AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.4.2.3

Soluble salts

Past-paper questions

Tier	**Higher**
Question groups	**34**
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.

4.4.2.3 Soluble salts

Question 01

January 2008 | CHY2H | Original Q5 | Legacy

5 Distress flares are used to attract attention in an emergency.



Flares often contain the element magnesium. Magnesium burns to form magnesium oxide.

(a) The distress flare burns with a bright flame because the reaction is very *exothermic*.

State the meaning of *exothermic*.

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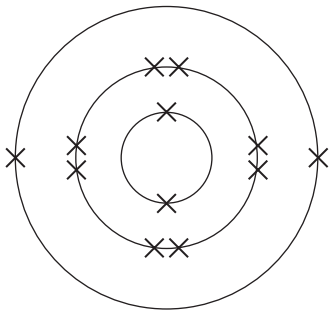
(1 mark)

(b) Write a balanced symbol equation for the reaction between magnesium (Mg) and oxygen (O_2) to form magnesium oxide (MgO).

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(1 mark)

(c) The diagram shows the electronic structure of a magnesium atom.
The atomic (proton) number of magnesium is 12.



Magnesium atom

Draw a similar diagram to show the electronic structure of an oxygen atom.
The atomic (proton) number of oxygen is 8.

(1 mark)

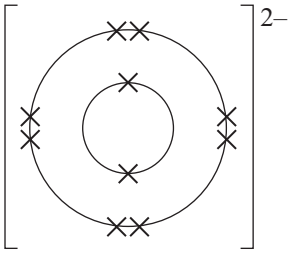
4.4.2.3 Soluble salts

Question 01 · continued

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(d) Magnesium ions and oxide ions are formed when magnesium reacts with oxygen.

The diagram shows the electronic structure of an oxide ion.



Oxide ion

Draw a similar diagram to show the electronic structure of a magnesium ion.

(1 mark)

(e) Magnesium oxide is a white solid with a high melting point.

Explain how the ions are held together in solid magnesium oxide.

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(2 marks)

(f) Indigestion tablets can be made from magnesium oxide. The magnesium oxide neutralises some of the hydrochloric acid in the stomach.

Complete the word equation for the reaction between magnesium oxide and hydrochloric acid.

hydrochloric acid + magnesium oxide → ..... + water.

(1 mark)

7

4.4.2.3 Soluble salts

Question 02

January 2008 | CHY2H | Original Q6 | Legacy

6 Photographic film often contains silver bromide. Silver bromide is changed by light to form silver which appears as a black solid. This darkens the photographic film.

A photographic film can be made by coating thin transparent plastic with a gel containing silver bromide.

The main steps in making this photographic film are as follows:

Step 1 Gelatine is dissolved in warm water to make a solution.

Step 2 Compound **A**, a soluble compound which contains bromide ions, is dissolved into this solution.

Step 3 The lights are turned out in the darkroom.

Step 4 Compound **B**, a soluble compound which contains silver ions, is dissolved in water.

Step 5 The solution of compound **B** is added to the solution containing compound **A** and gelatine. Solid silver bromide is formed.

Step 6 The warm mixture is poured onto thin, transparent plastic film.

Step 7 The mixture sets to form a gel containing solid silver bromide.

(a) The table below gives information about the solubility of some compounds.

SOLUBLE	INSOLUBLE
All sodium and potassium salts	
All nitrates	
Most chlorides, bromides and iodides	Silver and lead chlorides, bromides and iodides
Most sulfates	Lead sulfate and barium sulfate
Sodium, potassium and ammonium carbonates	Most other carbonates

Use the table to help you to name suitable compounds for **A** and **B**.

Compound **A** .....

Compound **B** .....

(2 marks)

4.4.2.3 Soluble salts

Question 02 · continued

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(b) Suggest why the lights are turned out at **step 3** in this method of making a photographic film.

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(1 mark)

(c) What type of chemical reaction takes place when the compounds are mixed in **step 5**?

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(1 mark)

(d) The photographic film is placed in a camera and a picture is taken. Where light hits the photographic film the silver ions (Ag^+) are changed into silver metal (Ag).

Explain why this reaction is a reduction.

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(2 marks)

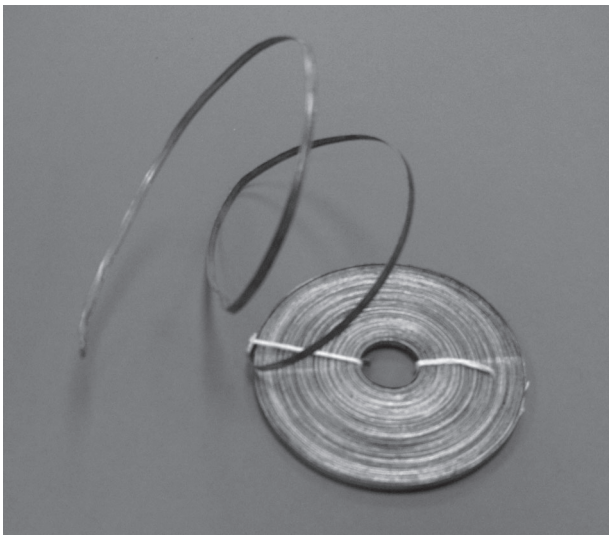
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4.4.2.3 Soluble salts

Question 03

January 2011 | CHY2H | Original Q3 | Legacy

3 (a) Magnesium metal is shaped to make magnesium ribbon.



