AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.3.4

Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Past-paper questions

Tier	**Higher**
Question groups	**25**
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.

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 01

January 2008 | CHY3H | Original Q5 | Legacy

5 In 1916, during the First World War, a German U-boat sank a Swedish ship which was carrying a cargo of champagne. The wreck was discovered in 1997 and the champagne was brought to the surface and analysed.

(a) 25.0 cm^3 of the champagne were placed in a conical flask.

Describe how the volume of sodium hydroxide solution needed to react completely with the weak acids in 25.0 cm^3 of this champagne can be found by titration, using phenolphthalein indicator.

Name any other apparatus used.

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(4 marks)

(b) The acid in 25.0 cm^3 of the champagne reacted completely with 13.5 cm^3 of sodium hydroxide of concentration 0.10 moles per cubic decimetre.

Calculate the concentration in moles per cubic decimetre of acid in the champagne.

Assume that 1 mole of sodium hydroxide reacts completely with 1 mole of acid.

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Concentration = ... moles per cubic decimetre

(2 marks)

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 01 · continued

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(c) Is analysis by titration enough to decide whether this champagne is safe to drink?

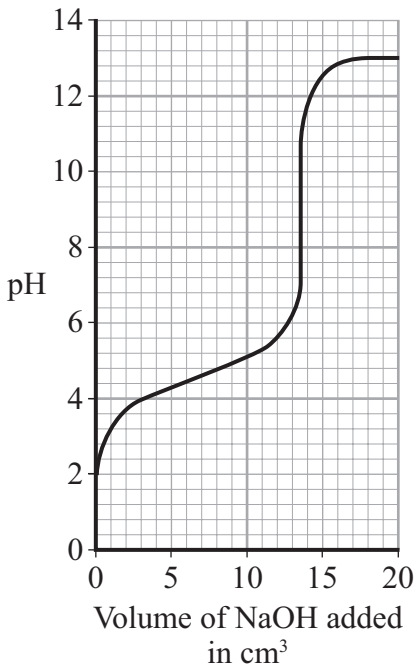
Explain your answer.

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(1 mark)

(d) The graph shows how the pH of the solution changes during this titration.



Phenolphthalein is the indicator used in this titration. It changes colour between pH 8.2 and pH 10.0.

Methyl orange is another indicator. It changes colour between pH 3.2 and pH 4.4.

Suggest why methyl orange is **not** a suitable indicator for this titration.

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(2 marks)

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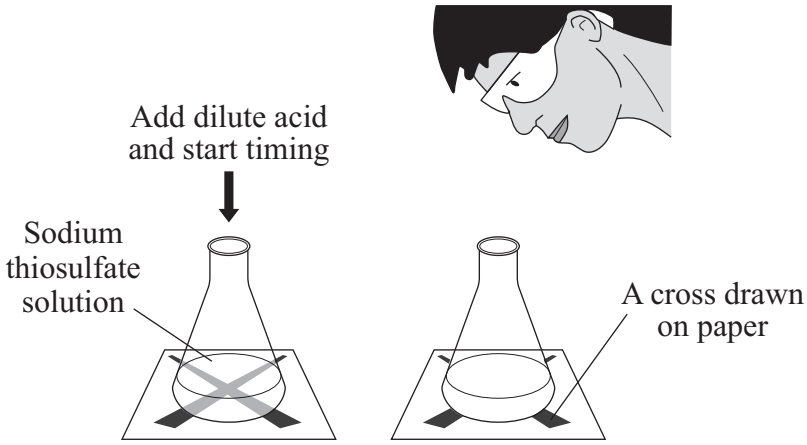
4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 02

June 2009 | CHY2H | Original Q1 | Legacy

1 Sodium thiosulfate solution reacts with hydrochloric acid. As the reaction takes place the solution slowly turns cloudy.

The diagram shows a method of measuring the rate of this reaction.



Time how long it takes for the cross to disappear

A student used this method to investigate how changing the concentration of the sodium thiosulfate solution affects the rate of this reaction.

The student used different concentrations of sodium thiosulfate solution. All the other variables were kept the same.

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

1 (a) (i) Draw a line of best fit on the graph. *(1 mark)*

1 (a) (ii) Suggest **two** reasons why all of the points do not lie on the line of best fit.

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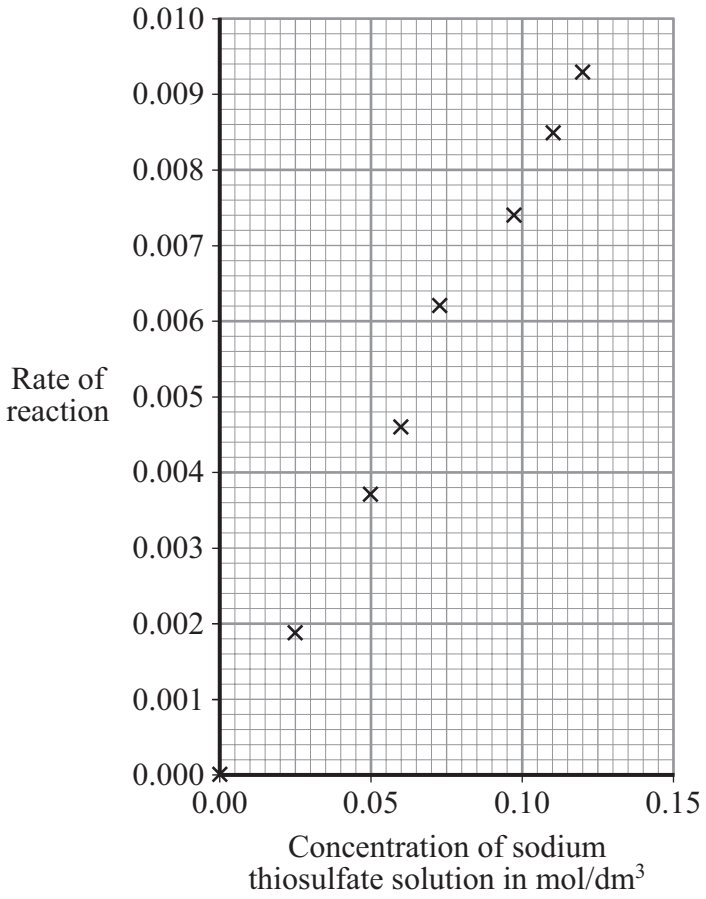
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(2 marks)

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 02 · continued

for mark



1 (b) (i) In a conclusion to the investigation the student stated that:

'The rate of this reaction is directly proportional to the concentration of the sodium thiosulfate solution.'

How does the graph support this conclusion?

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(1 mark)

1 (b) (ii) Explain, in terms of particles, why the rate of reaction increases when the concentration of sodium thiosulfate is increased.

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(2 marks)

6

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 03

7 Aminoethanoic acid (glycine), NH_2CH_2COOH, is an amino acid. It is found in fish, meat, beans and dairy produce. It can behave both as an acid and as a base.

7 (a) Explain, in terms of Brønsted and Lowry's ideas, why aminoethanoic acid behaves as:

an acid when it reacts with sodium hydroxide

$$NH_2CH_2COOH + Na^+OH^- \rightarrow NH_2CH_2COO^-Na^+ + H_2O$$

.....

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a base when it reacts with hydrochloric acid.

$$NH_2CH_2COOH + H^+Cl^- \rightarrow NH_3^+CH_2COOH + Cl^-$$

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(3 marks)

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 03 · continued

for mark

7 (b) In a titration, 25.00 cm^3 of a solution of aminoethanoic acid reacted with 18.40 cm^3 of sodium hydroxide solution of concentration 0.15 moles per cubic decimetre.

The equation which represents the reaction is:

$$NH_2CH_2COOH + Na^+OH^- \rightarrow NH_2CH_2COO^-Na^+ + H_2O$$

7 (b) (i) Calculate the concentration of aminoethanoic acid in moles per cubic decimetre.

.....

.....

.....

.....

Concentration = ... moles per cubic decimetre

(2 marks)

7 (b) (ii) Name an indicator used for weak acid-strong alkali titrations.

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(1 mark)

6

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 04

6 This label was on a bottle of vinegar.



Vinegar contains ethanoic acid, which is a *weak* acid.

6 (a) (i) According to Arrhenius, acids are chemicals that produce hydrogen ions (H^+) in aqueous solution.

Complete the following equation to show why ethanoic acid (CH_3COOH) is an acid in aqueous solution.

$$CH_3COOH\ (l) \xrightleftharpoons{\text{water}} \text{..... (aq)} + \text{..... (aq)}$$

(1 mark)

6 (a) (ii) Explain the meaning of *weak* in terms of ionisation.

.....

.....

(1 mark)

6 (a) (iii) What is the Brønsted and Lowry definition of acids?

.....

(1 mark)

6 (b) 25.0 cm^3 of diluted vinegar were placed in a conical flask using a pipette.

The volume of sodium hydroxide solution needed to react completely with the ethanoic acid in 25.0 cm^3 of diluted vinegar can be found by titration using phenolphthalein indicator.

6 (b) (i) Why is phenolphthalein used instead of methyl orange for this titration?

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.....

(1 mark)

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 04 · continued

6 (b) (ii) Describe how you would do the titration.

You should include the names of any apparatus you would use.

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(4 marks)

6 (c) The ethanoic acid in 25.0 cm^3 of diluted vinegar reacted completely with 15.0 cm^3 of sodium hydroxide solution of concentration 0.10 moles per cubic decimetre.

The equation which represents this reaction is:

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

Calculate the concentration of ethanoic acid in moles per cubic decimetre.

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Concentration = ... moles per cubic decimetre

(2 marks)

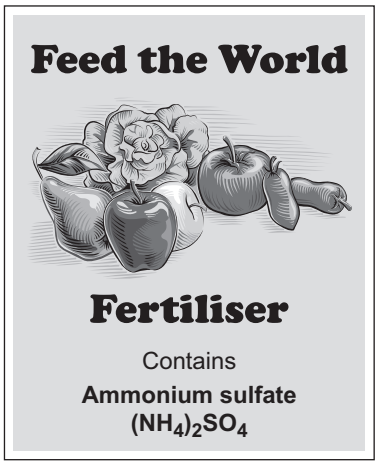
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4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 05

June 2011 | CHY3H | Original Q5 | Legacy

5 Ammonium sulfate is an artificial fertiliser.



5 (a) (i) When this fertiliser is warmed with sodium hydroxide solution, ammonia gas is given off. Describe and give the result of a test for ammonia gas.

Test .....

.....

Result .....

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(2 marks)

5 (a) (ii) Describe and give the result of a chemical test to show that this fertiliser contains sulfate ions (SO_4^{2-}).

Test .....

.....

Result .....

.....

(2 marks)

5 (b) Ammonium sulfate is made by reacting sulfuric acid (a *strong* acid) with ammonia solution (a *weak* alkali).

5 (b) (i) Explain the meaning of *strong* in terms of ionisation.

.....

(1 mark)

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 05 · continued

5 (b) (ii) A student made some ammonium sulfate in a school laboratory.

The student carried out a titration, using a suitable indicator, to find the volumes of sulfuric acid and ammonia solution that should be reacted together.

