the gas.

[1 mark]

0 7 . 9 The student tests the gas produced using a burning splint.

Name the gas the student is testing for.

Give the result of a positive test for this gas.

[2 marks]

Name of gas _____

Result _____

4.3.1.4 Chemical measurements

Question 17 · continued

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

4.3.1.4 Chemical measurements

Question 18

June 2019 | 8462/1F | Original Q5

0 5 A student investigated the reaction between lumps of calcium carbonate and dilute hydrochloric acid.

This is the method used.

1. Pour 100 cm^3 of dilute hydrochloric acid into a conical flask.

2. Place the conical flask on a balance.

3. Add 2 g of calcium carbonate lumps to the conical flask.

4. Wait until the calcium carbonate stops reacting.

5. Record the decrease in mass of the conical flask and contents.

6. Repeat steps 1 to 5 three more times.

The equation for the reaction is:

$$CaCO_3(\mathbf{X}) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

0 5 . 1 What is the state symbol **X** in the equation?

[1 mark]

Tick (✓) **one** box.

aq ☐ g ☐ l ☐ s ☐

Question 18 · continued

Table 2 shows the student's results.

Table 2

	Result 1	Result 2	Result 3	Result 4
Decrease in mass of the conical flask and contents in g	0.84	0.79	0.86	0.47

0 5 . 2 Why does the mass of the conical flask and contents decrease during the reaction?

[1 mark]

Tick (✓) **one** box.

A gas escapes. ☐

A new solution is made. ☐

The dilute hydrochloric acid is used up. ☐

The calcium carbonate lumps decrease in size. ☐

0 5 . 3 What is the range of the four results in **Table 2**?

[1 mark]

From _____ g to _____ g

0 5 . 4 Calculate the mean decrease in mass of the conical flask and contents.

Do **not** include the anomalous result.

Use **Table 2**.

[2 marks]

_____

_____

_____

Mean decrease in mass = _____ g

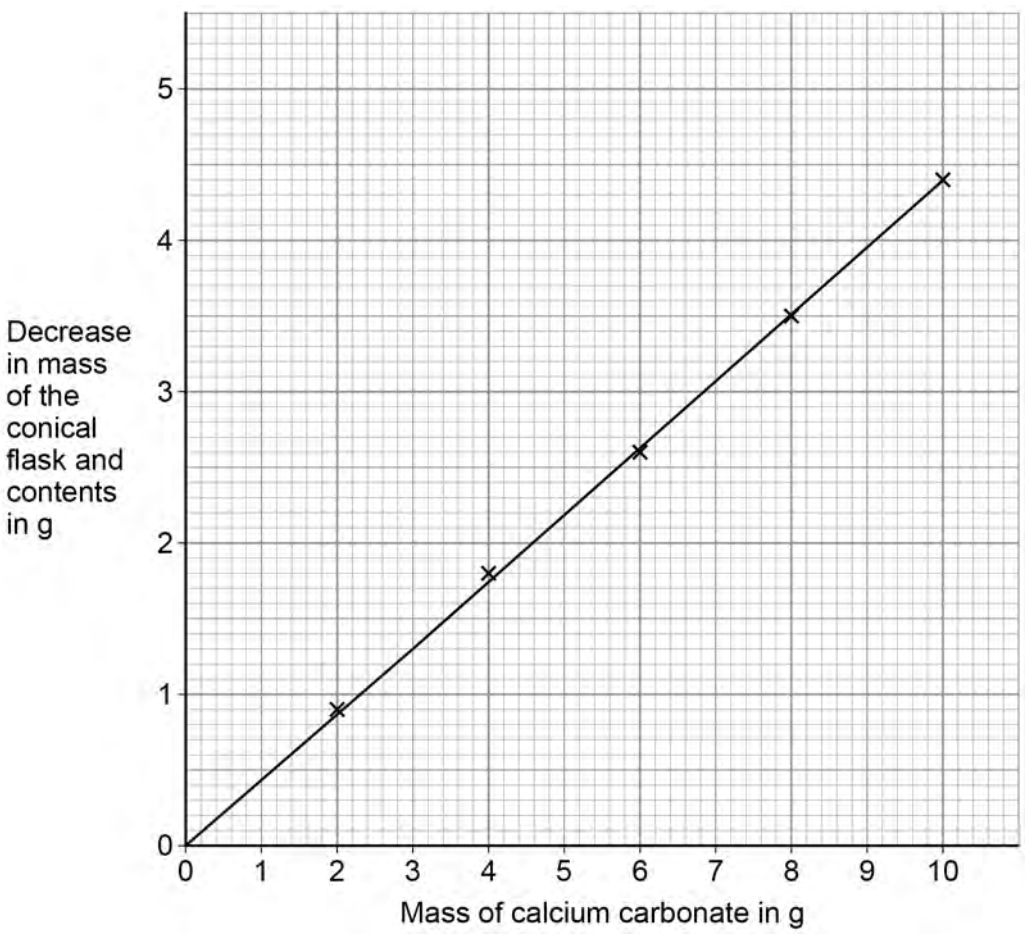
Question 18 · continued

A teacher demonstrated the investigation.

The teacher used different masses of calcium carbonate.

Figure 8 shows the teacher's results.

Figure 8



0 5 . 5 What type of variable is the mass of calcium carbonate?

[1 mark]

Tick (✓) **one** box.

Control ☐

Dependent ☐

Independent ☐

4.3.1.4 Chemical measurements

Question 18 · continued

Use **Figure 8** to answer Questions **05.6** and **05.7**

0 5 . 6 Complete the sentence.

[1 mark]

As the mass of calcium carbonate used increases, the decrease in mass of the conical flask and contents _____.