Explain why metals can be shaped.

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(2 marks)

3 (b) Magnesium sulfate is a salt of magnesium.

It can be prepared by the reaction of magnesium metal with an acid. The equation for the reaction of magnesium with this acid is:

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

3 (b) (i) Name the acid used to make magnesium sulfate.

..... acid

(1 mark)

4.4.2.3 Soluble salts

Question 03 · continued

3 (b) (ii) Use the equation to help you to describe what you would **observe** when magnesium reacts with the acid.

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(2 marks)

3 (b) (iii) The magnesium sulfate is in solution.

How could you obtain solid magnesium sulfate from this solution?

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(1 mark)

6

4.4.2.3 Soluble salts

Question 04

June 2011 | CHY1H | Original Q2 | Legacy

2 The raw materials used to make the polymer polyvinyl chloride (PVC) are crude oil and sea salt (sodium chloride).

2 (a) There are three main stages in the production of PVC.

2 (a) (i) **Stage 1** Cracking of hydrocarbons from crude oil produces ethene, C_2H_4

$$C_{10}H_{22} \longrightarrow C_8H_{18} + C_2H_4$$

How are hydrocarbons cracked?

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(2 marks)

2 (a) (ii) **Stage 2** Electrolysis of sodium chloride solution produces chlorine.
Ethene from **Stage 1** is then reacted with this chlorine.
One of the hydrogen atoms in each ethene molecule is replaced by a chlorine atom to produce vinyl chloride.

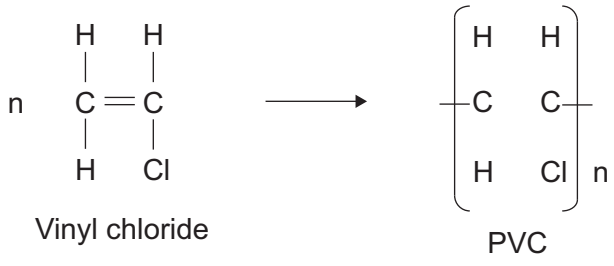
Complete the chemical equation by writing in the formula of the product vinyl chloride.

$$C_2H_4 + Cl_2 \longrightarrow \text{.....} + HCl$$

(1 mark)

2 (a) (iii) **Stage 3** Polymerisation of vinyl chloride produces polyvinyl chloride (PVC).

Complete the chemical equation by drawing in the missing bonds of the product, PVC.



(1 mark)

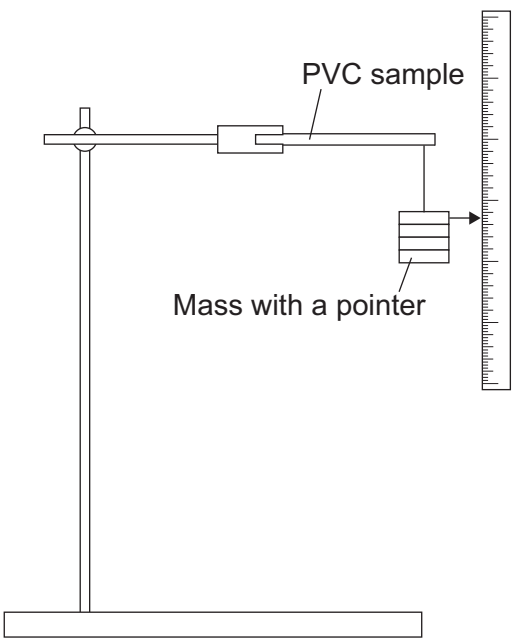
Question 2 continues on the next page

4.4.2.3 Soluble salts

Question 04 · continued

2 (b) Unplasticised polyvinyl chloride (uPVC) is used to make door and window frames.
PVC with a plasticiser added is used to make cling film for wrapping food.
A plasticiser is a chemical compound.

A student investigated how the percentage of plasticiser added to PVC affected its flexibility.
The student measured the bending of PVC samples when a mass was added.



The student's results are shown in the table.

Sample of PVC	Percentage (%) of plasticiser added	Bending of PVC sample in mm				
		Test 1	Test 2	Test 3	Test 4	Mean
A	**0**	2	3	3	4	3
B	**5**	22	15	23	24	
C	**10**	27	27	29	29	28
D	**15**	34	35	35	36	35

2 (b) (i) Each PVC sample should be the same size to make it a fair test.
Explain why.

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(1 mark)

4.4.2.3 Soluble salts

Question 04 · continued

2 (b) (ii) The student repeated the test four times for each sample.
Explain why.

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(1 mark)

2 (b) (iii) Calculate the mean value for sample **B**.

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(2 marks)

2 (b) (iv) Each of the samples bent the most in test **4**.
Suggest a possible reason for this.

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(1 mark)

2 (c) Suggest why unplasticised polyvinyl chloride (uPVC) is used to make door and window frames.

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(1 mark)

10

4.4.2.3 Soluble salts

Question 05

June 2012 | CH2HP | Original Q2 | Legacy

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

The salt called potassium chloride is made when potassium hydroxide solution reacts with hydrochloric acid.

potassium hydroxide solution + hydrochloric acid → potassium chloride solution + water

Describe a method for making **crystals** of potassium chloride from potassium hydroxide solution and hydrochloric acid.