Name a suitable indicator for strong acid-weak alkali titrations.

.....

(1 mark)

5 (b) (iii) The student found that 25.0 cm^3 of ammonia solution reacted completely with 32.0 cm^3 of sulfuric acid of concentration 0.050 moles per cubic decimetre.

The equation that represents this reaction is:

$$H_2SO_4\,(aq) + 2NH_3\,(aq) \rightarrow (NH_4)_2SO_4\,(aq)$$

Calculate the concentration of this ammonia solution in moles per cubic decimetre.

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Concentration = ... moles per cubic decimetre

(3 marks)

5 (b) (iv) Use your answer to (b)(iii) to calculate the concentration of ammonia in grams per cubic decimetre.

(If you did not answer part (b)(iii), assume that the concentration of the ammonia solution is 0.15 moles per cubic decimetre. This is **not** the correct answer to part (b)(iii).)

Relative formula mass of ammonia (NH_3) = 17.

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Concentration = ... grams per cubic decimetre

(2 marks)

11

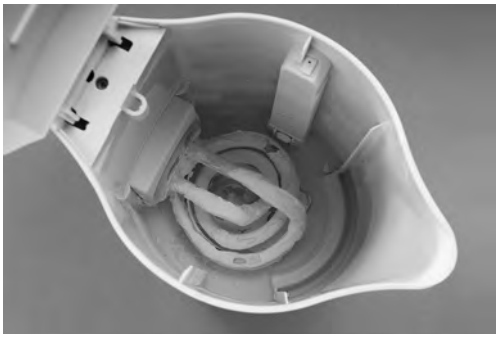
4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 06

June 2014 | CH3HP | Original Q4 | Legacy

4 Hard water causes scale in kettles, as shown in **Figure 4**.

Figure 4



4 (a) Acids are used to remove scale.

4 (a) (i) Give the name of a carbonate in scale.

[1 mark]

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4 (a) (ii) When acids react with scale a gas is produced.

What is the name of the gas?

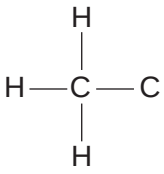
[1 mark]

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4 (b) Ethanoic acid is used to remove scale.

Complete the displayed structure of ethanoic acid (CH_3COOH).

[1 mark]



4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 06 · continued

4 (c) A student compared the rates at which ethanoic acid and hydrochloric acid react with scale.

Both acids had the same concentration.

4 (c) (i) The student found that hydrochloric acid reacts faster than ethanoic acid with scale.

Explain why hydrochloric acid reacts faster than ethanoic acid.

[2 marks]

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4 (c) (ii) Hydrochloric acid should **not** be used to dissolve scale in kettles.

Suggest why.

[1 mark]

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4 (d) A student does a titration to find the concentration of a solution of hydrochloric acid.

The student titrates 25.00 cm^3 of hydrochloric acid with sodium hydroxide solution of concentration 0.200 moles per dm^3. The equation for the reaction is:

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

The student added 28.60 cm^3 of sodium hydroxide solution to neutralise the hydrochloric acid.

Calculate the concentration of the hydrochloric acid.

[3 marks]

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Concentration = ... moles per dm^3

9

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 07

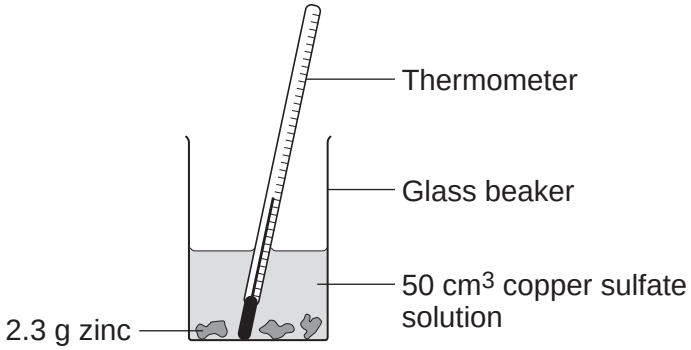
June 2015 | CH2HP | Original Q2 | Legacy

2 A student investigated the temperature change when zinc reacts with copper sulfate solution.

The student used a different concentration of copper sulfate solution for each experiment.

The student used the apparatus shown in **Figure 3**.

Figure 3



The student:

- measured 50 cm^3 copper sulfate solution into a glass beaker
- measured the temperature of the copper sulfate solution
- added 2.3 g zinc
- measured the highest temperature
- repeated the experiment using copper sulfate solution with different concentrations.

The equation for the reaction is:

$$Zn(s) + CuSO_4(aq) \longrightarrow Cu(s) + ZnSO_4(aq)$$

zinc + copper sulfate solution ⟶ copper + zinc sulfate solution

2 (a) The thermometer reading changes during the reaction.

Give **one** other change the student could **see** during the reaction.

[1 mark]

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Question 2 continues on the next page

Question 07 · continued

2 (b) Suggest **one** improvement the student could make to the apparatus in **Figure 3**.

Give a reason why this improves the investigation.

[2 marks]

Improvement .....

.....

Reason .....

.....

2 (c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The student's results are shown in **Table 1**.

Table 1

Experiment number	Concentration of copper sulfate in moles per dm^3	Increase in temperature in °C
1	0.1	5
2	0.2	10
3	0.3	12
4	0.4	20
5	0.5	25
6	0.6	30
7	0.7	35
8	0.8	35
9	0.9	35
10	1.0	35

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 07 · continued

Describe **and** explain the trends shown in the student's results.

[6 marks]

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4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 08

7 This question is about chemical analysis.

7 (a) A student has solutions of three compounds, **X**, **Y** and **Z**.

The student uses tests to identify the ions in the three compounds.

The student records the results of the tests in **Table 1**.

Table 1

	Test			
Compound	**Flame test**	**Add sodium hydroxide solution**	**Add hydrochloric acid and barium chloride solution**	**Add nitric acid and silver nitrate solution**
X	no colour	green precipitate	white precipitate	no reaction
Y	yellow flame	no reaction	no reaction	yellow precipitate
Z	no colour	brown precipitate	no reaction	cream precipitate

Identify the **two** ions present in each compound, **X**, **Y** and **Z**.

[3 marks]

X .....

Y .....

Z .....

7 (b) A chemist needs to find the concentration of a solution of barium hydroxide.
Barium hydroxide solution is an alkali.

The chemist could find the concentration of the barium hydroxide solution using two different methods.

Method 1

- An excess of sodium sulfate solution is added to 25 cm^3 of the barium hydroxide solution. A precipitate of barium sulfate is formed.
- The precipitate of barium sulfate is filtered, dried and weighed.
- The concentration of the barium hydroxide solution is calculated from the mass of barium sulfate produced.

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 08 · continued

Method 2

- 25 cm^3 of the barium hydroxide solution is titrated with hydrochloric acid of known concentration.
- The concentration of the barium hydroxide solution is calculated from the result of the titration.

Compare the advantages and disadvantages of the two methods.

[5 marks]

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4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 09

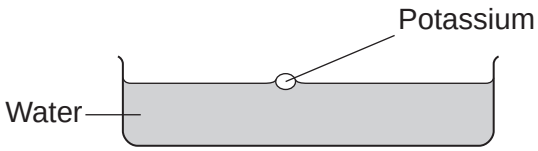
June 2017 | CH3HP | Original Q4 | Legacy

4 This question is about potassium and its compounds.

4 (a) (i) Potassium reacts with water to produce potassium hydroxide solution and a gas.

Figure 8 shows the apparatus used for the reaction.

Figure 8



Complete and balance the equation for the reaction.

[2 marks]

____ K + ____ H_2O ⟶ ____ KOH + _____

4 (a) (ii) Potassium and lithium are in Group 1 of the periodic table.

Give **two** differences you would see between the reactions of potassium and lithium with water.

[2 marks]

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_____

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 09 · continued

4 (b) Describe how a student could do titrations to find the mean volume of potassium hydroxide solution which would neutralise 25.00 cm^3 of nitric acid.

[5 marks]

4 (c) The student found that 26.25 cm^3 of potassium hydroxide solution with a concentration of 0.20 moles per dm^3 neutralises 25.00 cm^3 of nitric acid.

The equation for the reaction is:

$$KOH + HNO_3 \longrightarrow KNO_3 + H_2O$$

Calculate the concentration of the nitric acid.

[3 marks]

Concentration of nitric acid = _____ moles per dm^3

12

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 10

June 2018 | 8462/1H | Original Q9

0 9 This question is about acids and alkalis.

0 9 . 1 Dilute hydrochloric acid is a strong acid.

Explain why an acid can be described as both strong and dilute.

[2 marks]

0 9 . 2 A 1.0×10^{-3} mol/dm^3 solution of hydrochloric acid has a pH of 3.0

What is the pH of a 1.0×10^{-5} mol/dm^3 solution of hydrochloric acid?

[1 mark]

pH = _____

Question 9 continues on the next page

Question 10 · continued

A student titrated 25.0 cm^3 portions of dilute sulfuric acid with a 0.105 mol/dm^3 sodium hydroxide solution.

0 9 . 3 **Table 4** shows the student's results.

Table 4

	Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
Volume of sodium hydroxide solution in cm^3	23.50	21.10	22.10	22.15	22.15

The equation for the reaction is:

$$2\ NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2\ H_2O$$

Calculate the concentration of the sulfuric acid in mol/dm^3

Use only the student's concordant results.

Concordant results are those within 0.10 cm^3 of each other.

[5 marks]

Concentration of sulfuric acid = _____ mol/dm^3

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 10 · continued

0 9 . 4 Explain why the student should use a pipette to measure the dilute sulfuric acid and a burette to measure the sodium hydroxide solution.

[2 marks]

0 9 . 5 Calculate the mass of sodium hydroxide in 30.0 cm^3 of a 0.105 mol/dm^3 solution.

Relative formula mass (M_r): NaOH = 40

[2 marks]

Mass of sodium hydroxide = _____ g

12

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 11

June 2019 | 8462/1H | Original Q2

0 2 This question is about acids and alkalis.

0 2 . 1 Which ion do all acids produce in aqueous solution?

[1 mark]

Tick (✓) **one** box.

H^+ ☐

H^- ☐

O^{2-} ☐

OH^- ☐

0 2 . 2 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 + _____

Question 2 continues on the next page

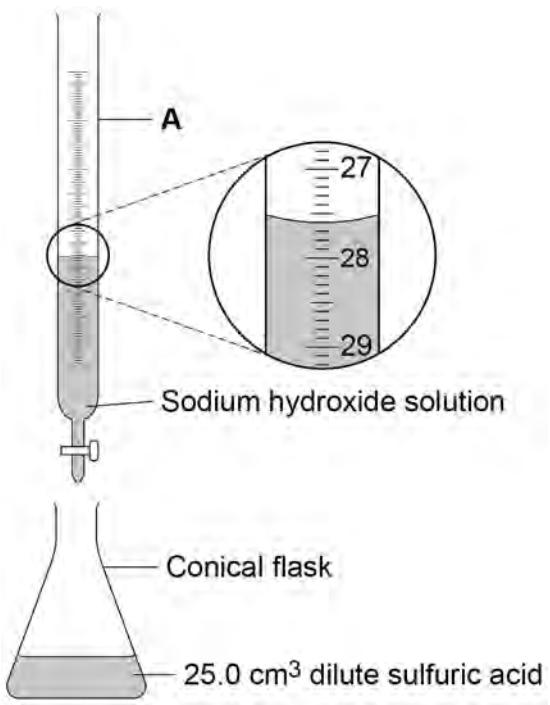
4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 11 · continued

A student investigates the volume of sodium hydroxide solution that reacts with 25.0 cm^3 of dilute sulfuric acid.

