AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.3.2.5

Concentration of solutions

Past-paper questions

Tier	**Higher**
Question groups	**15**
Available paper years	**2007–2025**

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.

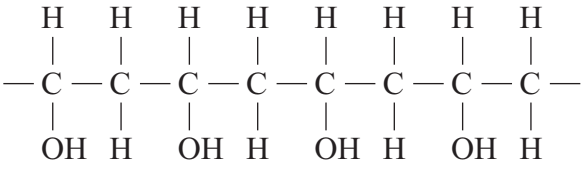
4.3.2.5 Concentration of solutions

Question 01

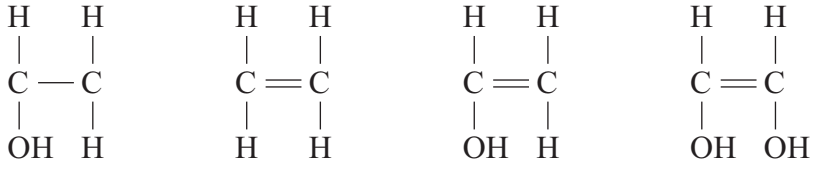
June 2007 | CHY1B | Original Q4 | Legacy

QUESTION FOUR

Poly(vinyl alcohol) has this structure:



4A The monomer from which poly(vinyl alcohol) is made can be represented by . . .



1 **2** **3** **4**

Poly(vinyl alcohol) reacts with a solution of sodium borate to form 'slime'.
Slime can be fluid or, when almost solid, it can retain its shape.

A student measured the relationship between the spread of a lump of slime and the concentration of the sodium borate solution used to make it.
She called this 'the slump test'.

The student followed this procedure:

- make a sample of slime using 50 cm^3 of 4 % poly(vinyl alcohol) solution and 5 cm^3 of a 1 % solution of sodium borate
- stir the mixture for 2 minutes
- measure out 50 cm^3 of the slime produced and make this into a disc shape
- place this disc on paper and mark its outline with a pencil line
- leave for 5 minutes
- mark the new outline of the slime with a pencil
- calculate the increase in area of the disc
- repeat, using different concentrations of sodium borate to make the slime.

4B The student would have achieved greater accuracy in the test if she had . . .

1 used a smaller piece of slime.

2 stirred the reacting mixture for more than 2 minutes.

3 allowed the slime to spread for less than 5 minutes.

4 controlled the starting area of the slime discs.

Question 01 · continued

4C One variable that she did not control was . . .

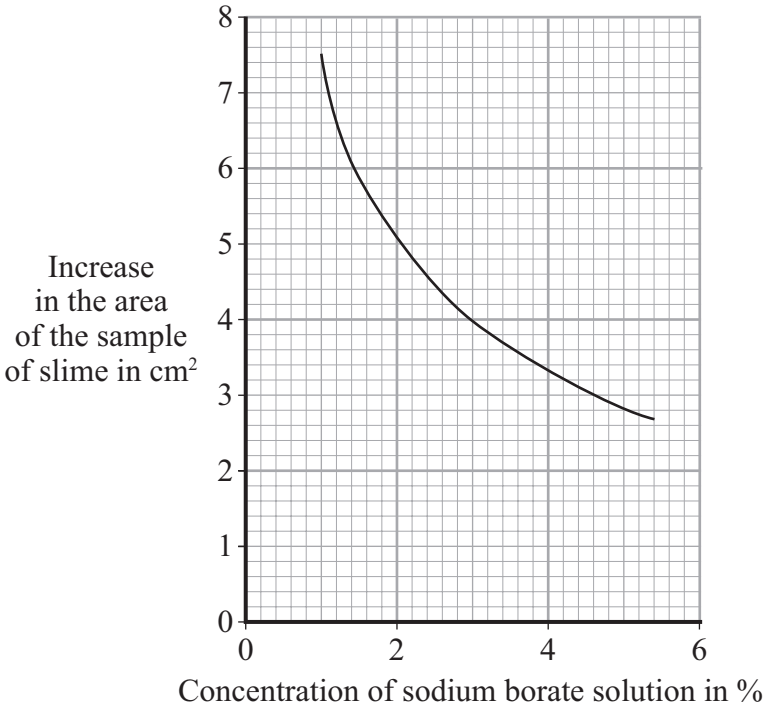
1 the concentration of the poly(vinyl alcohol).

2 the room temperature during the slump test.

3 the volume of the sodium borate solution.

4 the volume of the slime.

4D The student's results are shown on the graph.



The graph shows that . . .

1 the increase in area is directly proportional to the concentration of the sodium borate solution.

2 there is a linear relationship between the increase in area and the concentration of the sodium borate solution.

3 the increase in area is reduced as the sodium borate solution becomes more concentrated.