In this method you should:

- describe how you will add the correct amount of the hydrochloric acid to neutralise the potassium hydroxide solution
- describe how you will get crystals of potassium chloride.

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(6 marks)

Question 2 continues on the next page

4.4.2.3 Soluble salts

Question 05 · continued

2 (b) Ammonium nitrate is another salt.
Ammonium nitrate is made when ammonia solution is neutralised with an acid.

Name the acid to complete the word equation.

ammonia + ... acid → ammonium nitrate

(1 mark)

2 (c) Read the information.

Ammonium nitrate – good or bad?

Some farmers put a lot of ammonium nitrate on their farmland.

Many people are worried about this use of ammonium nitrate.

Rain water can wash the ammonium nitrate off the farmland and into rivers and lakes. The ammonium nitrate may get into drinking water supplies and could be harmful to health.

2 (c) (i) Why do some farmers put ammonium nitrate on their farmland?

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(1 mark)

4.4.2.3 Soluble salts

Question 05 · continued

2 (c) (ii) Which **one** of the questions in the table cannot be answered by science alone?

Tick (✓) **one** question.

Question	Tick (✓)
How much ammonium nitrate is in drinking water?	
Should farmers stop using ammonium nitrate on their farmland?	
Is ammonium nitrate soluble in rain water?	

Give **two** reasons why this question **cannot** be answered by science alone.

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(3 marks)

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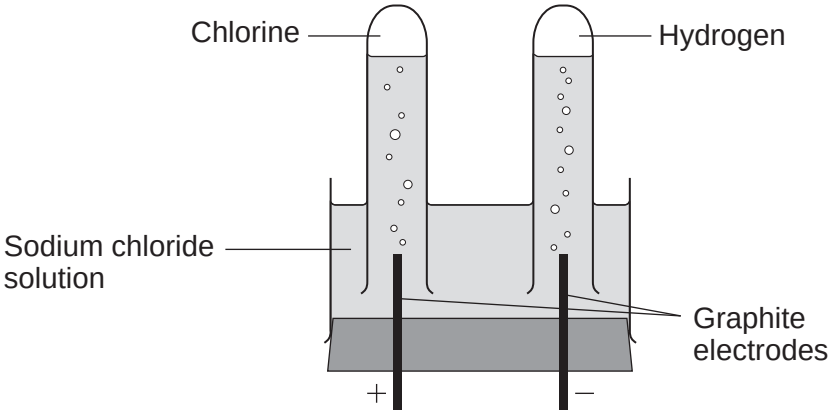
4.4.2.3 Soluble salts

Question 06

January 2013 | CH2HP | Original Q2 | Legacy

2 The electrolysis of sodium chloride solution is an industrial process.

The diagram shows the apparatus used in a school experiment.



2 (a) One of the products of the electrolysis of sodium chloride solution is hydrogen.

2 (a) (i) Why do hydrogen ions move to the negative electrode?

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(1 mark)

2 (a) (ii) How does a hydrogen ion change into a hydrogen atom?

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(1 mark)

4.4.2.3 Soluble salts

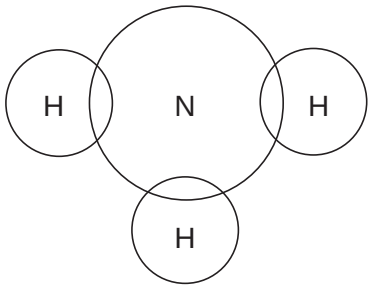
Question 06 · continued

2 (b) Hydrogen is used to make ammonia (NH_3).

Complete the diagram to show the bonding in ammonia.

Use dots (●) and crosses (x) to show electrons.

Show only outer shell electrons.



(2 marks)

2 (c) The table shows the ions in sodium chloride solution.

Positive ions	Negative ions
hydrogen	chloride
sodium	hydroxide

In industry, some of the waste from the electrolysis of sodium chloride solution is alkaline and has to be neutralised.

2 (c) (i) Which ion makes the waste alkaline?

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(1 mark)

2 (c) (ii) This waste must be neutralised.

Write the ionic equation for the neutralisation reaction.

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(1 mark)

Question 2 continues on the next page

4.4.2.3 Soluble salts

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

The electrolysis of sodium chloride solution also produces chlorine and sodium hydroxide.

In industry, the electrolysis of sodium chloride solution can be done in several types of electrolysis cell.

Some information about two different types of electrolysis cell is given below.

	Mercury cell	Membrane cell
Cost of construction	Expensive	Relatively cheap
Additional substances used	Mercury, which is recycled. Mercury is toxic so any traces of mercury must be removed from the waste.	Membrane, which is made of a polymer. The membrane must be replaced every 3 years.
Amount of electricity used for each tonne of chlorine produced in kWh	3400	2950
Quality of chlorine produced	Pure	Needs to be liquefied and distilled to make it pure.
Quality of sodium hydroxide solution produced	50% concentration. Steam is used to concentrate the sodium hydroxide solution produced.	30% concentration. Steam is used to concentrate the sodium hydroxide solution produced.

Use the information and your knowledge and understanding to compare the environmental and economic advantages and disadvantages of these **two** types of electrolysis cell.

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4.4.2.3 Soluble salts

Question 07

June 2013 | CH2HP | Original Q4 | Legacy

4 This question is about potassium.

4 (a) Humphrey Davy was a professor of chemistry.