Figure 2 shows the apparatus the student uses.

Figure 2



Use **Figure 2** to answer Questions **02.3** and **02.4**

0 2 . 3 Name apparatus **A**.

[1 mark]

0 2 . 4 What is the reading on apparatus **A**?

[1 mark]

_____ cm^3

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 11 · continued

0 2 . 5 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]

11

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 12

June 2019 | 8462/1H | Original Q9

0 9 A student investigated the temperature change in the reaction between dilute sulfuric acid and potassium hydroxide solution.

This is the method used.

1. Measure 25.0 cm^3 potassium hydroxide solution into a polystyrene cup.

2. Record the temperature of the solution.

3. Add 2.0 cm^3 dilute sulfuric acid.

4. Stir the solution.

5. Record the temperature of the solution.

6. Repeat steps 3 to 5 until a total of 20.0 cm^3 dilute sulfuric acid has been added.

0 9 . 1 Suggest why the student used a polystyrene cup rather than a glass beaker for the reaction.

[2 marks]

Question 9 continues on the next page

Question 12 · continued

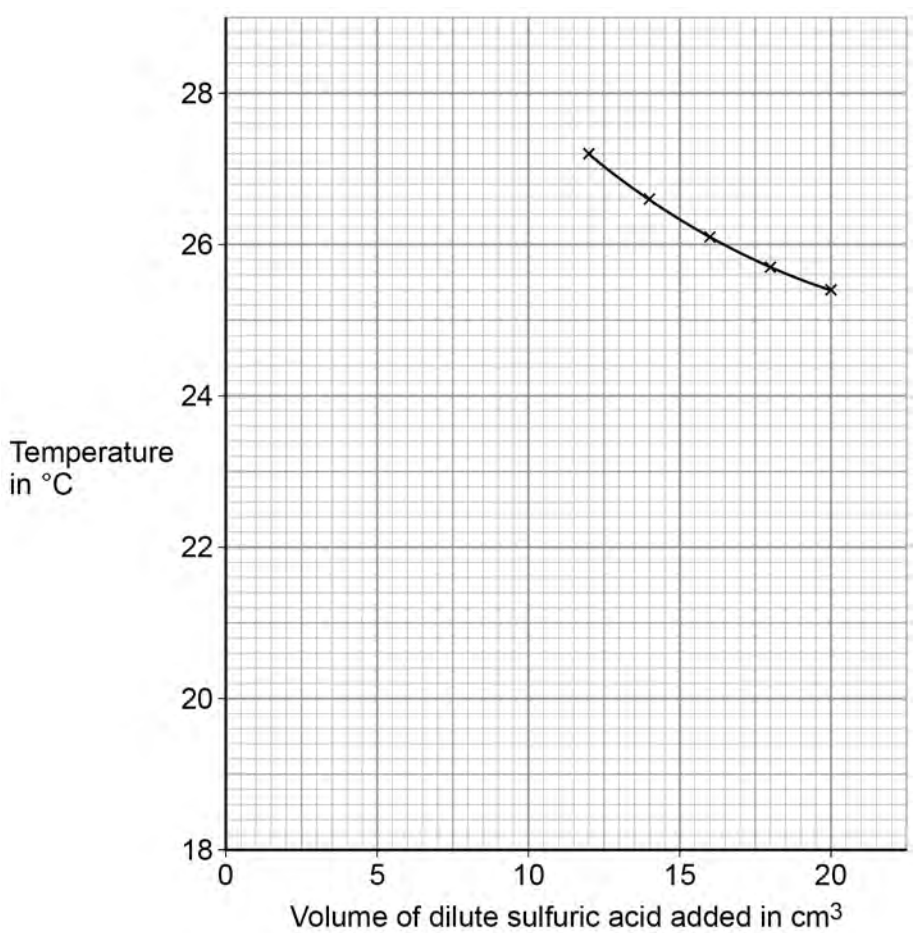
Table 6 shows some of the student's results.

Table 6

Volume of dilute sulfuric acid added in cm^3	Temperature in °C
0.0	18.9
2.0	21.7
4.0	23.6
6.0	25.0
8.0	26.1
10.0	27.1

Figure 11 shows some of the data from the investigation.

Figure 11



Question 12 · continued

0 9 . 2 Complete **Figure 11**:

- plot the data from **Table 6**
- draw a line of best fit through these points
- extend the lines of best fit until they cross.

[4 marks]

0 9 . 3 Determine the volume of dilute sulfuric acid needed to react completely with 25.0 cm^3 of the potassium hydroxide solution.

Use **Figure 11**.

[1 mark]

Volume of dilute sulfuric acid to react completely = _____ cm^3

0 9 . 4 Determine the overall temperature change when the reaction is complete.

Use **Figure 11**.

[1 mark]

_____

_____

Overall temperature change = _____ °C

Question 9 continues on the next page

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 12 · continued

0 9 . 5 The student repeated the investigation.

The student used solutions that had different concentrations from the first investigation.

The student found that 15.5 cm^3 of 0.500 mol/dm^3 dilute sulfuric acid completely reacted with 25.0 cm^3 of potassium hydroxide solution.

The equation for the reaction is:

$$2\,KOH + H_2SO_4 \rightarrow K_2SO_4 + 2\,H_2O$$

Calculate the concentration of the potassium hydroxide solution in mol/dm^3 and in g/dm^3

Relative atomic masses (A_r): H = 1 O = 16 K = 39

[6 marks]

Concentration in mol/dm^3 = _____ mol/dm^3

Concentration in g/dm^3 = _____ g/dm^3

14

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 13

0 9 This question is about citric acid ($C_6H_8O_7$).

Citric acid is a solid.

A student investigated the temperature change during the reaction between citric acid and sodium hydrogencarbonate solution.

This is the method used.

1. Pour 25 cm^3 of sodium hydrogencarbonate solution into a polystyrene cup.

2. Measure the temperature of the sodium hydrogencarbonate solution.

3. Add 0.20 g of citric acid to the polystyrene cup.

4. Stir the solution.

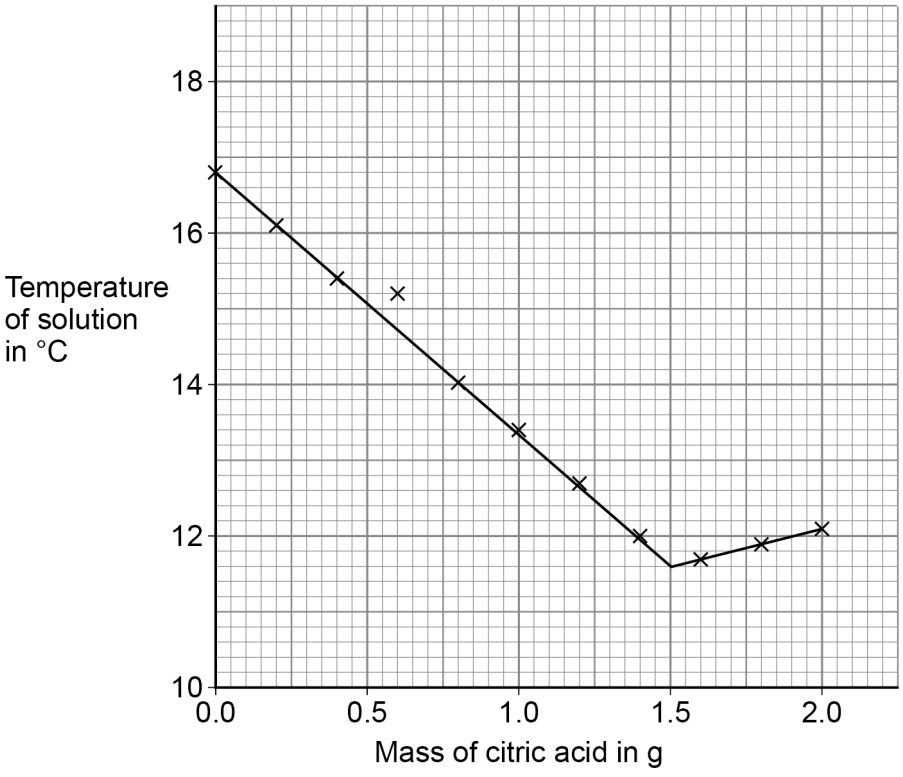
5. Measure the temperature of the solution.

6. Repeat steps 3 to 5 until a total of 2.00 g of citric acid has been added.

The student plotted the results on a graph.

Figure 6 shows the student's graph.

Figure 6



4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 13 · continued

0 9 . 1 **Figure 6** shows an anomalous point when 0.60 g of citric acid was added. This was caused by the student making an error.

The student correctly:

- measured the mass of the citric acid
- read the thermometer
- plotted the point.

Suggest **one** reason for the anomalous point.

[1 mark]

0 9 . 2 Explain the shape of the graph in terms of the energy transfers taking place.

You should use data from **Figure 6** in your answer.

[3 marks]

0 9 . 3 A second student repeated the investigation using a metal container instead of the polystyrene cup. The container and the cup were the same size and shape.

Sketch a line on **Figure 6** to show the second student's results until 1.00 g of citric acid had been added. The starting temperature of the solution was the same.

Explain your answer.

[3 marks]

Question 13 · continued

The student used a solution of citric acid to determine the concentration of a solution of sodium hydroxide by titration.

0 9 . 4 The student made 250 cm^3 of a solution of citric acid of concentration 0.0500 mol/dm^3

Calculate the mass of citric acid ($C_6H_8O_7$) required.

Relative atomic masses (A_r): H = 1 C = 12 O = 16

[3 marks]

Mass = _____ g

This is part of the method the student used for the titration.

1. Measure 25.0 cm^3 of the sodium hydroxide solution into a conical flask using a pipette.
2. Add a few drops of indicator to the flask.
3. Fill a burette with citric acid solution.

0 9 . 5 Describe how the student would complete the titration.

[3 marks]

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 13 · continued

0 9 . 6 Give **two** reasons why a burette is used for the citric acid solution.

[2 marks]

1 _____

_____

2 _____

_____

0 9 . 7 13.3 cm^3 of 0.0500 mol/dm^3 citric acid solution was needed to neutralise 25.0 cm^3 of sodium hydroxide solution.

The equation for the reaction is:

$$3\,NaOH + C_6H_8O_7 \rightarrow C_6H_5O_7Na_3 + 3\,H_2O$$

Calculate the concentration of the sodium hydroxide solution in mol/dm^3

[3 marks]

_____

_____

_____

_____

_____

_____

Concentration = _____ mol/dm^3

18

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 14

November 2021 | 8462/1H | Original Q9

0 9 This question is about acids.

Hydrogen chloride and ethanoic acid both dissolve in water.

All hydrogen chloride molecules ionise in water.