0 5 . 7 What is the decrease in mass of the conical flask and contents when a 3 g sample of calcium carbonate is used?

[1 mark]

Decrease in mass = _____ g

8

Turn over for the next question

4.3.1.4 Chemical measurements

Question 19

June 2019 | 8462/1F | Original Q7

0 7 This question is about energy changes in reactions.

0 7 . 1 Ammonium nitrate dissolves in water.

The change is endothermic.

Which piece of equipment uses this change?

[1 mark]

Tick (✓) **one** box.

Hand warmer ☐

Self-heating can ☐

Sports injury pack ☐

A student investigated the temperature change in the reaction between dilute sulfuric acid and potassium hydroxide solution.

This is the method used.

1. Measure 25 cm^3 of potassium hydroxide solution into a glass beaker.

2. Add 5 cm^3 of dilute sulfuric acid.

3. Stir the solution.

4. Measure the temperature of the solution.

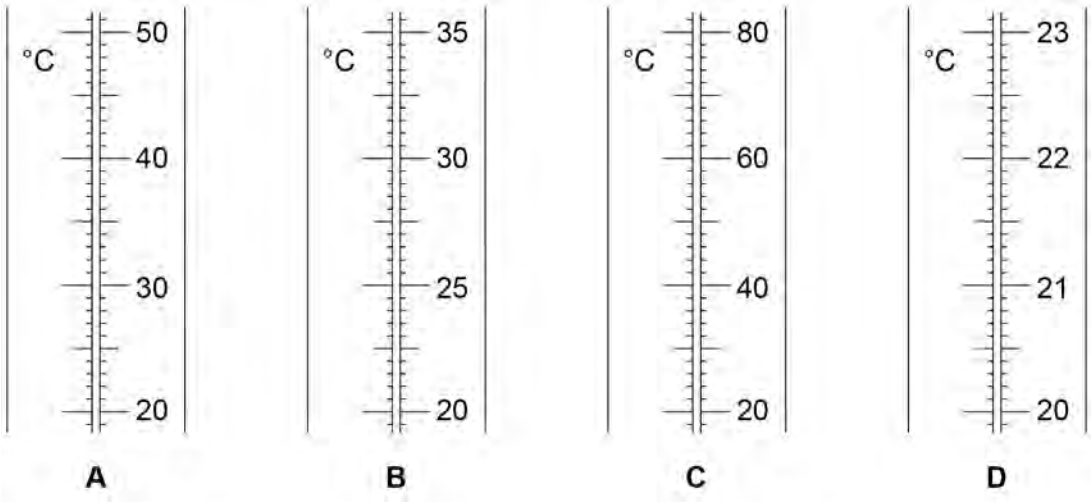
5. Repeat steps 2 to 4 until a total of 30 cm^3 of dilute sulfuric acid has been added.

4.3.1.4 Chemical measurements

Question 19 · continued

0 7 . 2 **Figure 9** shows part of the scales of four thermometers, **A**, **B**, **C** and **D**.

Figure 9



The student wanted to measure the temperature to a resolution of 0.1 °C

Which thermometer should the student use?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 7 . 3 Energy is lost to the surroundings during the reaction.

What type of error does this cause in the results?

[1 mark]

Tick (✓) **one** box.

Human error ☐

Random error ☐

Systematic error ☐

Zero error ☐

Question 19 · continued

0 7 . 4 The student used a glass beaker for the reaction.

Name a container the student could use instead of the glass beaker to improve the accuracy of the results.

[1 mark]

0 7 . 5 **Table 3** shows the student's results.

Table 3

Volume of dilute sulfuric acid added in cm^3	Temperature in °C
5	21.2
10	22.0
15	22.8
20	23.6
25	24.4
30	25.2

Plot the data from **Table 3** on **Figure 10**.

You should:

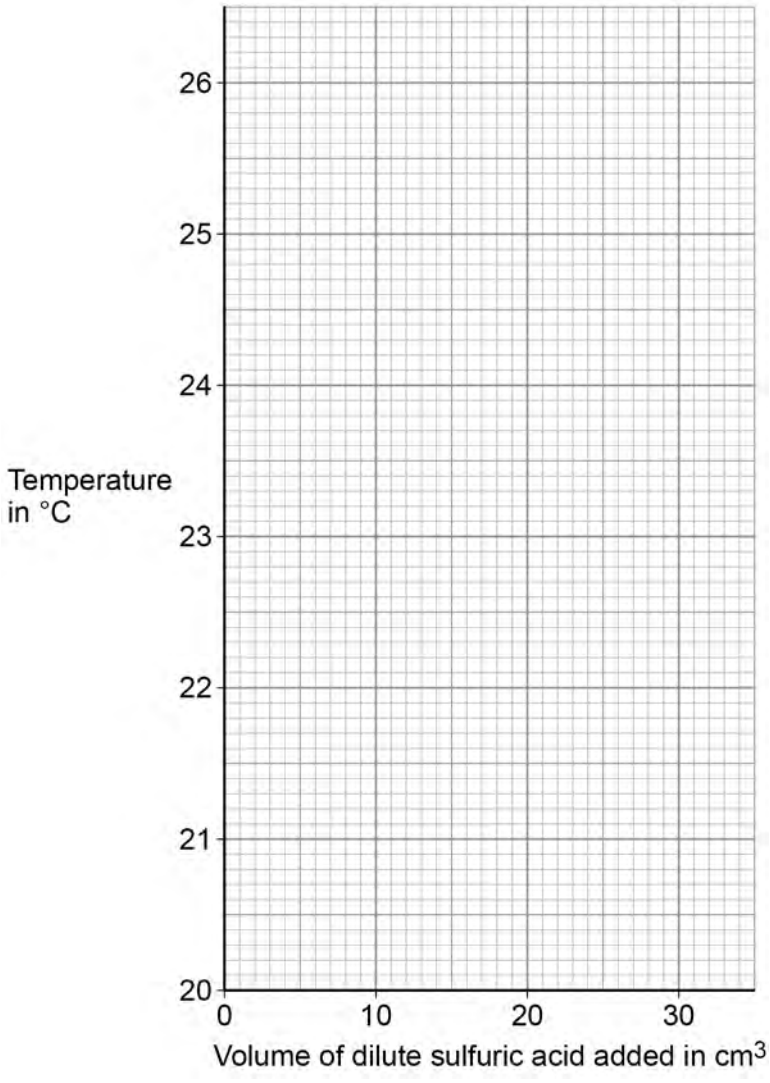
- draw a line of best fit
- extend your line of best fit to the y-axis.