In 1807 Davy did an electrolysis experiment to produce potassium.

4 (a) (i) Davy first tried to electrolyse a solid potassium salt to produce potassium.

Explain why this electrolysis did **not** work.

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(2 marks)

4 (a) (ii) Humphrey Davy was the first person to produce potassium.

Humphrey Davy's experiment to produce this new element was quickly accepted by other scientists.

Suggest why.

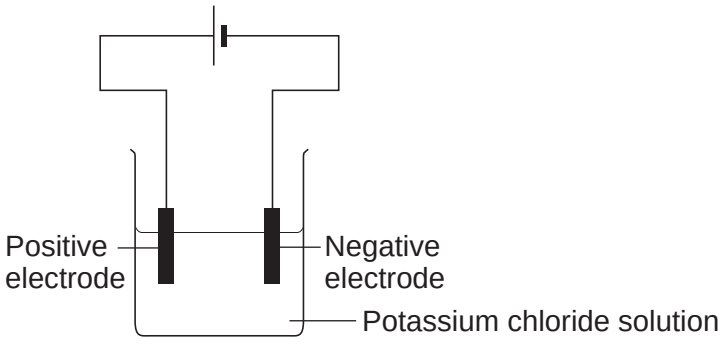
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(1 mark)

4 (b) A student dissolved some potassium chloride in water.
The student tried to electrolyse the potassium chloride solution to produce potassium.

The apparatus the student used is shown in the diagram.



4.4.2.3 Soluble salts

Question 07 · continued

The student expected to see potassium metal at the negative electrode, but instead saw bubbles of a gas.

- Name the gas produced at the negative electrode.
- Explain why this gas was produced at the negative electrode **and** why potassium was not produced.

The reactivity series of metals on the Chemistry Data Sheet may help you to answer this question.

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(3 marks)

4 (c) The student tried to electrolyse molten potassium chloride to produce potassium.

4 (c) (i) Potassium metal was produced at the negative electrode.

Describe how potassium atoms are formed from potassium ions.

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(2 marks)

Question 4 continues on the next page

4.4.2.3 Soluble salts

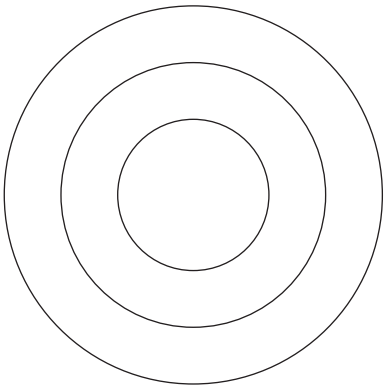
Question 07 · continued

4 (c) (ii) Complete and balance the equation for the reaction at the positive electrode.

.....Cl^- $\longrightarrow$ Cl_2 + ...

(1 mark)

4 (c) (iii) Complete the diagram to show the electronic structure of a chloride ion (Cl^-).



(1 mark)

10

4.4.2.3 Soluble salts

Question 08

5 Low sodium salt is used on food. This label is from a packet of low sodium salt.

Low Sodium Salt

Ingredients:

Sodium chloride
Potassium chloride
Drying agent: magnesium carbonate

A student tests the low sodium salt for the substances on the label.

5 (a) (i) The same test can be used to identify sodium ions and potassium ions.

Describe the test.

Give the result of the test for sodium ions and for potassium ions.

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(3 marks)

5 (a) (ii) It is difficult to identify potassium ions when sodium ions are present.

Suggest why.

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(1 mark)

4.4.2.3 Soluble salts

Question 08 · continued

5 (b) Describe how the student would test a solution of the low sodium salt for chloride ions.

Give the result of the test.

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(3 marks)

5 (c) To test for magnesium ions, the student adds a few drops of sodium hydroxide solution to a solution of the low sodium salt.

A white precipitate is produced.

This test also gives a white precipitate with aluminium ions and calcium ions.

5 (c) (i) Describe how the student could confirm that the low sodium salt contains magnesium ions and **not** aluminium ions.

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(2 marks)

5 (c) (ii) Describe a test the student could do to confirm that the low sodium salt does **not** contain calcium ions.

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(2 marks)

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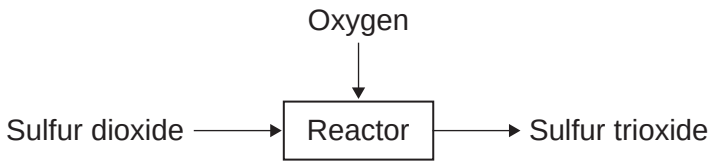
4.4.2.3 Soluble salts

Question 09

June 2014 | CH2HP | Original Q3 | Legacy

3 **Figure 2** represents a reaction in the production of sulfuric acid.

Figure 2



3 (a) Complete and balance the equation for the reaction.

[2 marks]

..... $SO_2(g)$ + ... (g) $\rightleftharpoons$ ..... $SO_3(g)$

3 (b) The conditions can affect the rate of the reaction.

3 (b) (i) The pressure of the reacting gases was increased.

State the effect of increasing the pressure on the rate of reaction.

Explain your answer in terms of particles.