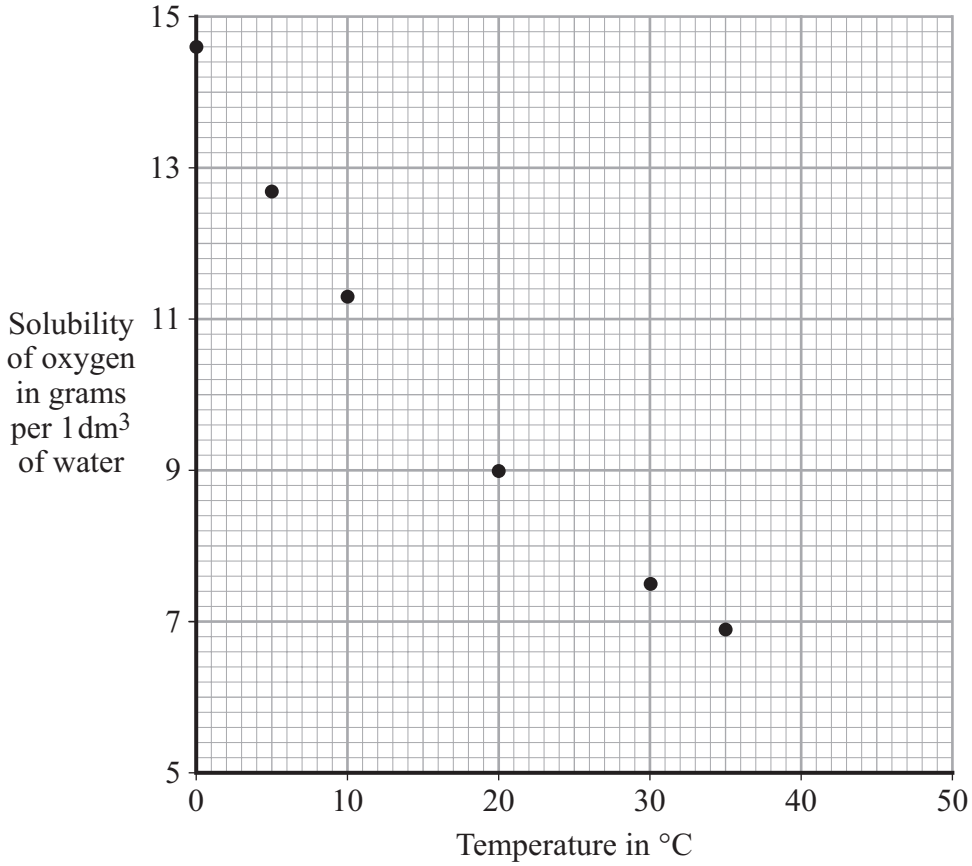
4 there is no relationship between the size of the disc and the concentration of the sodium borate solution.

4.3.2.5 Concentration of solutions

Question 02

January 2008 | CHY3H | Original Q2 | Legacy

2 The points on the graph show the mass of oxygen that dissolves in 1 dm^3 of water at different temperatures.



Use the graph to answer the following questions.

(a) (i) Draw a smooth curve through the points, extending your curve to 50 °C.

(1 mark)

(ii) Use your curve to estimate the mass of oxygen that dissolves in 1 dm^3 of water at 50 °C.

Mass = ... g

(1 mark)

4.3.2.5 Concentration of solutions

Question 02 · continued

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(iii) What mass of oxygen gas comes out of 1 dm^3 of water when the temperature increases from 15 °C to 50 °C?

.....

.....

Mass = ... g

(2 marks)

(iv) A student claimed that they were more sure of the value at 15 °C than the value at 50 °C.

Do you agree? Explain the reason for your answer.

.....

.....

(1 mark)

Question 2 continues on the next page

4.3.2.5 Concentration of solutions

Question 02 · continued

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(b) Read the following information and then answer the questions.

Dissolved oxygen is essential for aquatic life. For example, trout need about 7 g/dm^3 of dissolved oxygen. They can live in concentrations down to about 5 g/dm^3 for short periods but are likely to die if the water temperature is above 26 °C.

The amount of oxygen dissolved in water depends on many factors, including whether it is summer or winter, day or night. Factors such as photosynthesis and the action of wind add oxygen to water. Respiration of aquatic plants at night, decomposition of organic matter and higher temperatures remove oxygen.

The management of a factory wants to put small amounts of waste hot water at 50 °C directly into a lake that contains trout. The local council has objected to this proposal and there is to be an Independent Public Enquiry.

(i) Suggest why it is important to have an Independent Public Enquiry into adding hot water to this lake.

.....

.....

(1 mark)

(ii) Suggest how the experience and status of the people giving evidence at the Public Enquiry could influence the final decision.

.....

.....

(1 mark)

4.3.2.5 Concentration of solutions

Question 02 · continued

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(iii) At the Public Enquiry, the factory management and the council gave their opinions. Suggest what these opinions were by completing the sentences.

The factory management said that there was **no** risk to the trout because .....

.....

.....

.....

The council said that there **was** a risk to the trout because .....

.....

.....

.....

(2 marks)

9

4.3.2.5 Concentration of solutions

Question 03

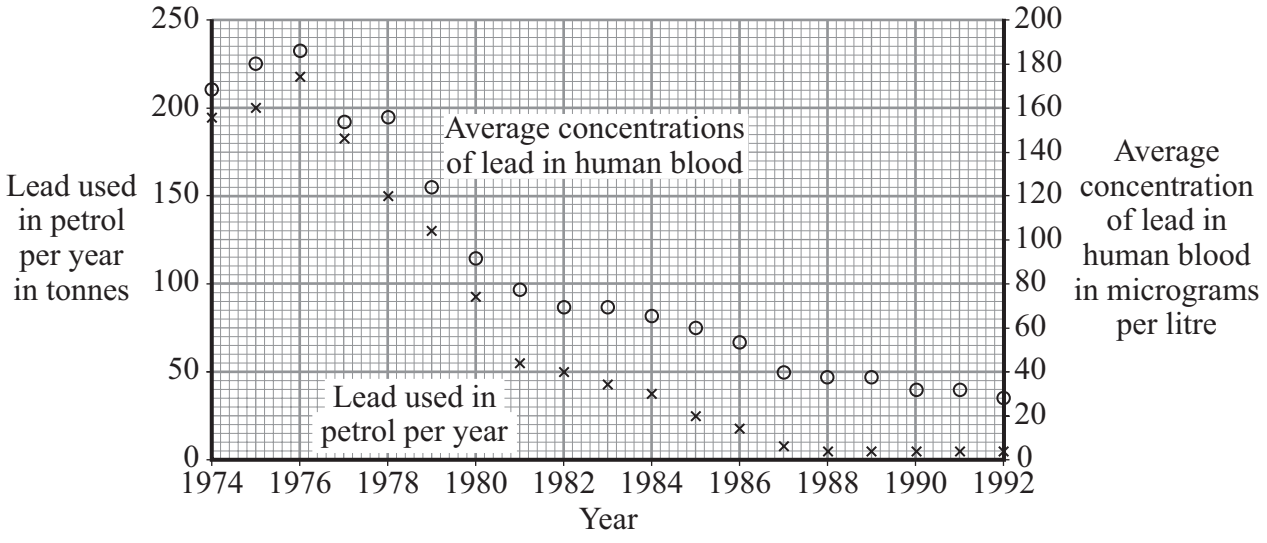
June 2009 | CHY1AP | Original Q8 | Legacy

QUESTION EIGHT

Lead compounds were added to petrol to improve its performance. The lead compounds leave the engine through the exhaust system.
During the 1970s, unleaded petrol was introduced, and between the 1970s and the 1990s leaded petrol was gradually removed from sale in petrol stations.