[4 marks]

4.3.1.4 Chemical measurements

Question 19 · continued

Figure 10



0 7 . 6 The intercept on the y-axis of **Figure 10** shows the starting temperature of the potassium hydroxide solution.

Give the starting temperature of the potassium hydroxide solution.

[1 mark]

Starting temperature = _____ °C

4.3.1.4 Chemical measurements

Question 19 · continued

0 7 . 7 Another student repeated the investigation and obtained an anomalous result.

This result was lower than expected.

What could have caused the anomalous result?

[2 marks]

Tick (✓) **two** boxes.

- The mixture was not stirred. ☐
- The temperature in the room increased. ☐
- The thermometer was not accurate. ☐
- Too little sulfuric acid was added. ☐
- Too much potassium hydroxide solution was used. ☐

11

4.3.1.4 Chemical measurements

Question 20

June 2019 | 8462/2F | Original Q6

0 6 This question is about the corrosion of metals.

The corrosion of iron is called rusting.

0 6 . 1 Plan an investigation to show that both water and air are needed for iron to rust.

You should include the results you expect to obtain.

Use apparatus and materials from the list:

- test tubes
- stoppers
- iron nails
- tap water
- boiled water
- drying agent
- oil.

[6 marks]

Question 20 · continued

A student investigated how the mass of three iron nails, **A**, **B** and **C**, increased after rusting.

Table 4 shows the student's results.

Table 4

Nail	Mass of nail before rusting in g	Mass of nail after rusting in g	Increase in mass of nail in g
A	1.22	1.30	0.08
B	1.25	1.36	**X**
C	1.24	1.33	0.09

0 6 . 2 Calculate **X** in **Table 4**.

[1 mark]

X = _____ g

0 6 . 3 Calculate the mean increase in mass of the three iron nails, **A**, **B** and **C**.

Use **Table 4** and your answer to Question **06.2**

[1 mark]

Mean increase in mass = _____ g

8

4.3.1.4 Chemical measurements

Question 21

November 2020 | 8462/1F | Original Q7

0 7 This question is about acids, bases and salts.

Zinc nitrate is a salt.

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

0 7 . 1 Which acid should the student use to produce zinc nitrate?

[1 mark]

Tick (✓) **one** box.

- Hydrochloric acid ☐
- Nitric acid ☐
- Sulfuric acid ☐

0 7 . 2 Which is a base the student could use to produce zinc nitrate?

[1 mark]

Tick (✓) **one** box.

- Zinc chloride ☐
- Zinc oxide ☐
- Zinc sulfate ☐

0 7 . 3 Name the salt with the formula $MgBr_2$

[1 mark]

_____

4.3.1.4 Chemical measurements

Question 21 · continued

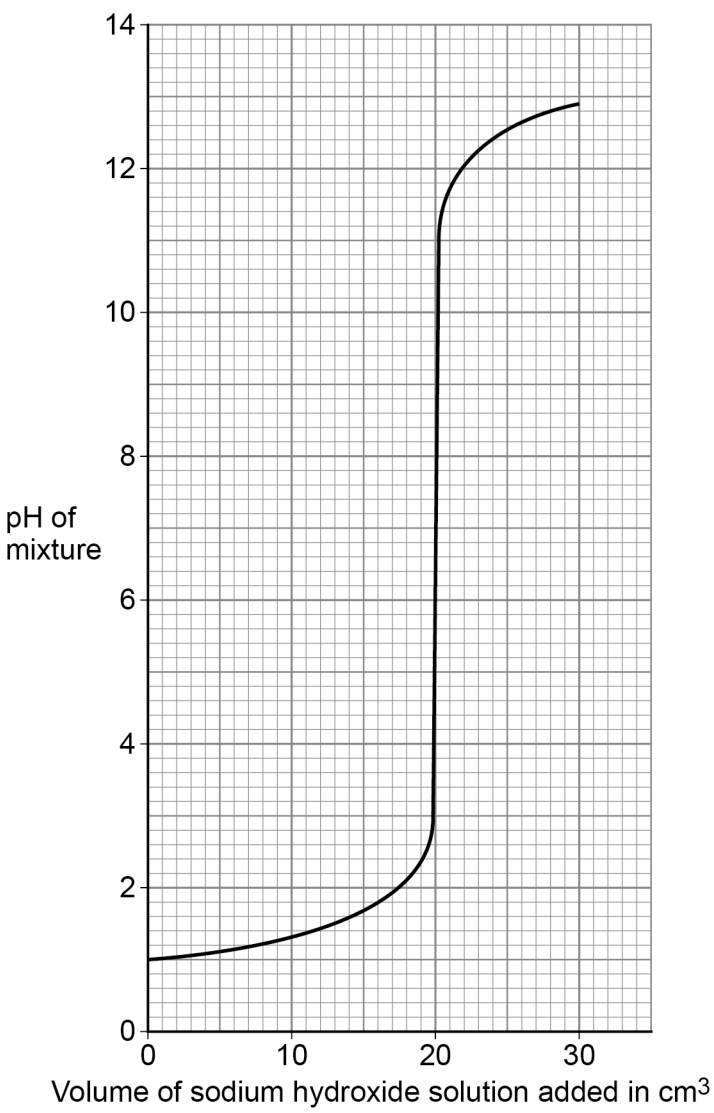
A student investigated how pH changes during a titration.