[3 marks]

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4.4.2.3 Soluble salts

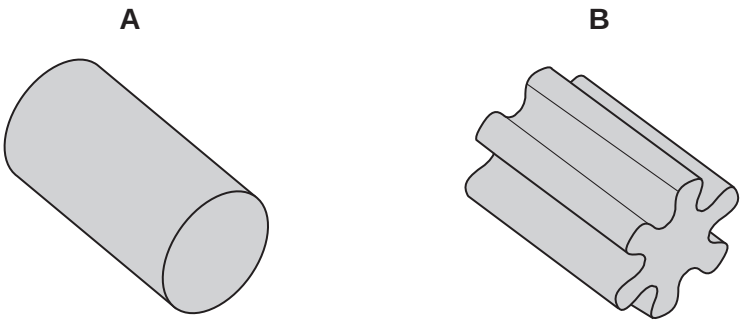
Question 09 · continued

3 (b) (ii) A catalyst is used for the reaction.

The gases pass through a layer containing pieces of the catalyst.

Figure 3 shows the shapes of pieces of catalyst.

Figure 3



Suggest and explain why shape **B** is more effective as a catalyst than shape **A**.

[2 marks]

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3 (c) The reaction is carried out at a high temperature to provide the reactants with the **activation energy**.

What is meant by the **activation energy**?

[1 mark]

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4.4.2.3 Soluble salts

Question 09 · continued

3 (d) Sulfuric acid reacts with metals to produce salts.

3 (d) (i) A student concluded that potassium would **not** be a suitable metal to react with sulfuric acid.

Explain why.

[2 marks]

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3 (d) (ii) A student reacted zinc metal with sulfuric acid to produce a salt and another product.

Complete the equation for this reaction.

[2 marks]

$Zn + H_2SO_4 \longrightarrow$ ..... + ...

3 (d) (iii) The student wanted to increase the rate of the reaction between the zinc and sulfuric acid.

State **one** way, other than using a catalyst, that the student could increase the rate of the reaction.

[1 mark]

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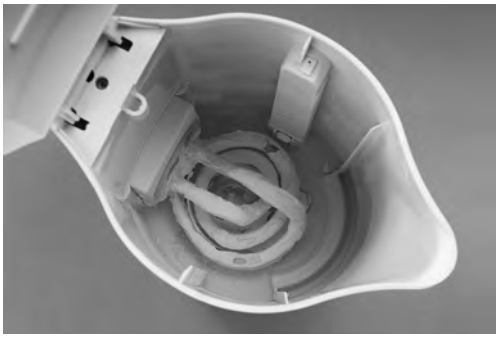
4.4.2.3 Soluble salts

Question 10

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?

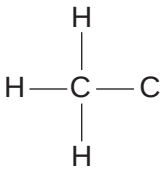
[1 mark]

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

Complete the displayed structure of ethanoic acid (CH_3COOH).

[1 mark]



4.4.2.3 Soluble salts

Question 10 · 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

4.4.2.3 Soluble salts

Question 11

June 2015 | CH1HP | Original Q2 | Legacy

2 Limestone is used to make many different materials.

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

Complete the sentences.

2 (a) (i) The main compound in limestone is calcium ..... .
[1 mark]

2 (a) (ii) The reaction to produce calcium oxide from limestone is thermal ..... .
[1 mark]

2 (a) (iii) Calcium hydroxide is produced when calcium oxide reacts with ..... .
[1 mark]

2 (a) (iv) Calcium hydroxide is used to neutralise acids because it is an ..... .
[1 mark]

Question 2 continues on the next page

Question 11 · continued

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

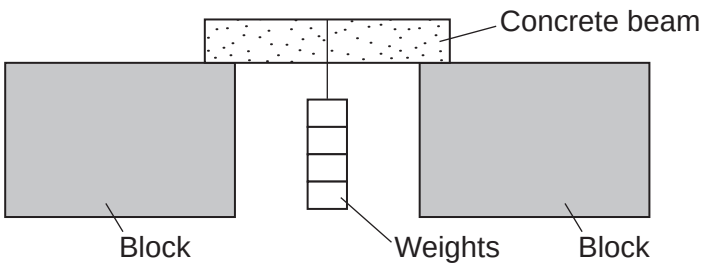
Concrete is made by mixing cement with water, sand and aggregate (small pieces of rock).

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

The students used this method:

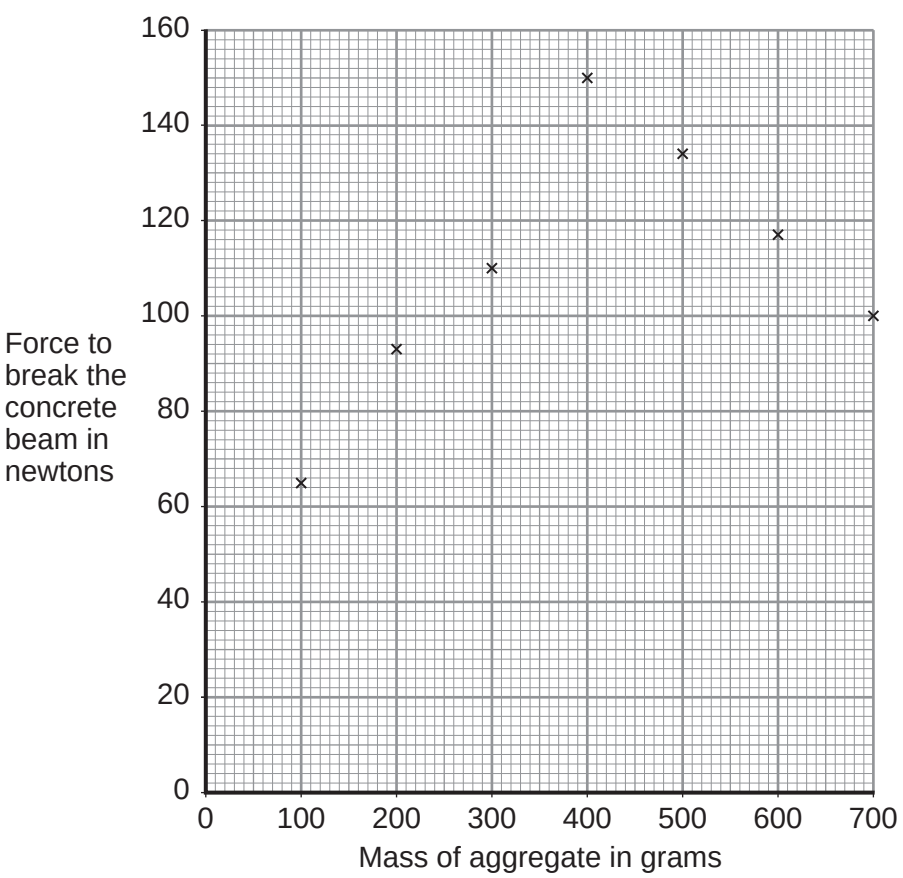
- use the same mass of cement and the same mass of sand but change the mass of aggregate to make seven different concrete mixtures
- use the different concrete mixtures to make beams of the same size
- add weights, as shown in **Figure 2**, until the concrete beam breaks.

Figure 2



The students' results are plotted on the graph in **Figure 3**.

Figure 3



4.4.2.3 Soluble salts

Question 11 · continued

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

Complete the graph in **Figure 3** by drawing **two** straight lines of best fit.

[2 marks]

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

[2 marks]

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

Show your working on the graph.

[2 marks]

Force = ... newtons

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

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

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

[3 marks]

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4.4.2.3 Soluble salts

Question 12

June 2015 | CH2HP | Original Q5 | Legacy

5 This question is about compounds.

5 (a) **Table 2** gives information about the solubility of some compounds.

Table 2

Soluble compounds
All potassium and sodium salts
All nitrates
Chlorides, bromides and iodides, except those of silver and lead

Use information from **Table 2** to answer these questions.

5 (a) (i) Name a soluble compound that contains silver ions.

[1 mark]

.....

5 (a) (ii) Name a soluble compound that contains carbonate ions.

[1 mark]

.....

5 (b) Metal oxides react with acids to make salts.

What type of compound is a metal oxide?

[1 mark]

.....

4.4.2.3 Soluble salts

Question 12 · continued

5 (c) Lead nitrate solution is produced by reacting lead oxide with nitric acid.

5 (c) (i) State how solid lead nitrate can be obtained from lead nitrate solution.

[1 mark]

.....

.....

5 (c) (ii) Balance the equation for the reaction.

[1 mark]

$$PbO \quad + \quad HNO_3 \quad \longrightarrow \quad Pb(NO_3)_2 \quad + \quad H_2O$$

5 (c) (iii) Give the total number of atoms in the formula $Pb(NO_3)_2$

[1 mark]

.....

5 (d) An oxide of lead that does **not** have the formula PbO contains 6.21 g of lead and 0.72 g of oxygen.

Calculate the empirical formula of this lead oxide.

Relative atomic masses (A_r): O = 16; Pb = 207

You must show your working to gain full marks.

[4 marks]

.....

.....

.....

.....

.....

.....

Empirical formula = ...

10

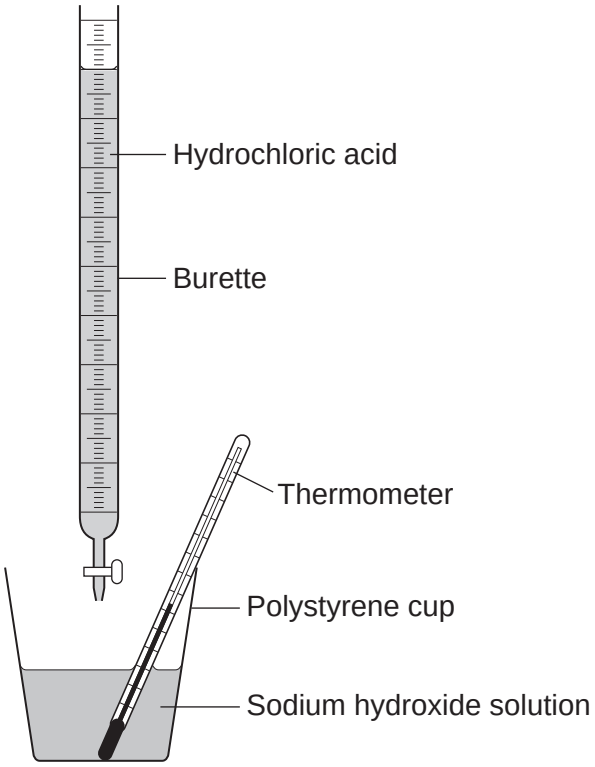
4.4.2.3 Soluble salts

Question 13

June 2015 | CH3HP | Original Q8 | Legacy

8 A student investigates the energy released when hydrochloric acid completely neutralises sodium hydroxide solution.
The student uses the apparatus shown in **Figure 4**.