The information in the graph was collected from one area of North America between 1974 and 1992.
The graph shows:

- the amounts of lead used in petrol (×)
- the average concentrations of lead in human blood (○).



8A What conclusion can be drawn from the graph?

1 Lead concentration in human blood is always greater than the amount of lead used.

2 There is a positive correlation between lead concentration in human blood and the year.

3 There is a positive correlation between the amount of lead used and the concentration of lead in human blood.

4 Lead concentration in human blood and the amount of lead used per year were almost the same in 1977.

4.3.2.5 Concentration of solutions

Question 03 · continued June 2009 | CHY1AP | Original Q8 | Legacy

8B The lead concentration in human blood will probably **not** drop to zero because . . .

1 some people will store leaded petrol.

2 lead will get into human blood from other sources.

3 scientists find it difficult to measure small quantities of lead.

4 lead concentrations rise when more unleaded petrol is burned during the summer months.

8C The points plotted on the graph for the average concentration of lead in human blood are always above the points plotted for the amount of lead used in petrol.

This is because . . .

1 micrograms per litre is a larger unit than tonnes.

2 people inhale fumes from petrol every day, so it accumulates.

3 the units are different and the scale for the *y*-axis for concentration in human blood creates a higher line.

4 the efficiency of the engine has been reduced, increasing the petrol consumption.

8D Which row in the table shows an advantage and a disadvantage of using unleaded petrol?

	Advantage	Disadvantage
1	Less lead released into the air	A replacement additive was needed and it cost a lot to develop
2	Cars will travel shorter distances	Lead will not be used as much
3	Lead levels in human blood will decrease	Companies will lose money removing lead from petrol
4	Less money will be spent on removing lead from petrol	Companies will need to store the lead removed from petrol

4.3.2.5 Concentration of solutions

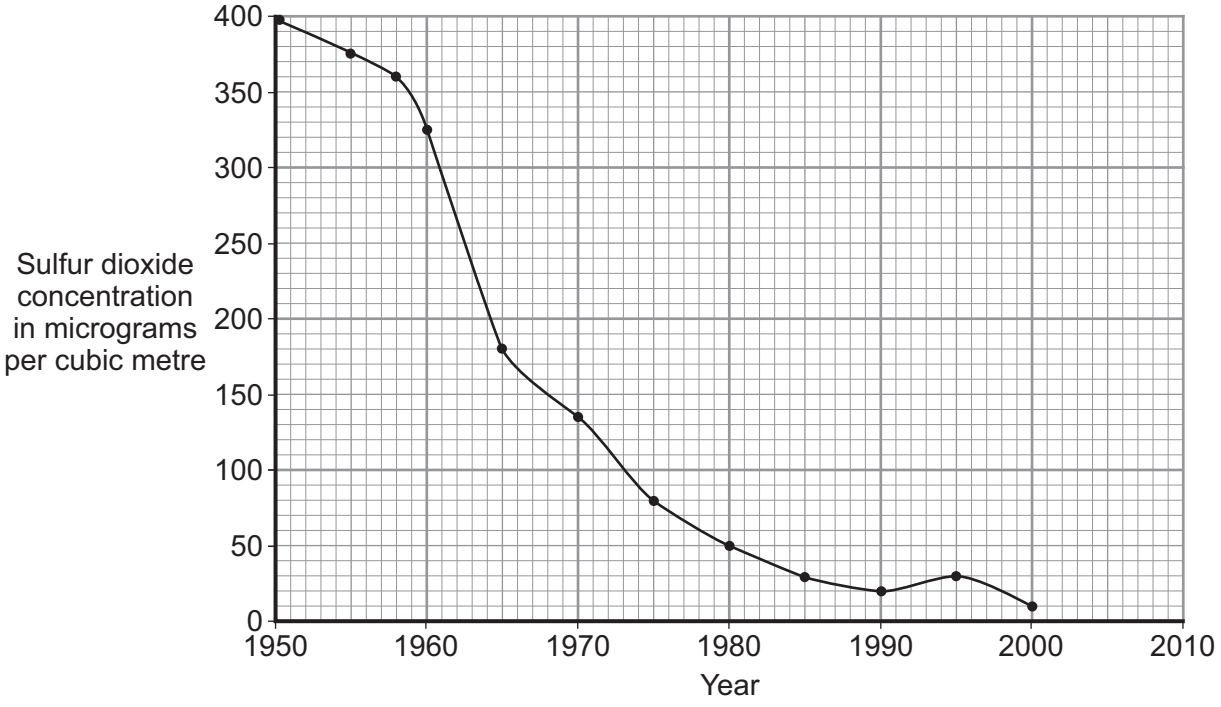
Question 04

June 2010 | CHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The graph shows how sulfur dioxide concentrations in the atmosphere above London changed between 1950 and 2000.

The table shows the energy used in London in 1950 and in 2000.



Year	Energy used in arbitrary units							
	Petrol	Diesel	Electricity	Oil	House coal	Other solid fuels	Gas	Total
1950	10	5	20	25	100	110	60	330
2000	60	20	130	10	0	10	310	540

7A The information in the graph and table suggests that sulfur dioxide levels have decreased due to . . .

1 an increase in the use of petrol.

2 a decrease in the use of coal and other solid fuels.