Approximately 1% of ethanoic acid molecules ionise in water.

0 9 . 1 A solution is made by dissolving 1 g of hydrogen chloride in 1 dm^3 of water.

Which is the correct description of this solution?

[1 mark]

Tick (✓) **one** box.

A concentrated solution of a strong acid ☐

A concentrated solution of a weak acid ☐

A dilute solution of a strong acid ☐

A dilute solution of a weak acid ☐

0 9 . 2 Which solution would have the lowest pH?

[1 mark]

Tick (✓) **one** box.

0.1 mol/dm^3 ethanoic acid solution ☐

0.1 mol/dm^3 hydrogen chloride solution ☐

1.0 mol/dm^3 ethanoic acid solution ☐

1.0 mol/dm^3 hydrogen chloride solution ☐

Question 14 · continued

A student investigated the concentration of a solution of sodium hydroxide by titration with a 0.0480 mol/dm^3 ethanedioic acid solution.

This is the method used.

1. Measure 25.0 cm^3 of the sodium hydroxide solution into a conical flask using a 25.0 cm^3 pipette.
2. Add two drops of indicator to the sodium hydroxide solution.
3. Fill a burette with the 0.0480 mol/dm^3 ethanedioic acid solution to the 0.00 cm^3 mark.
4. Add the ethanedioic acid solution to the sodium hydroxide solution until the indicator changes colour.
5. Read the burette to find the volume of the ethanedioic acid solution used.

0 9 . 3 Suggest **two** improvements to the method that would increase the accuracy of the result.

[2 marks]

1 _____

_____

2 _____

_____

Question 9 continues on the next page

0 9 . 4 Ethanedioic acid is a solid at room temperature.

Calculate the mass of ethanedioic acid ($H_2C_2O_4$) needed to make 250 cm^3 of a solution with concentration 0.0480 mol/dm^3

Relative formula mass (M_r): $H_2C_2O_4 = 90$

[2 marks]

Mass = _____ g

0 9 . 5 The student found that 25.0 cm^3 of the sodium hydroxide solution was neutralised by 15.00 cm^3 of the 0.0480 mol/dm^3 ethanedioic acid solution.

The equation for the reaction is:

$$H_2C_2O_4 + 2\,NaOH \rightarrow Na_2C_2O_4 + 2\,H_2O$$

Calculate the concentration of the sodium hydroxide solution in mol/dm^3

[3 marks]

Concentration = _____ mol/dm^3

9

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 15

November 2021 | 8462/2H | Original Q9

0 9 A student investigated how a change in concentration affects the rate of the reaction between zinc powder and sulfuric acid.

The equation for the reaction is:

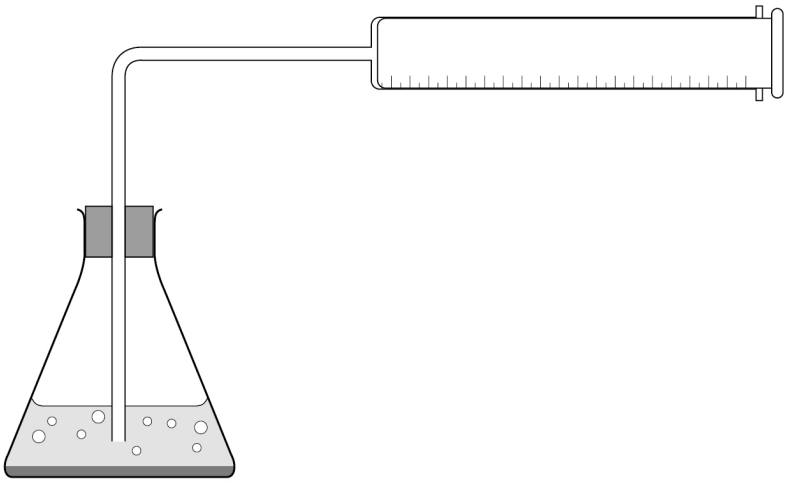
$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

This is the method used.

1. Pour 50 cm^3 of sulfuric acid of concentration 0.05 mol/dm^3 into a conical flask.
2. Add 0.2 g of zinc powder to the conical flask.
3. Put the stopper in the conical flask.
4. Measure the volume of gas collected every 30 seconds for 5 minutes.
5. Repeat steps 1 to 4 with sulfuric acid of concentration 0.10 mol/dm^3

Figure 8 shows the apparatus used.

Figure 8



0 9 . 1 The student made an error in setting up the apparatus in **Figure 8**.

What error did the student make?

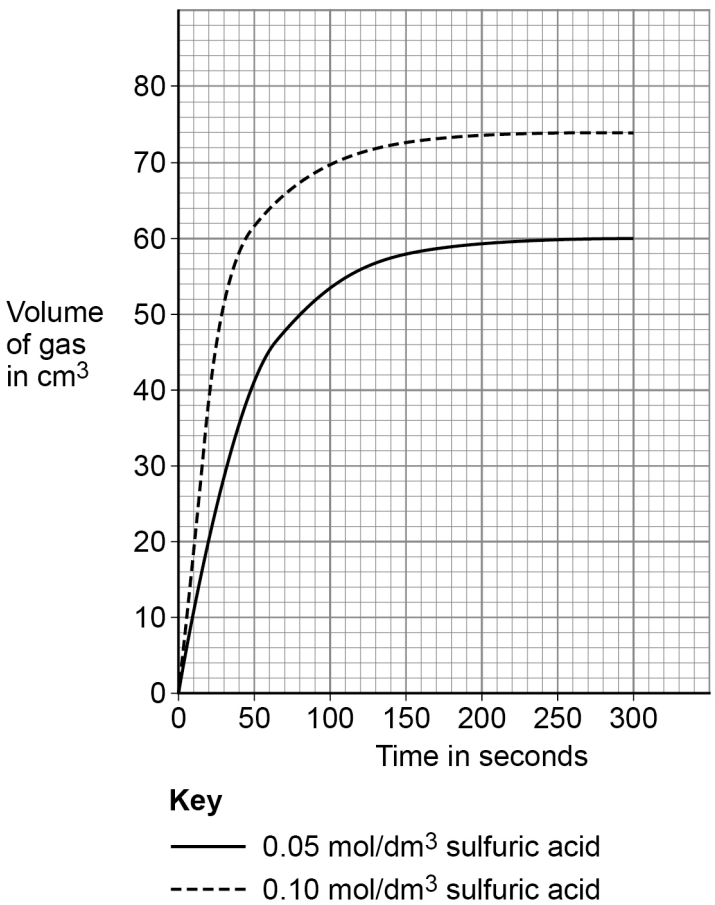
[1 mark]

Question 15 · continued

The student corrected the error.

Figure 9 shows the student's results.

Figure 9



0 9 . 2 Explain why the lines of best fit on **Figure 9** become horizontal.

[2 marks]

0 9 . 3 How does **Figure 9** show that zinc powder reacts more slowly with 0.05 mol/dm^3 sulfuric acid than with 0.10 mol/dm^3 sulfuric acid?

[1 mark]

0 9 . 4 Determine the rate of the reaction for 0.05 mol/dm^3 sulfuric acid at 80 seconds.

Show your working on **Figure 9**.

Give your answer to 2 significant figures.

[5 marks]

Rate of reaction (2 significant figures) = _____ cm^3/s

0 9 . 5 The activation energy for the reaction between zinc and sulfuric acid is lowered if a solution containing metal ions is added.

What is the most likely formula of the metal ions added?

[1 mark]

Tick (✓) **one** box.

Al^{3+} ☐

Ca^{2+} ☐

Cu^{2+} ☐

Na^{+} ☐

10

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 16

June 2022 | 8462/1H | Original Q8

0 8 This question is about acids and alkalis.

0 8 . 1 Explain why the pH of an acid depends on:

- the strength of the acid
- the concentration of the acid.

[4 marks]

0 8 . 2 A student titrated 25.00 cm^3 of hydrochloric acid with 0.100 mol/dm^3 barium hydroxide solution.

Table 2 shows the results.

Table 2

Titration number	1	2	3	4	5
Volume of barium hydroxide solution used in cm^3	23.90	23.45	23.55	23.55	23.45

The student calculated the volume of barium hydroxide solution to be used in the titration calculation as 23.50 cm^3.

Explain why the student used a volume of 23.50 cm^3 of barium hydroxide solution in the titration calculation.

[2 marks]

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 16 · continued

0 8 . 3 25.00 cm^3 of the hydrochloric acid reacted with 23.50 cm^3 of the 0.100 mol/dm^3 barium hydroxide solution.

The equation for the reaction is:

$$2\,HCl(aq) + Ba(OH)_2(aq) \rightarrow BaCl_2(aq) + 2\,H_2O(l)$$

Calculate the concentration of the hydrochloric acid in mol/dm^3.

[4 marks]

Concentration of the hydrochloric acid = _____ mol/dm^3

Question 8 continues on the next page

Question 16 · continued

Another student titrated sulfuric acid with barium hydroxide solution.

The equation for the reaction is:

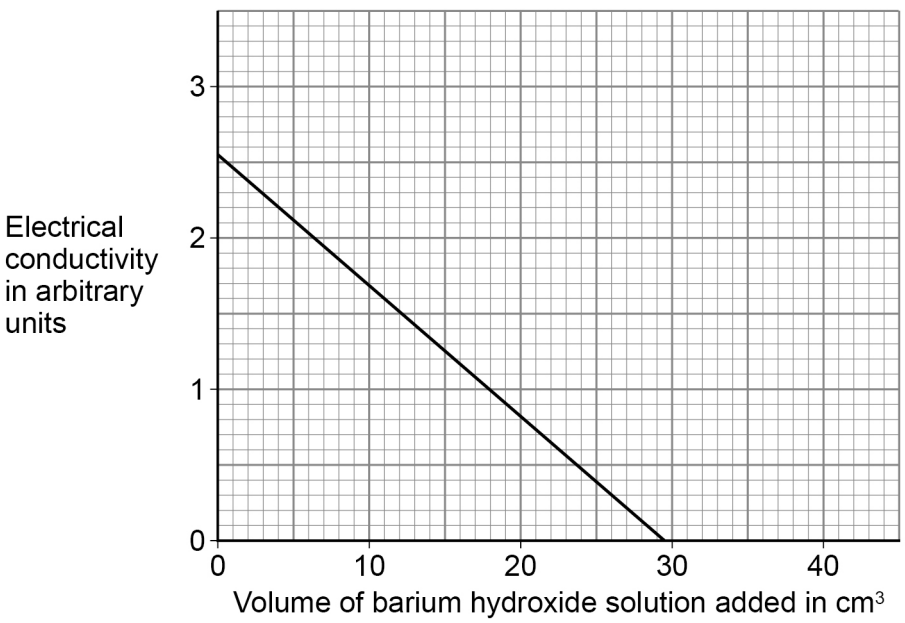
$$H_2SO_4(aq) + Ba(OH)_2(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$$

The student measured the electrical conductivity of the mixture during the titration.

The better a conductor, the higher the electrical conductivity value.

Figure 10 shows the results.

Figure 10



0 8 . 4 Explain why the electrical conductivity of the mixture was zero when the sulfuric acid had just been neutralised.