Figure 4



The student:

- measures 25 cm^3 sodium hydroxide solution into a polystyrene cup
- fills a burette with hydrochloric acid
- measures the temperature of the sodium hydroxide solution
- adds 5 cm^3 hydrochloric acid to the sodium hydroxide solution in the polystyrene cup
- stirs the mixture and measures the highest temperature of the mixture
- continues to add 5 cm^3 portions of hydrochloric acid, stirring and measuring the highest temperature of the mixture after each addition.

Question 8 continues on the next page

4.4.2.3 Soluble salts

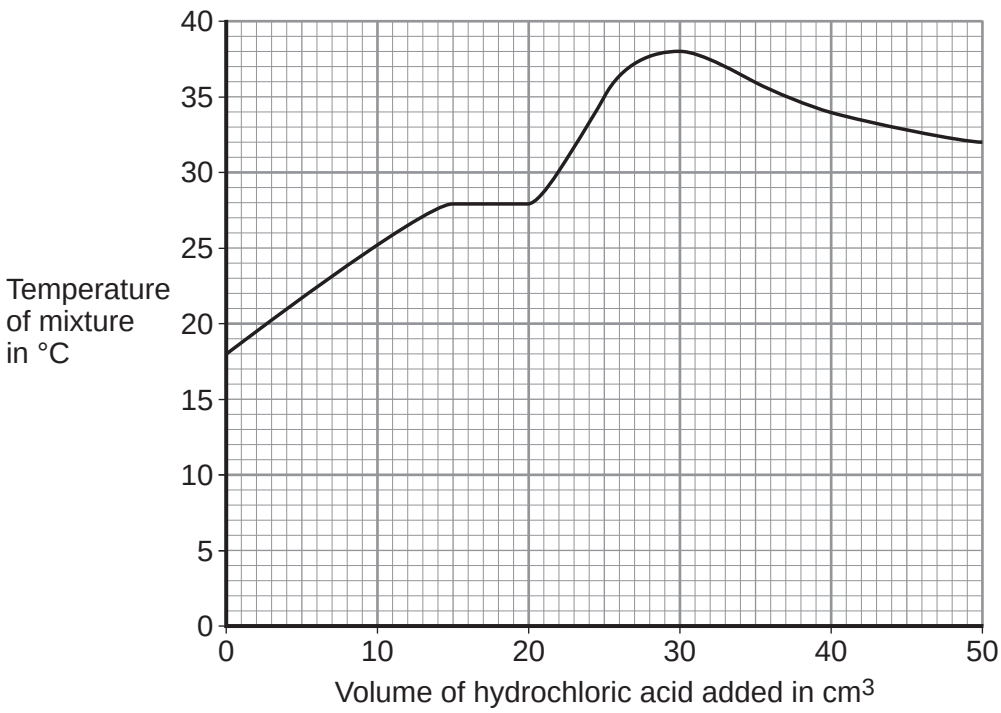
Question 13 · continued

8 (a) The student has plotted a graph of the results.

The graph line has been incorrectly drawn by including an anomalous result.

The graph is shown in **Figure 5**.

Figure 5



8 (a) (i) Suggest a cause for the anomalous result when 20 cm^3 of hydrochloric acid is added.

[1 mark]

.....

.....

8 (a) (ii) Suggest the true value of the temperature of the anomalous point.

[1 mark]

Temperature = ... °C

8 (a) (iii) What was the **total** volume of the mixture when the maximum temperature was reached?

[1 mark]

.....

Total volume of the mixture = ... cm^3

4.4.2.3 Soluble salts

Question 13 · continued

8 (a) (iv) Calculate the overall temperature increase in this experiment.

[1 mark]

.....

Overall temperature increase = ... °C

8 (a) (v) Use your answers to **8(a)(iii)** and **8(a)(iv)** and the equation to calculate the energy released in the reaction. Give the unit.

[2 marks]

Assume the volume in cm^3 is equivalent to the mass of solution in grams.

Equation: $Q = mc\Delta T$

where:
Q = energy released
m = mass of solution (g)
c = 4.2 (J per g per °C)
ΔT = change in temperature (°C)

.....

.....

Energy released = ... Unit = ...

8 (b) The student did the experiment on page 19 again, starting with 50 cm^3 of sodium hydroxide solution instead of 25 cm^3.

Explain why this would make no difference to the overall temperature increase.

[2 marks]

.....

.....

.....

.....

8

4.4.2.3 Soluble salts

Question 14

June 2016 | CH2HP | Original Q2 | Legacy

2 This question is about ammonia and fertilisers.

2 (a) Ammonia is produced by a reversible reaction.

The equation for the reaction is:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Complete the sentence.

[1 mark]

The forward reaction is exothermic, so the reverse reaction is _____ .

2 (b) Calculate the percentage by mass of nitrogen in ammonia (NH_3).
Relative atomic masses (A_r): H = 1; N = 14
You **must** show how you work out your answer.

[3 marks]

_____

_____

_____

_____

_____

_____

Percentage by mass of nitrogen = _____ %

4.4.2.3 Soluble salts

Question 14 · continued

2 (c) A neutral solution can be produced when ammonia reacts with an acid.