This is the method used.

1. Pour 25.0 cm^3 of hydrochloric acid into a beaker.
2. Measure the pH of the hydrochloric acid with a pH probe.
3. Add 1.0 cm^3 of sodium hydroxide solution from a burette.
4. Swirl the mixture.
5. Measure the pH of the mixture.
6. Repeat steps 3 to 5 until a total of 30.0 cm^3 of sodium hydroxide solution has been added.

Figure 10 shows the student's results.

Figure 10



4.3.1.4 Chemical measurements

Question 21 · continued

0 7 . 4 Describe how the pH of the mixture changes as sodium hydroxide solution is added to hydrochloric acid.

Use data from **Figure 10** in your answer.

[3 marks]

0 7 . 5 What volume of sodium hydroxide solution is needed to neutralise 25.0 cm^3 of hydrochloric acid?

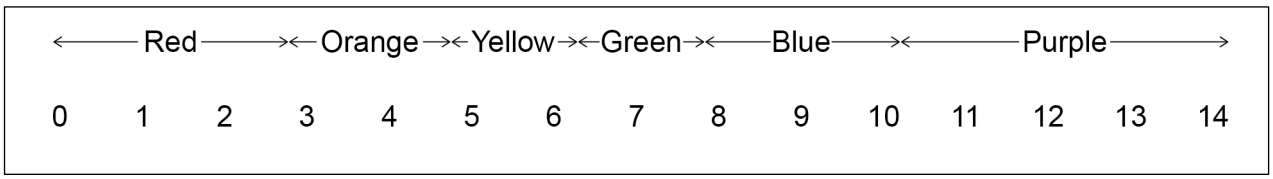
Use **Figure 10**.

[1 mark]

Volume = _____ cm^3

0 7 . 6 **Figure 11** shows the colour of universal indicator at different pH values.

Figure 11



The student could have used universal indicator instead of a pH probe.

Determine the colour of universal indicator when 10.0 cm^3 of sodium hydroxide solution has been added to 25.0 cm^3 of hydrochloric acid.

Use **Figure 10** and **Figure 11**.

[1 mark]

Colour = _____

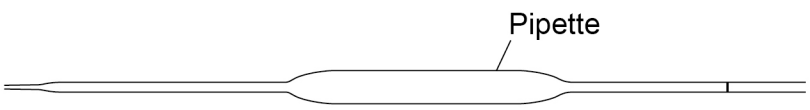
4.3.1.4 Chemical measurements

Question 21 · continued

0 7 . 7 The student used a pipette to measure 25.0 cm^3 of hydrochloric acid.

Figure 12 shows a pipette.

Figure 12



The pipette is labelled 25.0 ± 0.06 cm^3

Calculate the percentage uncertainty in the volume measured using this pipette.

Use the equation:

$$\text{percentage uncertainty} = \frac{\text{uncertainty}}{\text{volume measured}} \times 100$$

[2 marks]

Percentage uncertainty = _____ %

0 7 . 8 Give **one** advantage of using a pipette rather than using a measuring cylinder to measure the volume of hydrochloric acid.

[1 mark]

11

4.3.1.4 Chemical measurements

Question 22

November 2021 | 8462/1F | Original Q4

0 4 A student investigated the reactivity of metals with hydrochloric acid.

This is the method used.

1. Measure 50 cm^3 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

0 4 . 1 Calculate the mean temperature increase **X** for magnesium in **Table 4**.

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

[2 marks]

X = _____ °C

4.3.1.4 Chemical measurements

Question 22 · continued

0 4 . 2 Determine the order of reactivity for the metals cobalt, magnesium and zinc.

Use **Table 4**.

[1 mark]

Most reactive _____

_____

Least reactive _____

0 4 . 3 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 ± _____ °C

0 4 . 4 What type of variable is the volume of hydrochloric acid in this investigation?

[1 mark]

Tick (✓) **one** box.

Control ☐

Dependent ☐

Independent ☐

0 4 . 5 Suggest **one** way of improving **step 3** in the method to give results which are more repeatable.

[1 mark]

_____

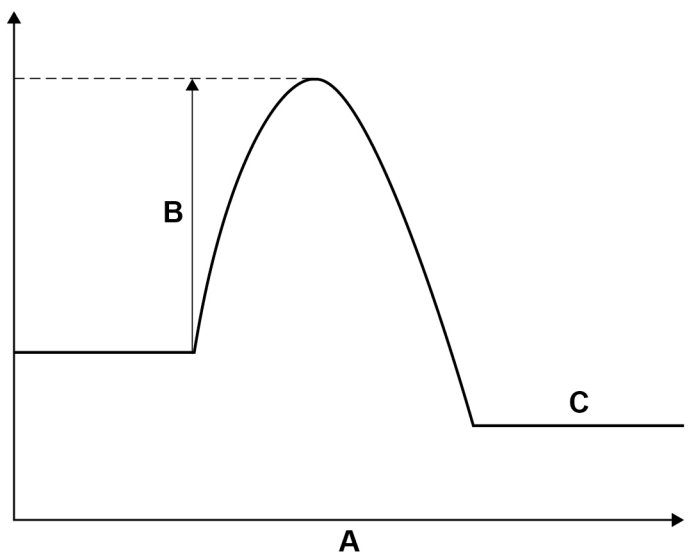
_____

_____

Question 22 · continued

0 4 . 6 **Figure 6** shows a reaction profile for the reaction of magnesium with hydrochloric acid.