Use the equation for the reaction.

Refer to ions in your answer.

[3 marks]

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 16 · continued

0 8 . 5 The student then added a further 10 cm^3 of barium hydroxide solution.

The electrical conductivity of the mixture increased.

Give **one** reason why.

[1 mark]

14

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 17

June 2022 | 8462/2H | Original Q5

0 5 This question is about water.

0 5 . 1 Sewage is waste water.

Sewage contains organic matter.

Describe how sewage is treated to remove organic matter.

[4 marks]

Question 5 continues on the next page

Question 17 · continued

Sea water and ground water are treated to make them potable.

Table 5 shows information about the composition and treatment of sea water and of ground water.

Table 5

	Sea water	Ground water
Concentration of sodium ions and chloride ions before **Process 1**	Na^+ : 0.5 mol/dm^3 Cl^- : 0.5 mol/dm^3	Na^+ : 0.001 mol/dm^3 Cl^- : 0.001 mol/dm^3
Process 1	Reverse osmosis	Filtration
Concentration of sodium ions and chloride ions after **Process 1**	**X**	Na^+ : 0.001 mol/dm^3 Cl^- : 0.001 mol/dm^3
Process 2	Add ozone	Expose to ultraviolet light

0 5 . 2 Sea water is desalinated during **Process 1**.

Which pair of concentrations could represent **X** in **Table 5**?

[1 mark]

Tick (✓) **one** box.

Na^+ : 0.003 mol/dm^3 Cl^- : 0.003 mol/dm^3 ☐

Na^+ : 0.003 mol/dm^3 Cl^- : 0.5 mol/dm^3 ☐

Na^+ : 0.5 mol/dm^3 Cl^- : 0.003 mol/dm^3 ☐

Na^+ : 0.5 mol/dm^3 Cl^- : 0.5 mol/dm^3 ☐

0 5 . 3 Explain why the concentrations of sodium ions and of chloride ions in the ground water in **Table 5** are unchanged by **Process 1**.

[2 marks]

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 17 · continued

0 5 . 4 Explain why the ground water in **Table 5** requires **Process 2** before the water is safe to drink.

[2 marks]

0 5 . 5 After treatment the ground water in **Table 5** is sold by a company as pure water.

The ground water in **Table 5** is not chemically pure because the water contains sodium ions and chloride ions.

Suggest what the company means by 'pure'.

[1 mark]

0 5 . 6 Chlorine is also used to treat some ground water.

Describe the test for chlorine gas.

Give the result of the test.

[2 marks]

Test

Result

12

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 18

June 2022 | 8462/2H | Original Q8

0 8 This question is about the reaction between sodium thiosulfate solution and hydrochloric acid.

When hydrochloric acid is added to sodium thiosulfate solution, the mixture gradually becomes cloudy.

The equation for the reaction is:

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

0 8 . 1 Sulfur is produced in the reaction.

Why does the mixture become cloudy?

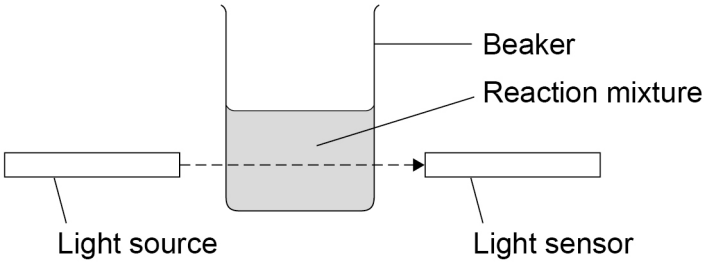
[1 mark]

Question 18 · continued

A student investigated the effect of changing the concentration of sodium thiosulfate solution on the rate of the reaction.

Figure 6 shows the apparatus used.

Figure 6



A smaller percentage of light from the light source reaches the light sensor as the mixture becomes more cloudy.

This is the method used.

1. Measure 50 cm^3 of 0.10 mol/dm^3 sodium thiosulfate solution into the beaker.
2. Add 10 cm^3 of hydrochloric acid to the sodium thiosulfate solution.
3. Immediately start a timer.
4. Record the percentage of light from the light source that reaches the light sensor every 20 seconds for 120 seconds.
5. Repeat steps 1 to 4 using 0.20 mol/dm^3 sodium thiosulfate solution.

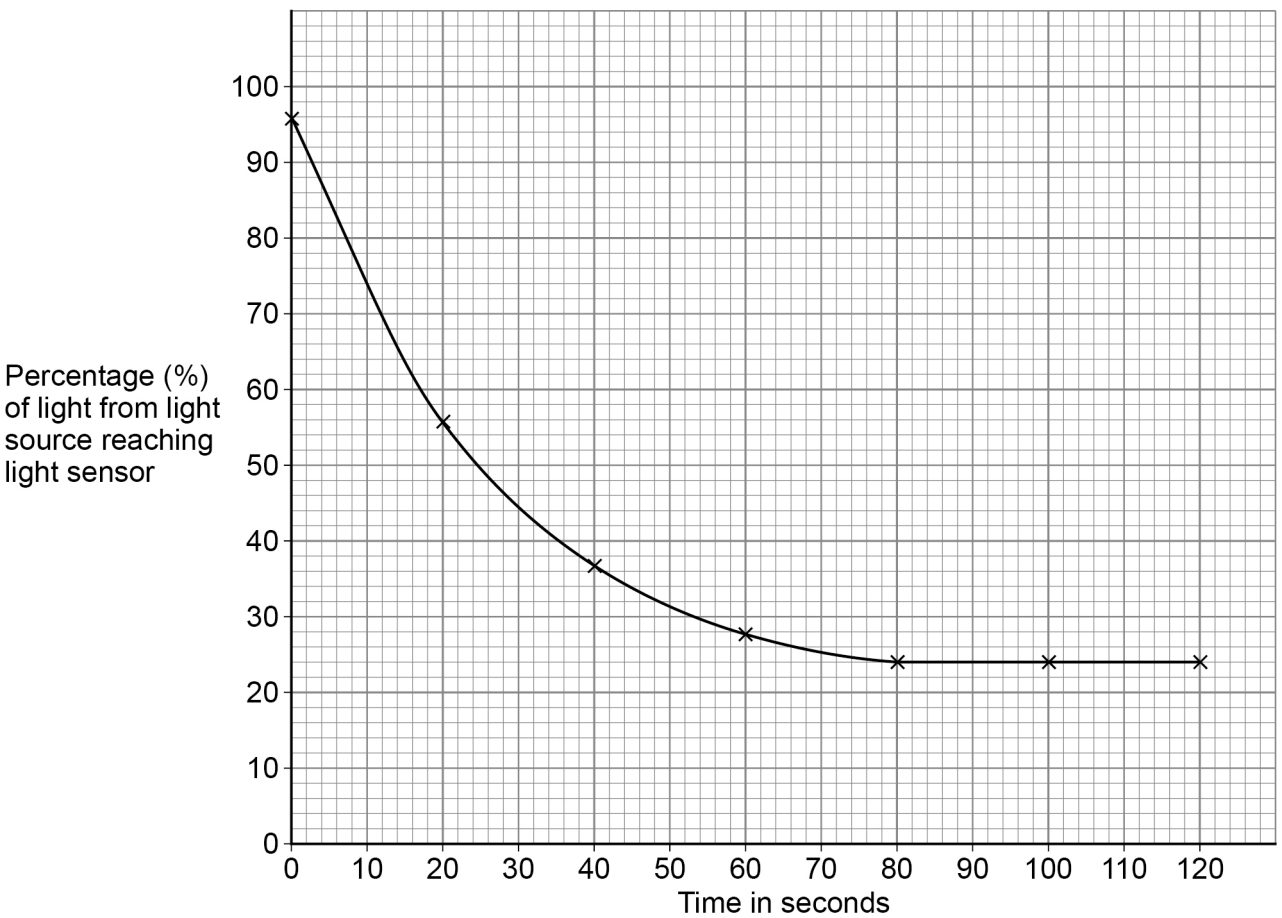
Question 8 continues on the next page

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 18 · continued

Figure 7 shows the results for 0.10 mol/dm^3 sodium thiosulfate solution.

Figure 7



4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 18 · continued

0 8 . 2 The percentage of light reaching the light sensor decreases by 1% when 7.1×10^{-5} moles of sulfur is produced.

Determine the rate of reaction in mol/s for the production of sulfur at 30 seconds.

You should draw a tangent on **Figure 7**.

[5 marks]

Rate = _____ mol/s

0 8 . 3 Explain why the rate of reaction changes between 0 and 60 seconds.

Answer in terms of concentration.

Use **Figure 7**.

[2 marks]

Question 18 · continued

Figure 8 is a repeat of **Figure 7**.

Figure 8

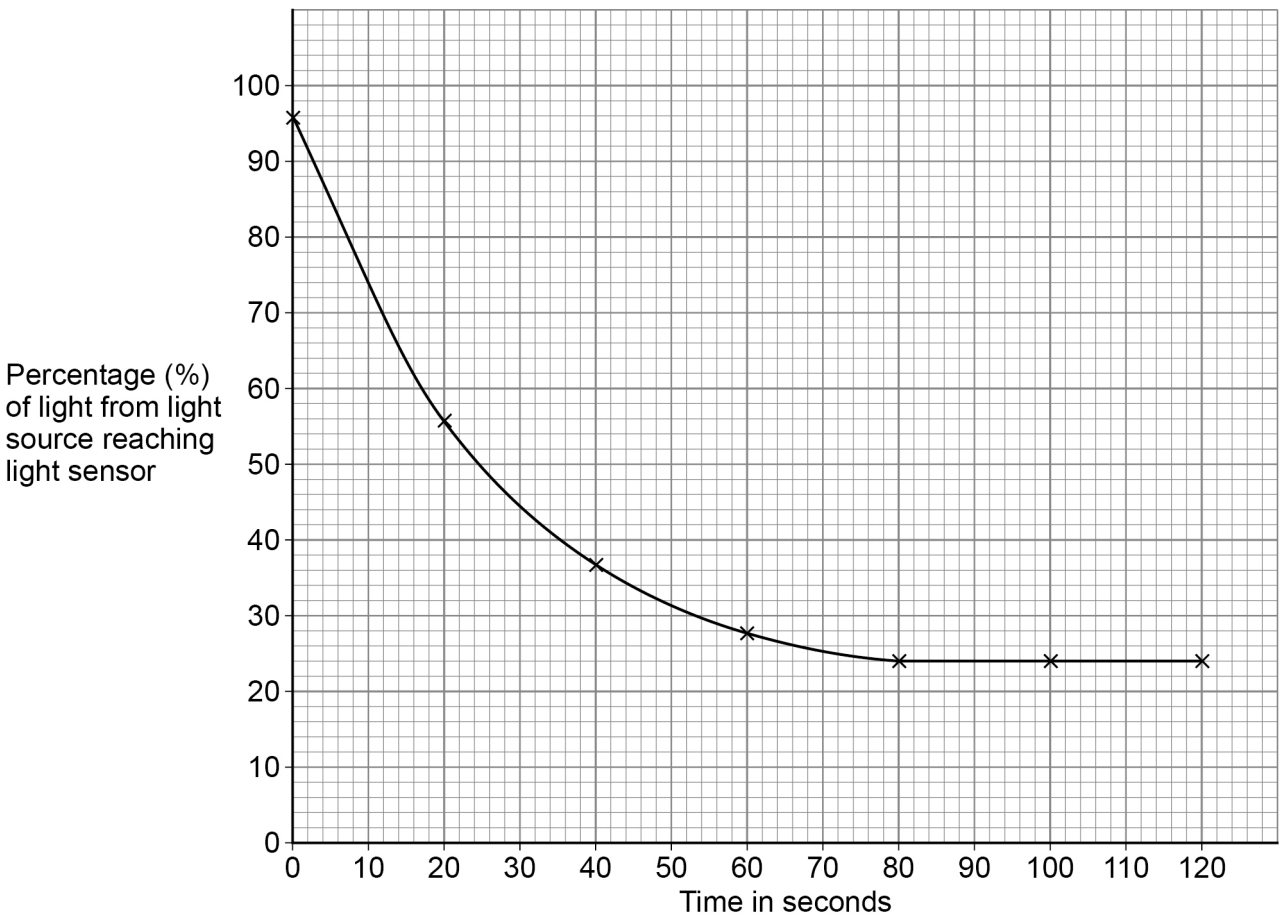


Figure 8 shows the results for 0.10 mol/dm^3 sodium thiosulfate solution.