3 an increase in the use of electricity that is generated at coal-burning power stations.

4 an increase in the use of diesel.

4.3.2.5 Concentration of solutions

Question 04 · continued

7B Which one of the following is a reason why a prediction for sulfur dioxide concentration in 2010 might be unreliable?

1 Sulfur dioxide has a natural cycle in London of increasing and decreasing.

2 Sulfur dioxide dissolves in water to produce acid rain.

3 The concentration of sulfur dioxide has, in previous years, both increased and decreased.

4 Sulfur dioxide is very difficult to measure in such small concentrations.

7C It was found that the amount of sulfur dioxide from transport increased during years 2000 to 2004, even though many more cars were using low-sulfur fuels.

The reason for this could be . . .

1 a decrease in the use of transport.

2 the introduction of more efficient cars that burn less fuel.

3 an increase in the number of cars used in London.

4 an increase in the price of crude oil.

7D A newspaper published an article about sulfur dioxide concentrations in the atmosphere above London. It stated that in one five-year period, sulfur dioxide levels had fallen by about 44 %.

The five-year period was . . .

1 1960–1965.

2 1965–1970.

3 1985–1990.

4 1995–2000.

4.3.2.5 Concentration of solutions

Question 05

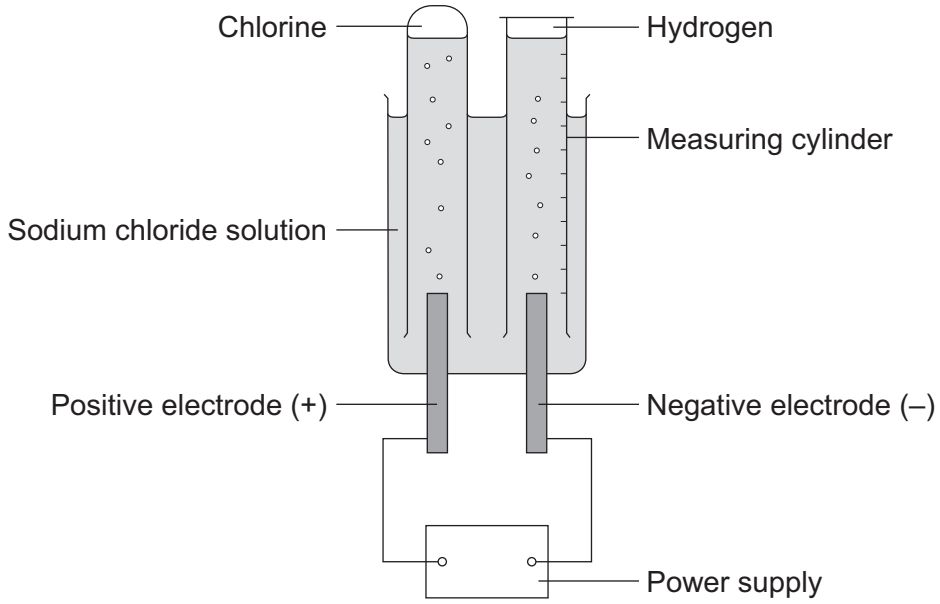
1 A student investigated the electrolysis of sodium chloride solution.

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.

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

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

.....

.....

(1 mark)

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

Why are chloride ions attracted to the positive electrode?

.....

(1 mark)

Question 1 continues on the next page

4.3.2.5 Concentration of solutions

Question 05 · continued

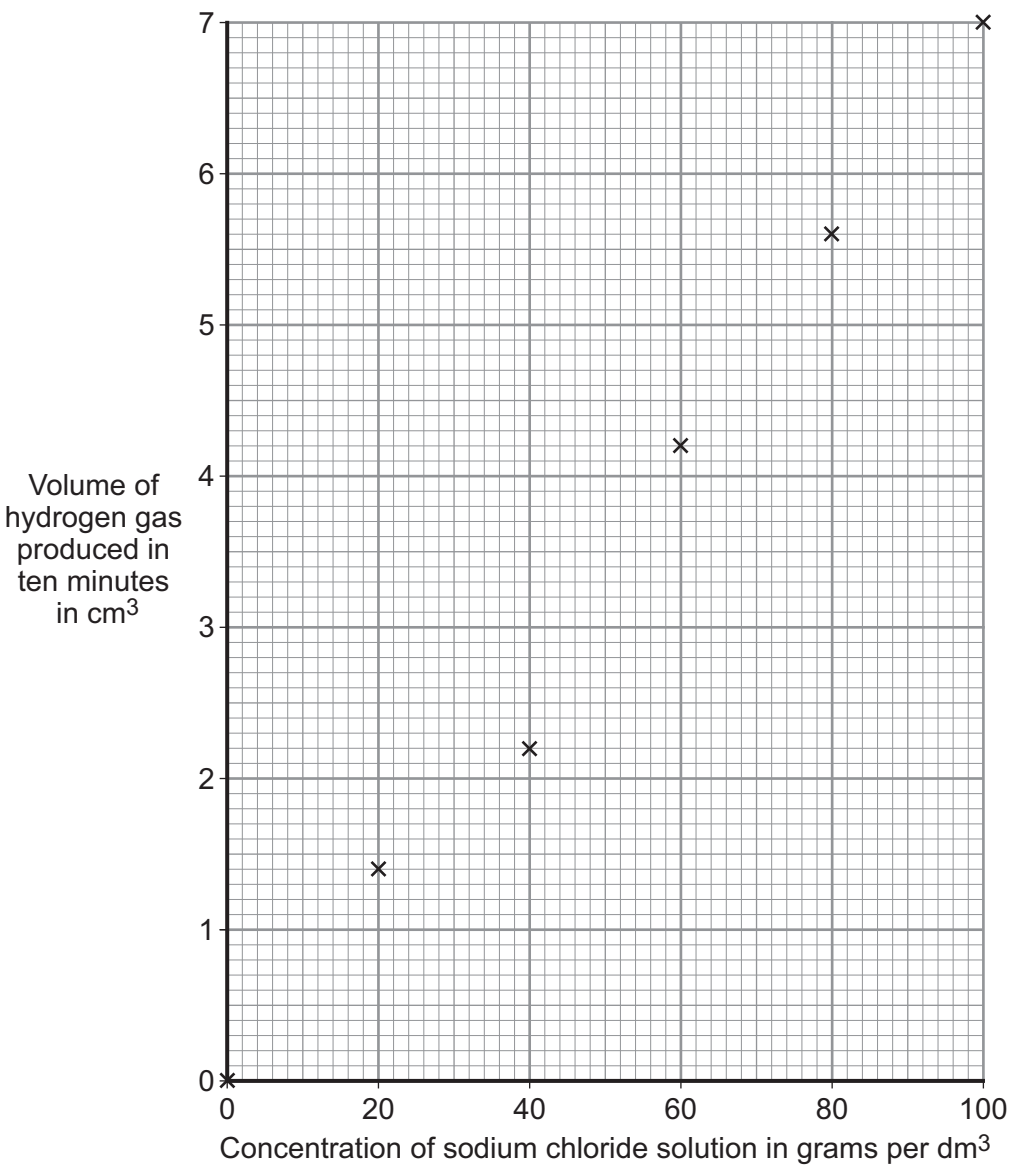
1 (c) The solution left at the end of each experiment contains sodium hydroxide.