Figure 6



What do labels **A**, **B** and **C** represent on **Figure 6**?

Choose answers from the box.

[3 marks]

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

A _____

B _____

C _____

9

4.3.1.4 Chemical measurements

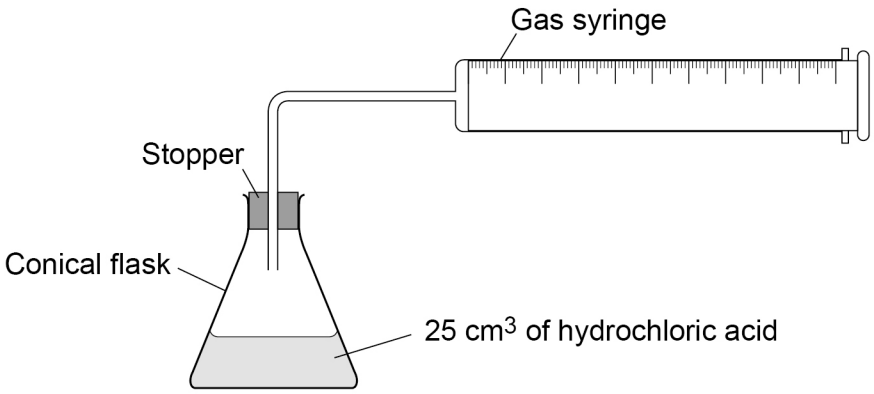
Question 23

June 2022 | 8462/1F | Original Q5

0 5 A student investigated the reaction of magnesium with hydrochloric acid.

Figure 7 shows the apparatus used.

Figure 7



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.

4.3.1.4 Chemical measurements

Question 23 · continued

0 5 . 1 Which gas is produced when magnesium reacts with hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

- Carbon dioxide ☐
- Chlorine ☐
- Hydrogen ☐
- Oxygen ☐

0 5 . 2 What was the independent variable in the investigation?

[1 mark]

_____

0 5 . 3 Give **one** control variable in the investigation.

[1 mark]

_____

Question 5 continues on the next page

4.3.1.4 Chemical measurements

Question 23 · continued

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.

0 5 . 4 Which trial in **Table 5** gave an anomalous result?

[1 mark]

Trial _____

0 5 . 5 Suggest **one** reason for the anomalous result in **Table 5**.

[1 mark]

_____

_____

4.3.1.4 Chemical measurements

Question 23 · continued

0 5 . 6 **Table 6** shows the mean volume of gas produced for each length of magnesium ribbon.

Table 6

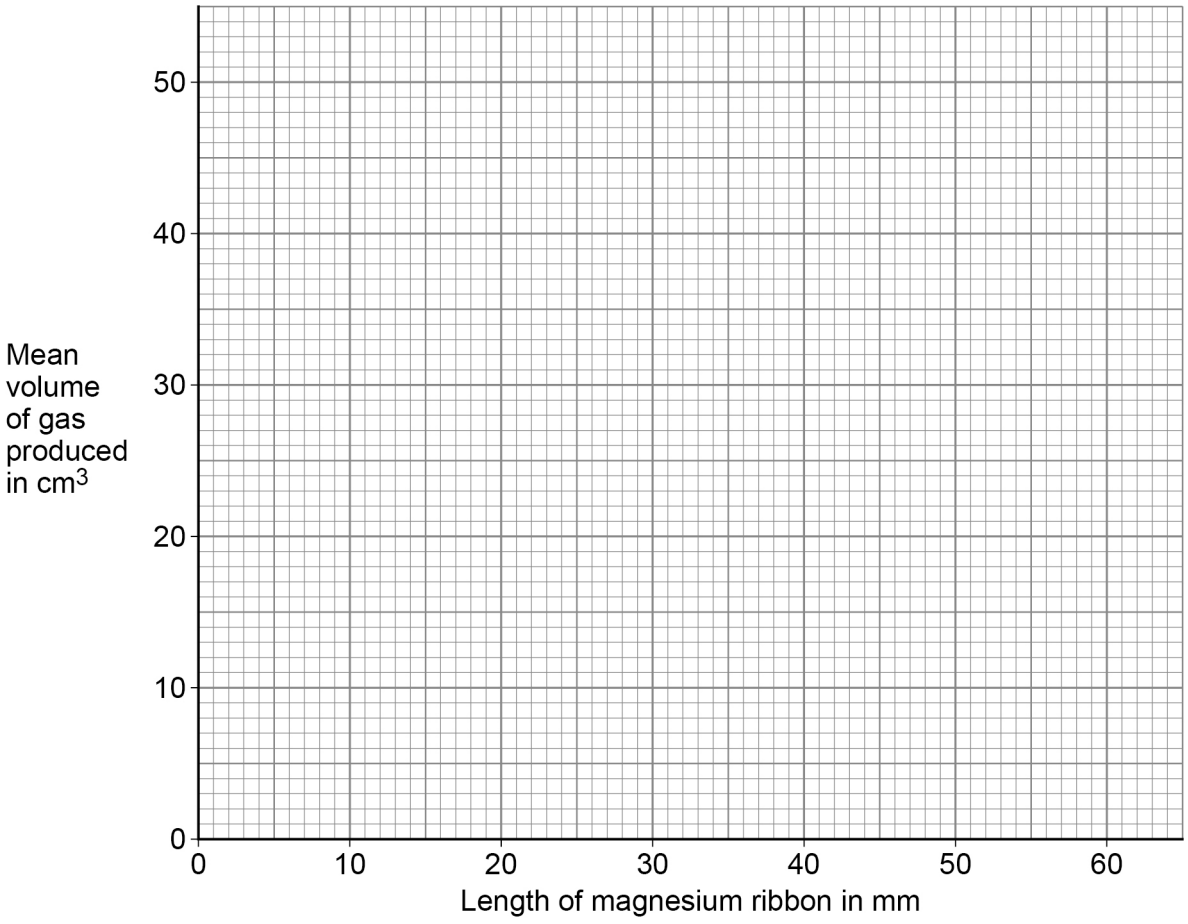
Length of magnesium ribbon in mm	10	20	30	40	50	60
Mean volume of gas produced in cm^3	7	14	21	28	35	42

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

Draw a line of best fit.