Sodium thiosulfate solution was in excess in the investigation.

0 8 . 4 The line of best fit on **Figure 8** is horizontal between 80 and 120 seconds because the reaction stopped.

Why did the reaction stop?

[1 mark]

0 8 . 5 Sketch a line on **Figure 8** to show the results you would predict for 0.20 mol/dm^3 sodium thiosulfate solution.

[2 marks]

Question 18 · continued

The same student did the investigation again the next day.

The student found that the same method produced different results for the percentage of light reaching the light sensor.

0 8 . 6 How could the student improve the method so that the same percentages of light reached the light sensor?

[1 mark]

Tick (✓) **one** box.

- Record the percentage of light every 10 seconds. ☐
- Stop light from other sources reaching the light sensor. ☐
- Use a larger volume of sodium thiosulfate solution. ☐
- Use a more sensitive light sensor. ☐

0 8 . 7 The student improved the method so that similar results were obtained on different days.

What name is given to similar results obtained on different days under the same conditions by the same student?

[1 mark]

Tick (✓) **one** box.

- Anomalous ☐
- Precise ☐
- Repeatable ☐
- Reproducible ☐

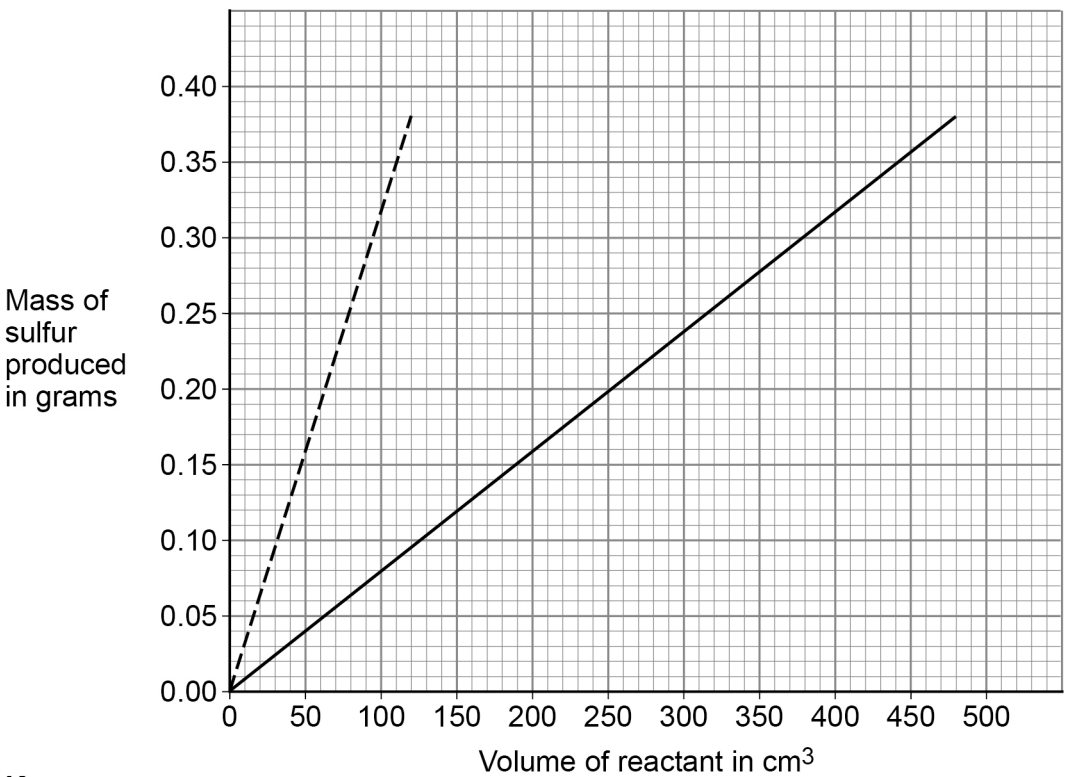
Question 18 · continued

Figure 9 shows the volumes of:

- sodium thiosulfate solution of concentration 0.10 mol/dm^3
- hydrochloric acid of concentration 0.05 mol/dm^3

which completely react to produce different masses of sulfur.

Figure 9



Key

– – – 0.10 mol/dm^3 sodium thiosulfate solution

—— 0.05 mol/dm^3 hydrochloric acid

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 18 · continued

0 8 . 8 Which expression represents the relationship between the volume (V) of sodium thiosulfate solution used and the mass (m) of sulfur produced?

Use **Figure 9**.

[1 mark]

Tick (✓) **one** box.

V ∝ m ☐

V ~ m ☐

V << m ☐

V = m ☐

0 8 . 9 Determine the simplest whole number ratio of the volumes of

sodium thiosulfate solution : hydrochloric acid

which completely react with each other.

Use **Figure 9**.

[3 marks]

Simplest whole number ratio = _____ : _____

17

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 19

June 2023 | 8462/1H | Original Q5

0 5 This question is about acids and alkalis.

0 5 . 1 Ethanoic acid is a weak acid.

What is meant by 'weak acid'?

Answer in terms of ionisation.

[1 mark]

_____

_____

0 5 . 2 The concentration of an acid can be measured in mol/dm^3.

Which combination of changes **increases** the concentration of an acid?

[1 mark]

Tick (✓) **one** box.

- The mass of acid dissolved is halved and the volume of the solution is halved. ☐
- The mass of acid dissolved is halved and the volume of the solution is doubled. ☐
- The mass of acid dissolved is doubled and the volume of the solution is halved. ☐
- The mass of acid dissolved is doubled and the volume of the solution is doubled. ☐

0 5 . 3 The concentration of an acid can be determined by titration.

An indicator is added to an alkali in a flask.

Name an indicator that can be used in this titration.

Give the colour change of the indicator when acid from a burette is added to the alkali in the flask.

[2 marks]

Name of indicator _____

Colour change from _____ to _____

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 19 · continued

0 5 . 4 Sodium carbonate dissolves in water to produce an alkaline solution.

Give the formula of the ion that makes a solution alkaline.

[1 mark]

_____

0 5 . 5 A student does a titration using sodium carbonate solution and nitric acid.

The equation for the reaction is:

$$Na_2CO_3 + 2\,HNO_3 \rightarrow 2\,NaNO_3 + CO_2 + H_2O$$

25.0 cm^3 of 0.124 mol/dm^3 sodium carbonate solution is neutralised by 23.6 cm^3 of nitric acid.

Calculate the concentration of the nitric acid.

Give your answer to 3 significant figures.

You should calculate:

- the number of moles of sodium carbonate in 25.0 cm^3 of the solution
- the number of moles of nitric acid in 23.6 cm^3 of the nitric acid
- the concentration of the nitric acid in mol/dm^3.

[5 marks]

Concentration (3 significant figures) = _____ mol/dm^3

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 19 · continued

When hydrochloric acid dissolves in water, hydrogen ions (H^+) and chloride ions (Cl^-) are produced.

0 5 . 6 A solution of hydrochloric acid with pH 4.5 has a concentration of H^+ ions of 3.16×10^{-5} mol/dm^3.

What is the concentration of H^+ ions in a solution of hydrochloric acid with pH 2.5?

[1 mark]

Concentration of H^+ ions = _____ mol/dm^3

0 5 . 7 Which element has atoms that have the same electronic structure as the chloride ion?

Use the periodic table.

[1 mark]

_____

12

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 20

June 2023 | 8462/2H | Original Q7

0 7 Manganese dioxide catalyses the decomposition of hydrogen peroxide solution.

Oxygen and water are produced.

0 7 . 1 Explain how a manganese dioxide catalyst increases the rate of decomposition of hydrogen peroxide.

[2 marks]

A student investigated the rate of this reaction.

This is the method used.

1. Add 50 cm^3 of 2.0 mol/dm^3 hydrogen peroxide solution to a conical flask.

2. Add 1.0 g of manganese dioxide to the conical flask.

3. Place the conical flask on a balance and start a timer.

4. Record the total mass lost from the conical flask every 20 seconds for 180 seconds.

0 7 . 2 Explain why the mass of the conical flask and contents decreased.

[2 marks]

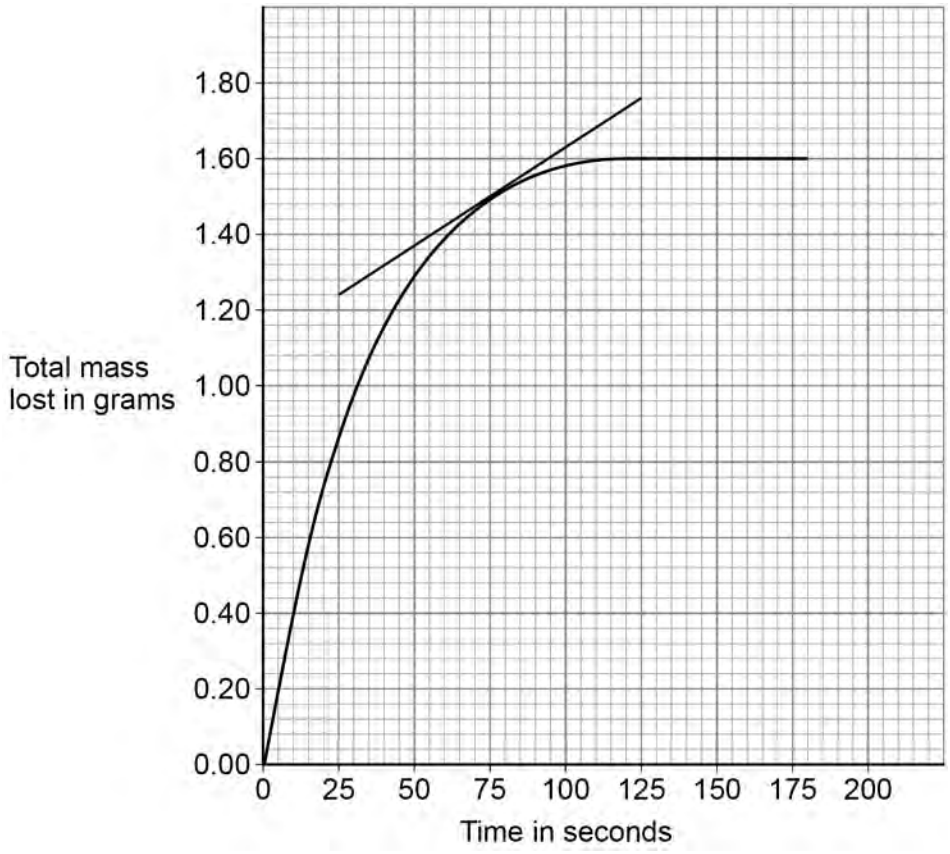
4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 20 · continued

0 7 . 3 **Figure 4** shows the results for 50 cm^3 of 2.0 mol/dm^3 hydrogen peroxide solution and 1.0 g of manganese dioxide.