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

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

(1 mark)

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



4.3.2.5 Concentration of solutions

Question 05 · continued

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

(1 mark)

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

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

(1 mark)

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

1 .....

.....

2 .....

.....

(2 marks)

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

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(1 mark)

1 (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)

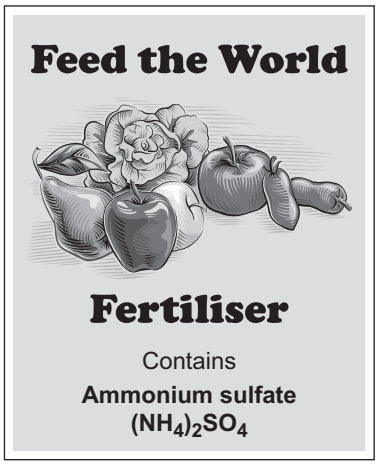
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4.3.2.5 Concentration of solutions

Question 06

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 .....

.....

(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)

4.3.2.5 Concentration of solutions

Question 06 · 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.

.....

.....

.....

Concentration = ... grams per cubic decimetre

(2 marks)

11

4.3.2.5 Concentration of solutions

Question 07

June 2015 | CH3HP | Original Q7 | Legacy

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.

4.3.2.5 Concentration of solutions

Question 07 · 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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8

4.3.2.5 Concentration of solutions

Question 08

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

4.3.2.5 Concentration of solutions

Question 08 · continued

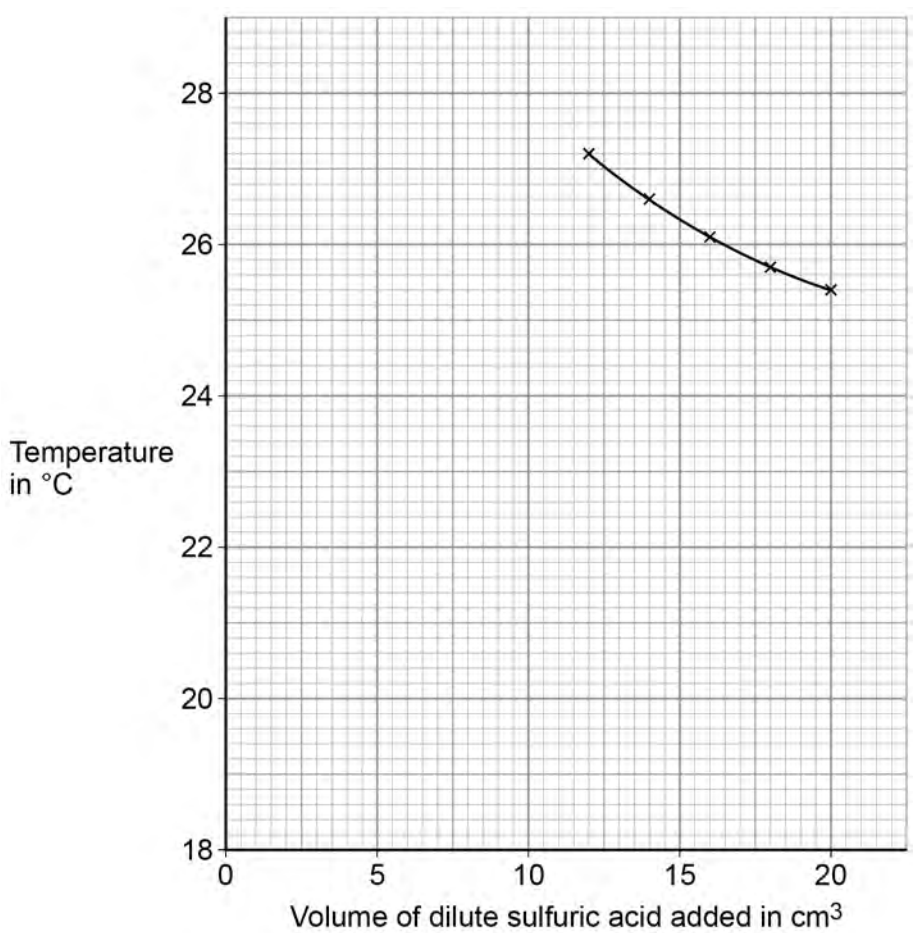
Table 6 shows some of the student's results.

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



4.3.2.5 Concentration of solutions

Question 08 · 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

4.3.2.5 Concentration of solutions

Question 08 · 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

4.3.2.5 Concentration of solutions

Question 09

November 2020 | 8462/1H | Original Q3

0 3 This question is about silver iodide.