[3 marks]

Figure 8



0 5 . 7 Complete the sentence.

[1 mark]

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

_____.

9

4.3.1.4 Chemical measurements

Question 24

June 2022 | 8462/1F | Original Q7

0 7 This question is about small particles.

0 7 . 1 Coarse particles, fine particles and nanoparticles are all small particles.

Which is the largest particle?

[1 mark]

Tick (✓) **one** box.

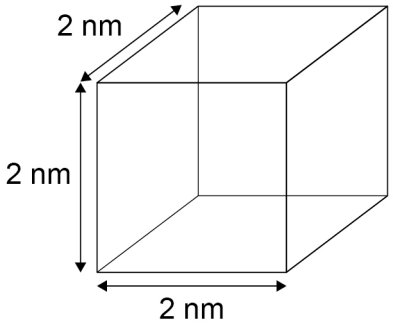
Coarse particle ☐

Fine particle ☐

Nanoparticle ☐

0 7 . 2 **Figure 12** shows a cubic nanoparticle.

Figure 12



The surface area of the cubic nanoparticle is 24 nm^2.

Calculate:

- the volume of the cubic nanoparticle
- the simplest surface area : volume ratio of the cubic nanoparticle.

[4 marks]

Volume = _____ nm^3

Simplest surface area : volume ratio = _____ : 1

Question 24 · continued

0 7 . 3 Catalysts made of nanoparticles are often more effective than catalysts made of normal sized particles.

Complete the sentences.

[2 marks]

Compared with normal sized particles, the surface area to volume ratio of

nanoparticles is _____.

This means that the mass of a nanoparticle catalyst needed to have the same effect

as the same catalyst made of normal sized particles is _____.

0 7 . 4 Silver nanoparticles can be added to the material used to make socks.

Some facts about silver and bacteria are:

- silver nanoparticles are small enough to be breathed in
- silver is very expensive
- silver can kill bacteria
- bacteria can cause infections
- bacteria can break down sweat to produce unpleasant smells.

Suggest **one** advantage and **one** disadvantage of wearing socks containing silver nanoparticles.

[2 marks]

Advantage _____

_____

Disadvantage _____

_____

4.3.1.4 Chemical measurements

Question 24 · continued

0 7 . 5 An atom has a radius of 1×10^{-10} m.

A spherical nanoparticle has a radius of 1×10^{-8} m.

How many times larger is the radius of the nanoparticle than the radius of the atom?

[1 mark]

Tick (✓) **one** box.

2 times ☐

10 times ☐

100 times ☐

200 times ☐

10

4.3.1.4 Chemical measurements

Question 25

0 1 This question is about water.

A student investigated pure water.

The student measured:

- the boiling point of pure water
- the pH of pure water.

0 1 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

0	**4**	**7**	**10**	**25**	**100**

Pure water has a boiling point of _____ °C.

Pure water has a pH of _____.

0 1 . 2 What could the student use to measure the pH of pure water?

[1 mark]

_____

_____

4.3.1.4 Chemical measurements

Question 25 · continued

A different student investigated sea water.

Sea water contains dissolved solids.

This is the method used.

1. Measure a 50 cm^3 sample of the sea water.
2. Heat the sample until all the water has evaporated.
3. Measure the mass of solid that remains.
4. Repeat steps 1 to 3 three more times.

0 1 . 3 Which **two** pieces of equipment were needed in this investigation?

[2 marks]

Tick (✓) **two** boxes.

- Balance ☐
- Measuring cylinder ☐
- Ruler ☐
- Thermometer ☐
- Timer ☐

Question 1 continues on the next page

0 1 . 4 **Table 1** shows the results.

Table 1

Sea water sample	Mass of solid that remained in grams
1	1.73
2	1.70
3	1.75
4	1.78

Calculate the mean mass of solid that remained.

[2 marks]

Mean mass = _____ g

0 1 . 5 A 50 cm^3 sample of sea water from a different source contained 1.50 g of dissolved solids.

Calculate the mass of dissolved solids in 1000 cm^3 of this sea water.

[2 marks]

Mass = _____ g

4.3.1.4 Chemical measurements

Question 25 · continued

Sodium chloride is a dissolved solid in sea water.

Sodium chloride contains sodium ions and chloride ions.

0 1 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

crimson	**lilac**	**yellow**

The student tested sea water for sodium ions using a flame test.

The colour of the flame was _____.

0 1 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

brown	**green**	**white**

The student tested sea water for chloride ions by adding nitric acid and silver nitrate solution.

The colour of the precipitate formed was _____.

11

4.3.1.4 Chemical measurements

Question 26

June 2023 | 8462/1F | Original Q2

0 2 This question is about acids and alkalis.

0 2 . 1 Acids and alkalis are substances that produce ions in aqueous solution.

Draw **one** line from each substance to the ion always produced by that substance in aqueous solution.

[2 marks]

Substance	Ion always produced in aqueous solution
Acid	Cl^-
	H^+
Alkali	Na^+
	OH^-
	SO_4^{2-}

0 2 . 2 What type of aqueous solution has a pH of 11?