A tangent to the line has been drawn at 75 seconds.

Figure 4



Determine the rate of reaction when the time was 75 seconds.

Give your answer to 2 significant figures.

[4 marks]

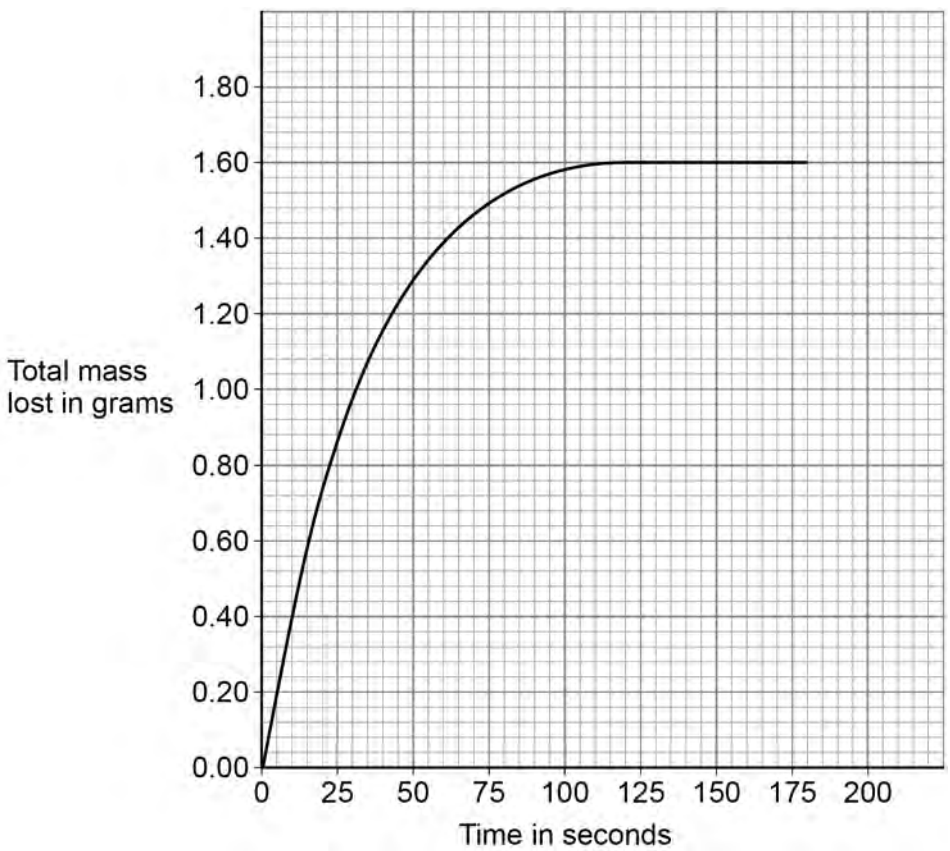
Rate (2 significant figures) = _____ g/s

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 20 · continued

0 7 . 4 The results for 50 cm^3 of 2.0 mol/dm^3 hydrogen peroxide solution and 1.0 g of manganese dioxide are shown again on **Figure 5**.

Figure 5



The student repeated the investigation using 50 cm^3 of 1.0 mol/dm^3 hydrogen peroxide solution and 1.0 g of manganese dioxide.

Sketch the expected results for 1.0 mol/dm^3 hydrogen peroxide solution on **Figure 5**.

[2 marks]

10

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 21

June 2024 | 8462/1H | Original Q9

0 9 This question is about acids and their reactions.

Acids can be either weak or strong.

0 9 . 1 What is meant by 'a **weak** acid'?

[2 marks]

0 9 . 2 Explain what happens to the pH of an acid as the acid is diluted with water.

[2 marks]

Question 9 continues on the next page

Question 21 · continued

0 9 . 3 A student does a titration to find the volume of acid needed to neutralise an alkali.

The student fills a burette with the acid.

Give **three** more steps the student must do before adding the acid to the alkali from the burette.

You should name any equipment used.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

0 9 . 4 The student titrated a solution containing 0.0045 moles of sodium hydroxide with 0.15 mol/dm^3 hydrochloric acid.

The equation for the reaction is:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Calculate the volume of hydrochloric acid in cm^3 needed in the titration.

[2 marks]

_____

_____

_____

Volume of acid = _____ cm^3

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 21 · continued

0 9 . 5 A calcium atom is larger than a magnesium atom.

Explain why calcium reacts more vigorously than magnesium with hydrochloric acid of the same concentration.

[3 marks]

12

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 22

June 2024 | 8462/2H | Original Q1

0 1 A student investigated an aqueous solution of a salt.

The student identified that the salt solution contained only sodium ions and chloride ions.

0 1 . 1 Describe a test to identify sodium ions.

Give the result of the test.

[2 marks]

Test for sodium ions _____

_____

Result _____

_____

0 1 . 2 Describe a test to identify chloride ions.

Give the result of the test.

[2 marks]

Test for chloride ions _____

_____

Result _____

_____

Question 22 · continued

The student determined the concentration of sodium chloride in the salt solution.

This is the method used.

1. Weigh an empty evaporating dish.
2. Add 25.0 cm^3 of the salt solution into the evaporating dish.
3. Heat the evaporating dish and contents.
4. Weigh the evaporating dish and contents.
5. Repeat steps 3 to 4 until there is no further change in mass.
6. Repeat steps 1 to 5 three more times.

0 1 . 3 Why did the student heat the evaporating dish and contents until the mass did not change?

[1 mark]

0 1 . 4 How did the student calculate the mass of solid sodium chloride remaining after steps 1 to 5?

[1 mark]

Tick (✓) **one** box.

- Mass of 25 cm^3 of salt solution + mass of empty evaporating dish ☐
- Mass of 25 cm^3 of salt solution – mass of empty evaporating dish ☐
- Mass of evaporating dish and dry contents + mass of empty evaporating dish ☐
- Mass of evaporating dish and dry contents – mass of empty evaporating dish ☐

Question 1 continues on the next page

Question 22 · continued

0 1 . 5 The student calculated the concentration of sodium chloride in the salt solution.

Table 1 shows the results.

Table 1

Concentration of sodium chloride in g/dm^3			
Trial 1	**Trial 2**	**Trial 3**	**Trial 4**
35.2	34.6	36.4	33.8

The percentage by mass of sodium ions in sodium chloride is 39.3%.

Calculate the mean concentration of sodium ions in the salt solution.

[4 marks]

Mean concentration = _____ g/dm^3

10

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 23

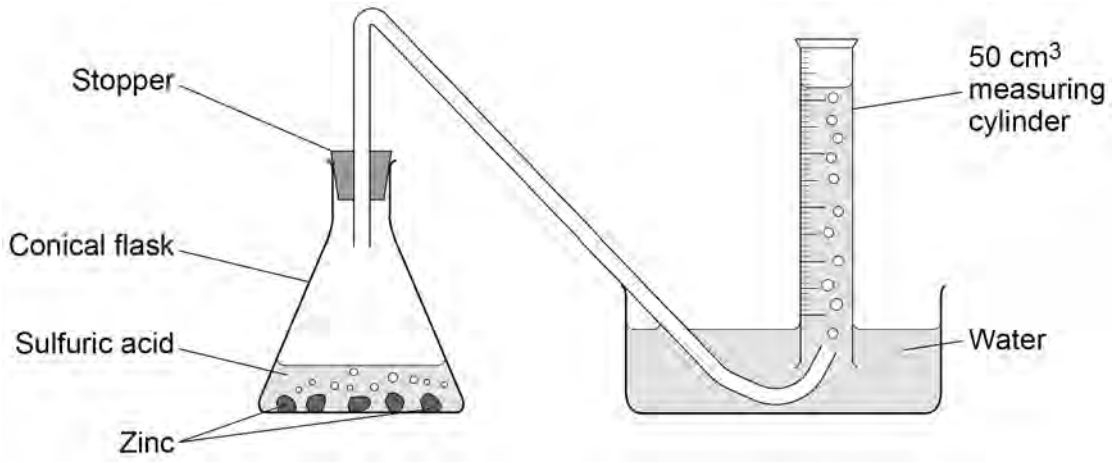
0 9 A student investigated the rate of the reaction between zinc and sulfuric acid.

The equation for the reaction is

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

Figure 10 shows the apparatus.

Figure 10



This is the method used.

1. Pour 50 cm^3 of sulfuric acid into the conical flask.
2. Add excess zinc to the conical flask.
3. Insert the stopper and start a timer.
4. Measure the volume of hydrogen collected in the 50 cm^3 measuring cylinder every 20 seconds for 180 seconds.

0 9 . 1 Explain why the volume of hydrogen collected in the 50 cm^3 measuring cylinder is less than the volume of hydrogen produced.

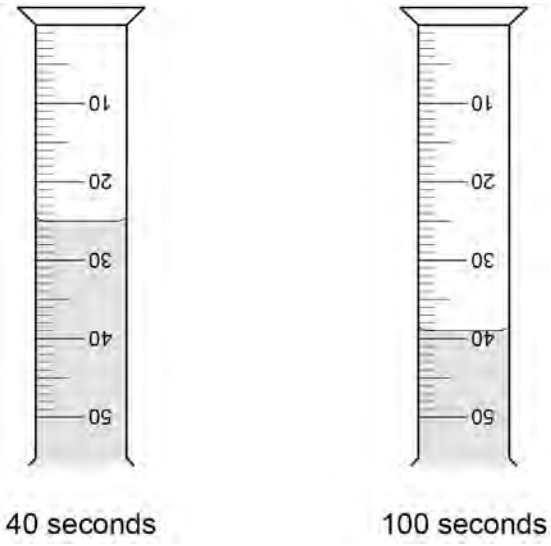
[2 marks]

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 23 · continued

Figure 11 shows the volumes of hydrogen collected in the 50 cm^3 measuring cylinder after 40 seconds and after 100 seconds.

Figure 11



0 9 . 2 Determine the number of moles of hydrogen collected between 40 seconds and 100 seconds.

The volume of one mole of any gas at room temperature and pressure is 24 dm^3.