Silver iodide is produced in the reaction between silver nitrate solution and sodium iodide solution.

The equation for the reaction is:

$$AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$$

0 3 . 1 A student investigated the law of conservation of mass.

This is the method used.

1. Pour silver nitrate solution into a beaker labelled **A**.
2. Pour sodium iodide solution into a beaker labelled **B**.
3. Measure the masses of both beakers and their contents.
4. Pour the solution from beaker **B** into beaker **A**.
5. Measure the masses of both beakers and their contents again.

Table 3 shows the student's results.

Table 3

	Mass before mixing in g	**Mass after mixing in g**
Beaker **A** and contents	78.26	108.22
Beaker **B** and contents	78.50	48.54

Explain how the results demonstrate the law of conservation of mass.

You should use data from **Table 3** in your answer.

[2 marks]

4.3.2.5 Concentration of solutions

Question 09 · continued

0 3 . 2 Suggest how the student could separate the insoluble silver iodide from the mixture at the end of the reaction.

[1 mark]

The student purified the separated silver iodide.

This is the method used.

1. Rinse the silver iodide with distilled water.

2. Warm the silver iodide.

0 3 . 3 Suggest **one** impurity that was removed by rinsing with water.

[1 mark]

0 3 . 4 Suggest why the student warmed the silver iodide.

[1 mark]

Question 3 continues on the next page

4.3.2.5 Concentration of solutions

Question 09 · continued

0 3 . 5 Calculate the percentage atom economy for the production of silver iodide in this reaction.

The equation for the reaction is:

$$AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$$

Give your answer to 3 significant figures.

Relative formula masses (M_r): $AgNO_3 = 170$ NaI = 150 AgI = 235 $NaNO_3 = 85$

[4 marks]

Percentage atom economy (3 significant figures) = _____ %

0 3 . 6 Give **one** reason why reactions with a high atom economy are used in industry.

[1 mark]

10

4.3.2.5 Concentration of solutions

Question 10

November 2020 | 8462/1H | Original Q9

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.

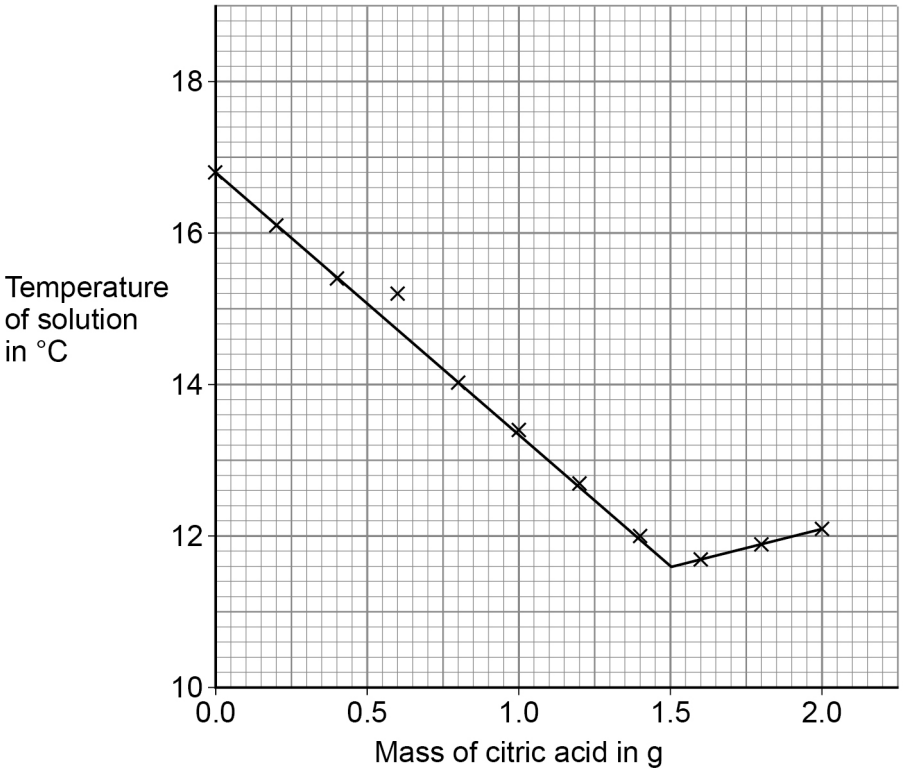
5. Measure the temperature of the solution.

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



4.3.2.5 Concentration of solutions

Question 10 · 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]

4.3.2.5 Concentration of solutions

Question 10 · 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]

4.3.2.5 Concentration of solutions

Question 10 · 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

4.3.2.5 Concentration of solutions

Question 11

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 ☐

4.3.2.5 Concentration of solutions

Question 11 · 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

4.3.2.5 Concentration of solutions

Question 11 · continued

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

4.3.2.5 Concentration of solutions

Question 12

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]

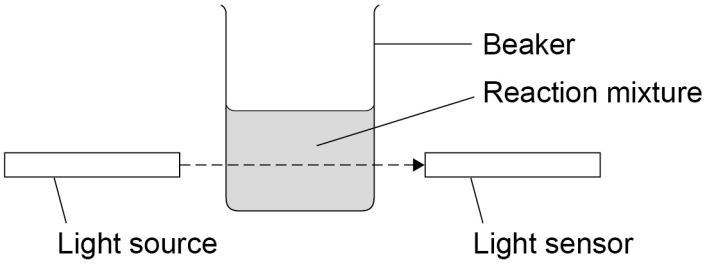
4.3.2.5 Concentration of solutions

Question 12 · 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.