[1 mark]

Tick (✓) **one** box.

- Acidic ☐
- Alkaline ☐
- Neutral ☐

Question 2 continues on the next page

4.3.1.4 Chemical measurements

Question 26 · continued

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.

0 2 . 3 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 ☐

0 2 . 4 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 ☐

Question 26 · continued

Table 1 shows the results.

Table 1

Trial	**1**	**2**	**3**	**4**
Volume of hydrochloric acid added in cm^3	24.3	24.5	28.1	24.4

0 2 . 5 Which is the anomalous result in **Table 1**?

[1 mark]

Trial 1 ☐ Trial 2 ☐ Trial 3 ☐ Trial 4 ☐

0 2 . 6 Suggest **one** reason for the anomalous result in **Table 1**.

[1 mark]

0 2 . 7 The student used a solution of sodium hydroxide of concentration 4.00 g/dm^3.

Calculate the mass of sodium hydroxide in 25.0 cm^3 of this solution.

1 dm^3 = 1000 cm^3

[3 marks]

Mass = _____ g

10

4.3.1.4 Chemical measurements

Question 27

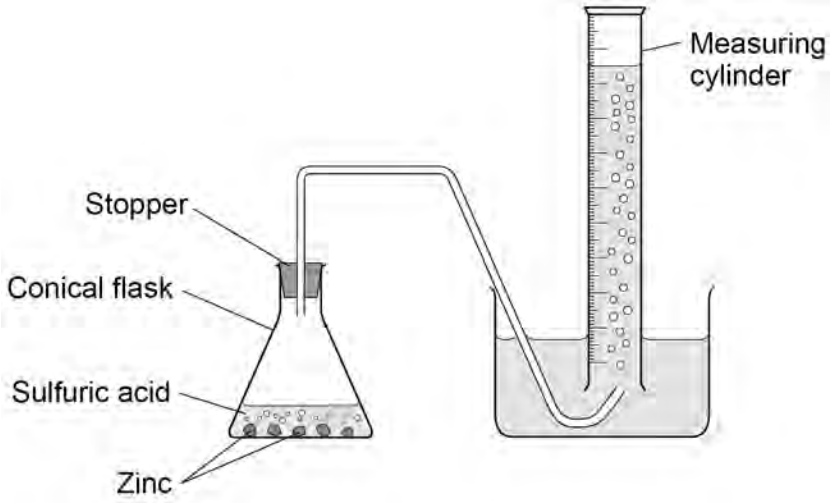
June 2023 | 8462/2F | Original Q8

0 8 A student investigated the rate of the reaction between zinc and sulfuric acid.

Hydrogen gas is produced during this reaction.

Figure 7 shows the apparatus.

Figure 7



This is the method used.

1. Add 50 cm^3 of sulfuric acid to a conical flask.

2. Add 2.0 g of zinc to the conical flask.

3. Quickly put a stopper in the conical flask and start a timer.

4. Measure the time taken to collect 20 cm^3 of gas.

5. Repeat steps 1 to 4 three more times.

0 8 . 1 Suggest why the stopper must be put in the conical flask as quickly as possible in **step 3**.

[1 mark]

Question 27 · continued

0 8 . 2 The student calculated the rate of the reaction for each trial.

Table 7 shows the results of the calculations.

Table 7

	Trial 1	Trial 2	Trial 3	Trial 4
Rate of reaction in cm^3/s	0.78	0.81	0.68	0.81

Determine the mean time taken to collect 20 cm^3 of gas.

Do **not** include any anomalous results.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas collected}}{\text{mean time taken}}$$

[5 marks]

Mean time taken = _____ s

Question 8 continues on the next page

Question 27 · continued

0 8 . 3 The student changed the investigation so that the mean time taken to collect 20 cm^3 of gas was greater.

Which **two** changes would increase the mean time taken to collect 20 cm^3 of gas?

[2 marks]

Tick (✓) **two** boxes.

- Use a catalyst ☐
- Use a larger conical flask ☐
- Use a lower temperature ☐
- Use smaller pieces of zinc ☐
- Use sulfuric acid of a lower concentration ☐

0 8 . 4 Hydrogen gas is produced during this reaction.

Describe the test for hydrogen gas.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

10

4.3.1.4 Chemical measurements

Question 28

June 2025 | 8462/1F | Original Q4

0 4 A student did an experiment to find the volume of an acid that neutralised 25.0 cm^3 of an alkali.

This is the method used.

1. Measure 25.0 cm^3 of the alkali into a conical flask.
2. Add a few drops of substance **X** to the alkali.
3. Place the conical flask on a white tile.
4. Add the acid to the alkali until a colour change is seen.
5. Measure the volume of acid added.
6. Repeat steps 1 to 5 three more times.

0 4 . 1 What is the name of this experiment?

[1 mark]

Tick (✓) **one** box.

- Crystallisation ☐
- Distillation ☐
- Electrolysis ☐
- Titration ☐

0 4 . 2 Substance **X** is used in step 2 of the method.

What type of substance is **X**?

[1 mark]

_____

4.3.1.4 Chemical measurements

Question 28 · continued

0 4 . 3 Which piece of equipment is used to add the acid to the alkali in step 4?

[1 mark]

Tick (✓) **one** box.

Beaker ☐

Burette ☐

Test tube ☐

0 4 . 4 Suggest **one** improvement to step 4 of the method.

[1 mark]

_____

_____

Question 4 continues on the next page

Question 28 · continued

0 4 . 5 **Table 3** shows the results.

Table 3

	Trial 1	Trial 2	Trial 3	Trial 4
Volume of acid in cm^3	8.95	9.00	8.85	8.45

Calculate the mean volume of the acid needed to neutralise 25.0 cm^3 of the alkali.