[4 marks]

Moles of hydrogen = _____

Question 9 continues on the next page

Question 23 · continued

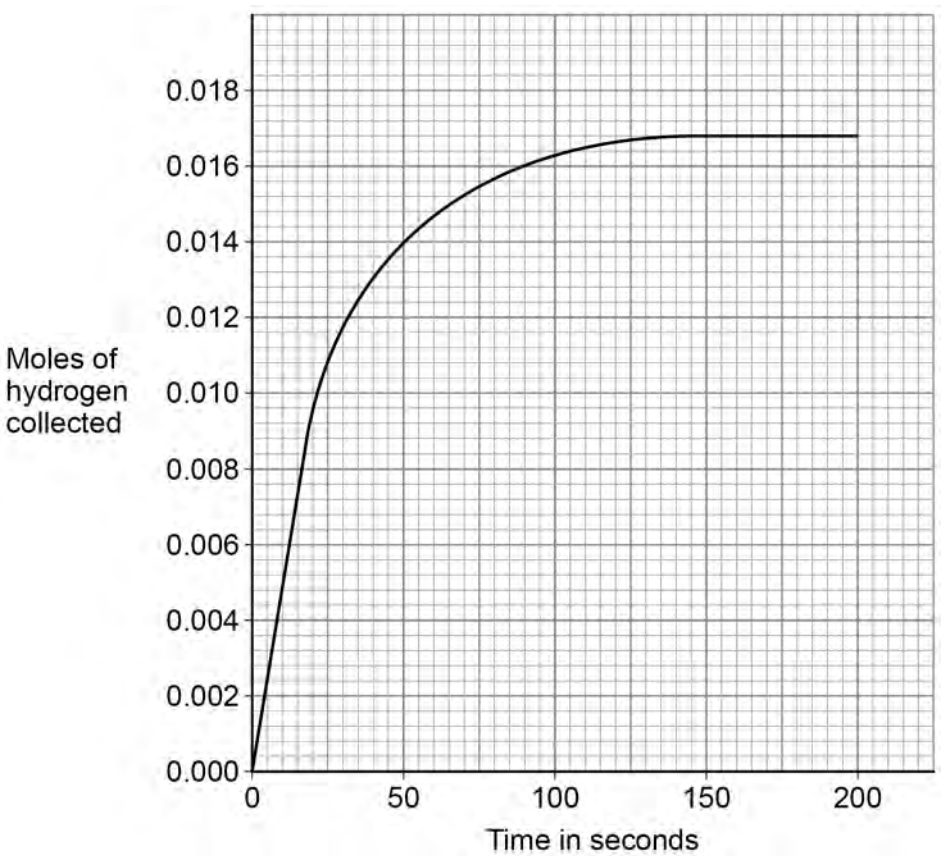
A different student investigated how the concentration of sulfuric acid affected the rate of the reaction.

0 9 . 3 The student did a different experiment using sulfuric acid of concentration 0.40 mol/dm^3.

The student calculated the number of moles of hydrogen collected after every 20 seconds.

Figure 12 shows the results.

Figure 12



4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 23 · continued

Determine the rate of reaction at 45 seconds.

You should draw a tangent on **Figure 12**.

Give your answer in standard form.

[5 marks]

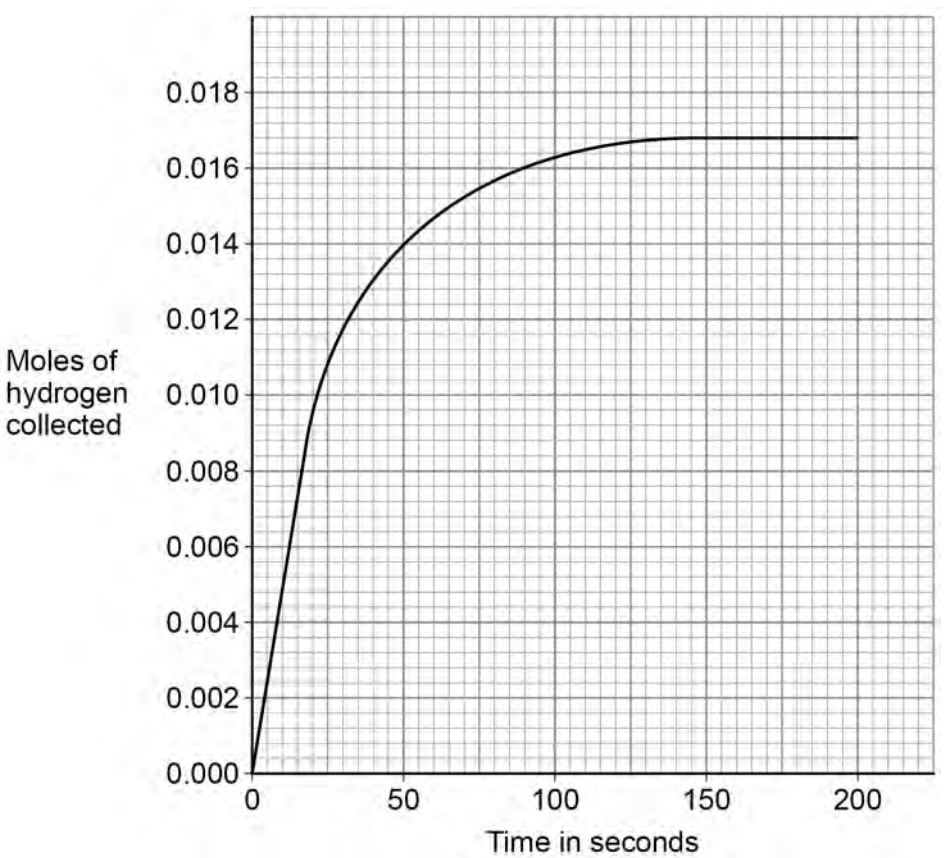
Rate of reaction (in standard form) = _____ mol/s

Question 9 continues on the next page

Question 23 · continued

0 9 . 4 **Figure 13** shows the results for 0.40 mol/dm^3 sulfuric acid.

Figure 13



The student repeated the experiment using 0.20 mol/dm^3 sulfuric acid instead of 0.40 mol/dm^3 sulfuric acid.

Excess zinc was used in each experiment.

Sketch a line on **Figure 13** to show the results you would expect.

[2 marks]

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 23 · continued

June 2024 | 8462/2H | Original Q9

0 9 . 5 Explain how increasing the temperature would affect the rate of reaction between zinc and sulfuric acid.

[3 marks]

16

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 24

June 2025 | 8462/1H | Original Q8

0 8 This question is about alkalis and acids.

0 8 . 1 What is the formula of the ion that **all** alkalis contain when in solution?

[1 mark]

_____

A student planned a titration experiment to determine the concentration of a sodium hydroxide solution.

This is the student's plan.

1. Measure 25.0 cm^3 of sulfuric acid of known concentration using a pipette.
2. Add the sulfuric acid to a conical flask.
3. Add 3 drops of universal indicator to the conical flask.
4. Place the conical flask on a white tile.
5. Fill a burette with sodium hydroxide solution to the 0.00 cm^3 mark.
6. Add sodium hydroxide solution to the conical flask and swirl the flask.
7. Stop adding sodium hydroxide solution when there is a colour change.
8. Record the volume of sodium hydroxide solution used.
9. Repeat steps 1 to 8 until consistent results are obtained.

0 8 . 2 Suggest **two** improvements to the plan.

Give **one** reason for each improvement.

[4 marks]

Improvement 1 _____

_____

Reason _____

_____

Improvement 2 _____

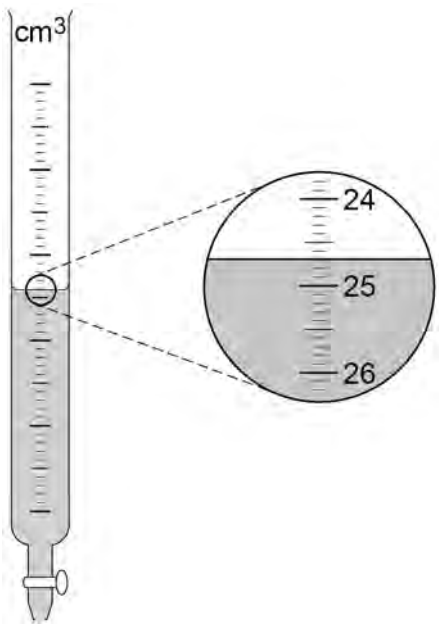
_____

Reason _____

_____

0 8 . 3 **Figure 9** shows the burette after one titration.

Figure 9



What is the reading on the burette?

[1 mark]

_____ cm^3

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 24 · continued

0 8 . 4 In a different titration, 25.0 cm^3 of 0.216 mol/dm^3 sulfuric acid needed 11.25 cm^3 of sodium hydroxide solution for neutralisation.

The equation for the reaction is:

$$2\ NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2\ H_2O$$

Calculate the concentration of the sodium hydroxide solution.

[4 marks]

Concentration = _____ mol/dm^3

Question 8 continues on the next page

Question 24 · continued

Table 4 gives information about solutions of two acids.

Table 4

Formula of acid	Concentration of solution in mol/dm^3	Percentage (%) of acid molecules that are ionised
HCl	0.1	100
HCN	2.0	0.01

0 8 . 5 Which is a correct statement about the solutions of HCl and HCN in **Table 4**?

[1 mark]

Tick (✓) **one** box.

The HCl is a more concentrated and stronger acid than the HCN. ☐

The HCl is a more concentrated and weaker acid than the HCN. ☐

The HCl is a more dilute and stronger acid than the HCN. ☐

The HCl is a more dilute and weaker acid than the HCN. ☐

0 8 . 6 In **Table 4**, the solution of HCl has a lower pH than the solution of HCN.

Explain why.

Use the data in **Table 4**.

[2 marks]

13

4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only)

Question 25

0 6 A student analysed three solutions, **A**, **B** and **C**.

Each solution contained one ionic compound.

The student added a few drops of sodium hydroxide solution to solution **A**.

Solution **A** produced a white precipitate.

Aluminium ions produce a white precipitate with a few drops of sodium hydroxide solution.

0 6 . 1 Name **one other** metal ion which produces a white precipitate with a few drops of sodium hydroxide solution.

[1 mark]

_____

0 6 . 2 Describe how the student could confirm the presence of aluminium ions in solution **A**.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

The student tested solution **B** to identify the ions present.

0 6 . 3 The student did a flame test on solution **B**.

An orange-red flame was produced.

Write the symbol for the metal ion in solution **B**.

[1 mark]

_____

0 6 . 4 The student added dilute nitric acid followed by silver nitrate solution to solution **B**.

A white precipitate was produced.

Write the symbol for the non-metal ion in solution **B**.

[1 mark]

_____

Question 6 continues on the next page

Question 25 · continued

The student added 1.0 mol/dm^3 nitric acid to solution **C**.

Bubbles of gas were produced.

0 6 . 5 Describe a test on the bubbles of gas that confirms that solution **C** contained carbonate ions.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 6 . 6 The student repeated the test on solution **C** using 1.0 mol/dm^3 ethanoic acid instead of 1.0 mol/dm^3 nitric acid.

Bubbles of gas were produced more slowly using ethanoic acid.

Explain why.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

11