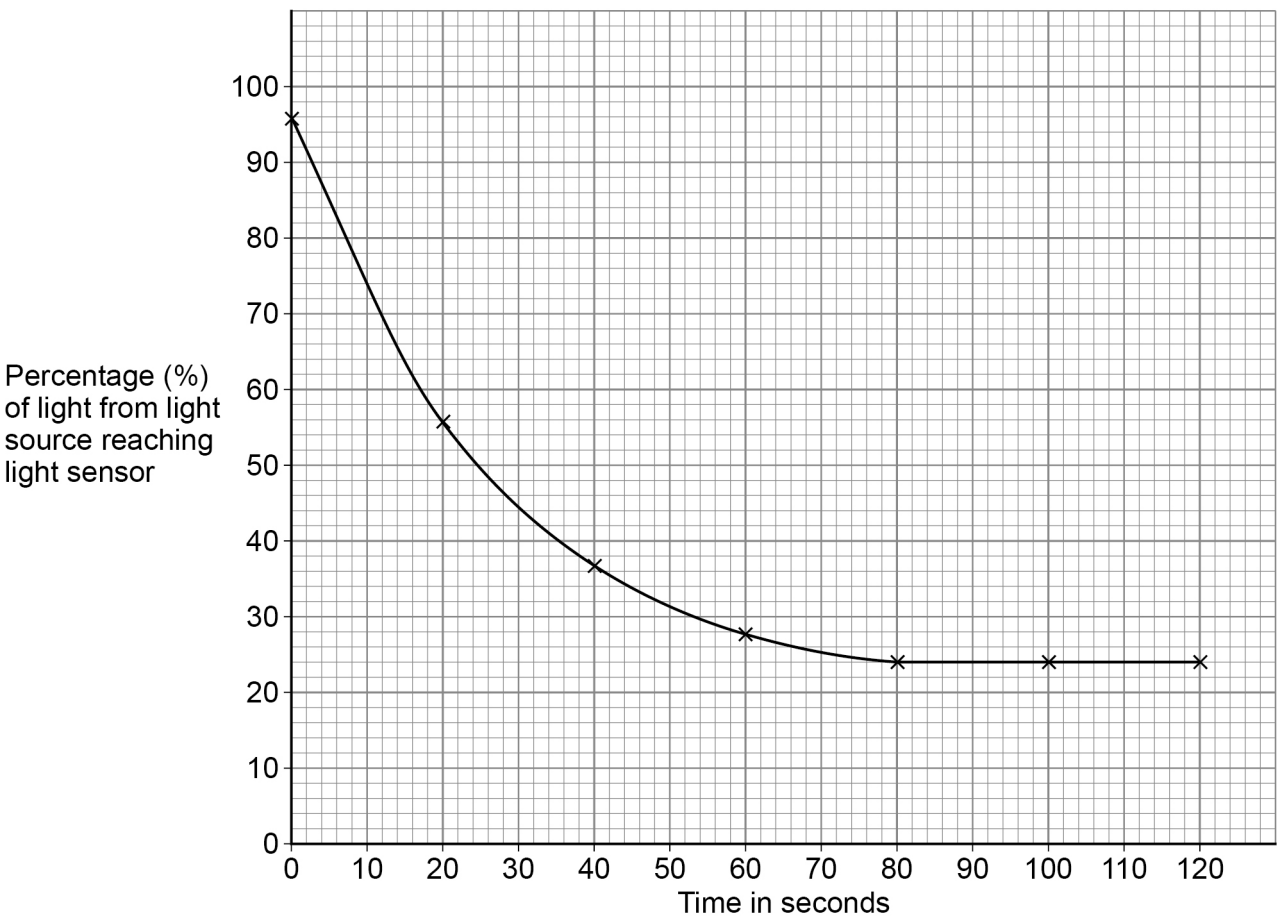
Question 8 continues on the next page

4.3.2.5 Concentration of solutions

Question 12 · continued

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

Figure 7



4.3.2.5 Concentration of solutions

Question 12 · 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]