Give your answer to 3 significant figures.

Do **not** include the anomalous result.

[4 marks]

Mean volume (3 significant figures) = _____ cm^3

4.3.1.4 Chemical measurements

Question 28 · continued

0 4 . 6 Aqueous solutions of acids and alkalis contain ions.

Draw **one** line from each type of aqueous solution to the ion that is **always** in the aqueous solution.

[2 marks]

Type of aqueous solution	Ion
	Cl^-
Acid	H^+
Alkali	Na^+
	OH^-

10

4.3.1.4 Chemical measurements

Question 29

June 2025 | 8462/2F | Original Q4

0 4 Ammonia is produced in the Haber process.

The word equation for the reaction to produce ammonia is:

nitrogen + hydrogen ⇌ ammonia

0 4 . 1 Draw **one** line from each element to a source of that element.

[2 marks]

Element	Source of element
Nitrogen	Air
Hydrogen	Clay
	Limestone
	Natural gas
	Sand

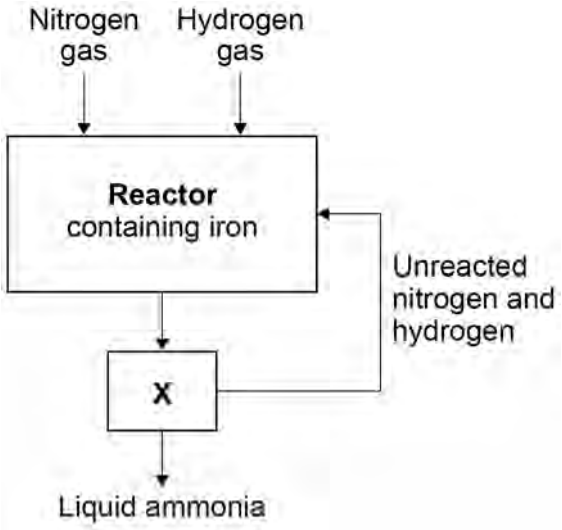
4.3.1.4 Chemical measurements

Question 29 · continued

Ammonia is a gas at room temperature.

Figure 3 shows how ammonia is produced from nitrogen and hydrogen.

Figure 3



0 4 . 2 Which process takes place at **X** in **Figure 3**?

[1 mark]

Tick (✓) **one** box.

Cooling ☐

Filtering ☐

Melting ☐

0 4 . 3 Complete the sentence.

Use **Figure 3**.

[1 mark]

The iron in the reactor is used as a _____.

Question 29 · continued

Table 1 shows the world production of ammonia between 1990 and 2020.

Table 1

Year	World production of ammonia in arbitrary units
1990	120
2000	130
2010	155
2020	165

0 4 . 4 How did the world production of ammonia change between 1990 and 2020?

Use **Table 1**.

[1 mark]

0 4 . 5 Determine the mean change in mass of ammonia produced per year between 2000 and 2020.

Use **Table 1** and the equation:

$$\text{mean change in mass produced per year} = \frac{\text{change in mass produced between 2000 and 2020}}{\text{number of years}}$$

[4 marks]

Change in mass = _____ arbitrary units

Number of years = _____

Mean change = _____ arbitrary units per year

4.3.1.4 Chemical measurements

Question 29 · continued

Most of the ammonia produced in the Haber process is used to make fertilisers.

0 4 . 6 Which is a reason for the change in the world production of ammonia shown in **Table 1**?

[1 mark]

Tick (✓) **one** box.

- Change in amount of acid rain ☐
- Change in global temperatures ☐
- Change in world population ☐

0 4 . 7 Fertilisers produced using ammonia contain nitrogen.

Which **two** compounds used in fertilisers contain nitrogen?

Use the periodic table.

[2 marks]

Tick (✓) **two** boxes.

- $Ca(NO_3)_2$ ☐
- $Ca_3(PO_4)_2$ ☐
- KCl ☐
- K_2SO_4 ☐
- $(NH_4)_2SO_4$ ☐

12

4.3.1.4 Chemical measurements

Question 30

June 2025 | 8462/2F | Original Q8

0 8 A student investigated the mass of dissolved solids in sea water.

This is the method used.

1. Weigh an empty evaporating basin.
2. Measure 10.0 cm^3 of sea water sample **A** into the evaporating basin using a burette.
3. Heat the evaporating basin until all the water seems to have evaporated.
4. Weigh the evaporating basin and contents.
5. Calculate the mass of dissolved solids in the sample.
6. Repeat steps 1 to 5 with sea water samples **B**, **C** and **D**.

0 8 . 1 Why did the student use a burette rather than a measuring cylinder to measure 10.0 cm^3 of each sample?

[1 mark]

0 8 . 2 What was the dependent variable in this investigation?

[1 mark]

0 8 . 3 Describe how the student could make sure **all** of the water had evaporated in **step 3**.

[2 marks]

0 8 . 4 How did the student calculate the mass of dissolved solids in each sea water sample?

[1 mark]

Question 30 · continued

Table 3 shows the results.

Table 3

Sea water sample	A	B	C	D
Mass of dissolved solids in grams	0.35	0.37	0.33	0.34

0 8 . 5 Calculate the mean concentration of dissolved solids in 10.0 cm^3 samples of sea water **A**, **B**, **C** and **D**.

Use **Table 3** and the equation:

$$\text{mean concentration of dissolved solids } (g/dm^3) = \frac{\text{mean mass of dissolved solids (g)}}{\text{volume of sample } (dm^3)}$$

Give your answer in g/dm^3.

[5 marks]

Mean concentration = _____ g/dm^3

0 8 . 6 Suggest why sea water samples **A**, **B**, **C** and **D** contain different masses of dissolved solids.

[1 mark]

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