4.3.2.5 Concentration of solutions

Question 12 · continued

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

Figure 8

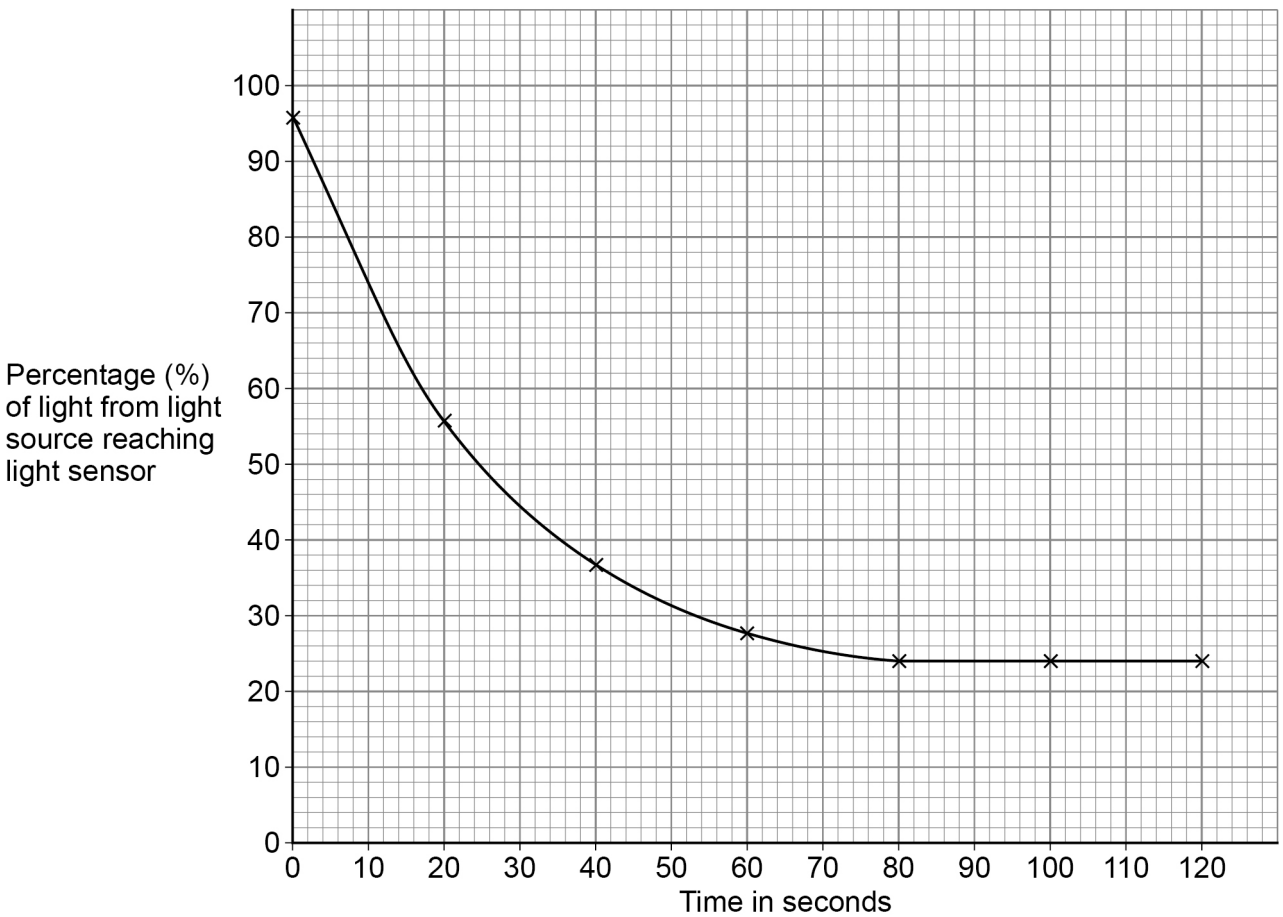


Figure 8 shows the results for 0.10 mol/dm^3 sodium thiosulfate solution.

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]

4.3.2.5 Concentration of solutions

Question 12 · 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 ☐

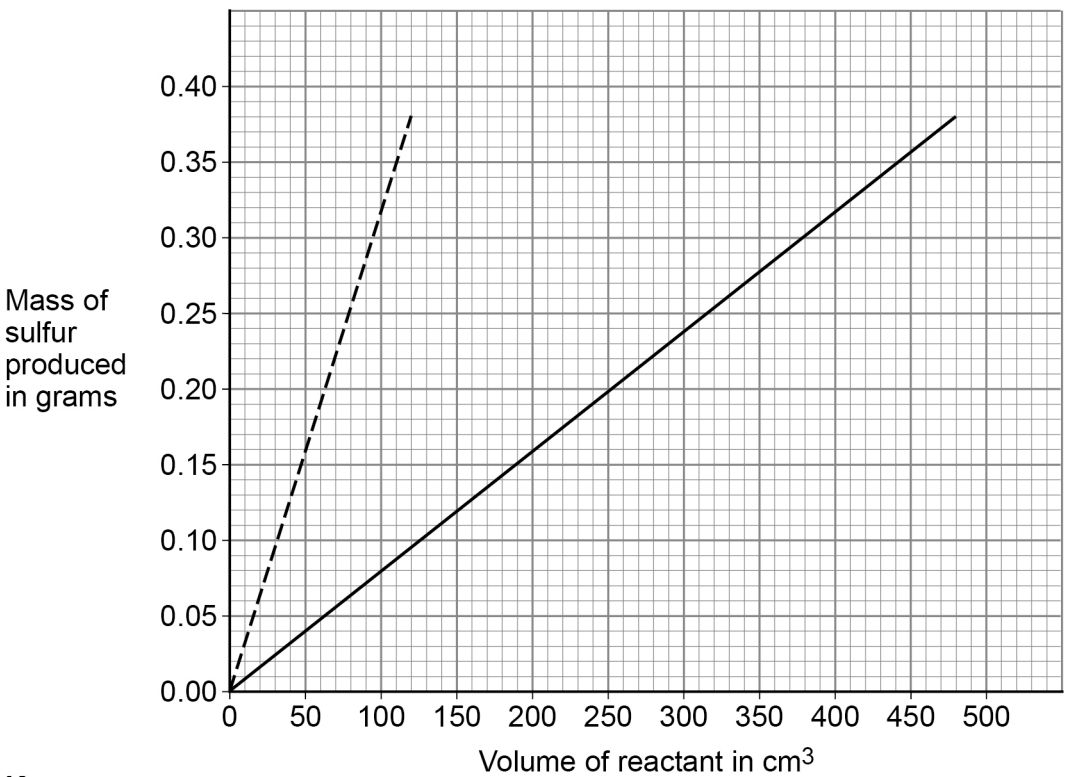
Question 12 · continued

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

4.3.2.5 Concentration of solutions

Question 12 · 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

4.3.2.5 Concentration of solutions

Question 13

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 _____

4.3.2.5 Concentration of solutions

Question 13 · 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

4.3.2.5 Concentration of solutions

Question 13 · 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

4.3.2.5 Concentration of solutions

Question 14

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 _____

_____

4.3.2.5 Concentration of solutions

Question 14 · 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

4.3.2.5 Concentration of solutions

Question 14 · 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

4.3.2.5 Concentration of solutions

Question 15

June 2025 | 8462/2H | Original Q1

0 1 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 1 . 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 1 . 2 What was the dependent variable in this investigation?

[1 mark]

0 1 . 3 Describe how the student could make sure **all** of the water had evaporated in **step 3**.

[2 marks]

0 1 . 4 How did the student calculate the mass of dissolved solids in each sea water sample?

[1 mark]

Question 15 · continued

Table 1 shows the results.

Table 1

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

0 1 . 5 Calculate the mean concentration of dissolved solids in 10.0 cm^3 samples of sea water **A**, **B**, **C** and **D**.

Use **Table 1** 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 1 . 6 Suggest why sea water samples **A**, **B**, **C** and **D** contain different masses of dissolved solids.

[1 mark]

11