2 (c) (i) Give the pH of a neutral solution.

[1 mark]

pH _____

2 (c) (ii) Which of these ionic equations shows a neutralisation reaction?

[1 mark]

Tick (✓) **one** box.

$H^+ + OH^- \longrightarrow H_2O$ ☐

$NH_4^+ + OH^- \longrightarrow NH_4OH$ ☐

$H^+ + Cl^- \longrightarrow HCl$ ☐

$H^+ + H_2O \longrightarrow H_3O^+$ ☐

2 (c) (iii) Name the salt produced when ammonia reacts with hydrochloric acid.

[1 mark]

_____

Question 2 continues on the next page

Question 14 · continued

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

Farmers use ammonium nitrate as a fertiliser for crops.

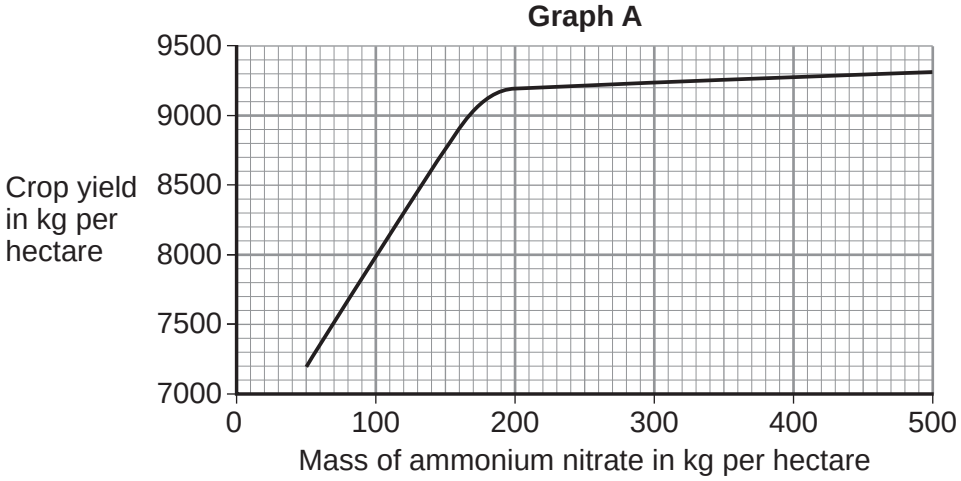
Rainwater dissolves ammonium nitrate in the soil.

Some of the dissolved ammonium nitrate runs off into rivers and lakes.

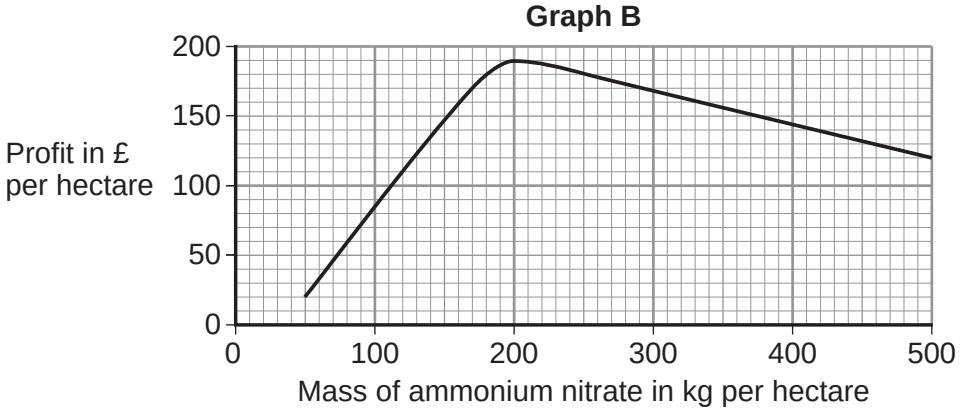
Figure 2 shows three graphs **A**, **B** and **C**. The graphs show information about the use of ammonium nitrate as a fertiliser. A hectare is a measurement of an area of land.

Figure 2

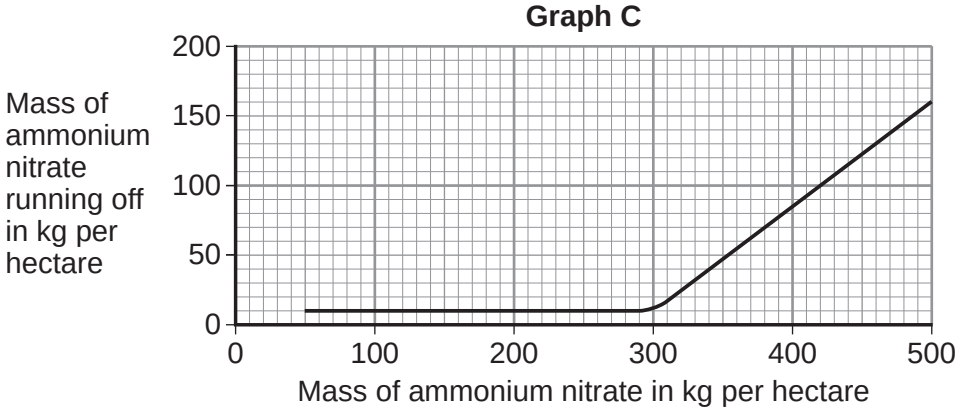
Graph A



Graph B



Graph C



4.4.2.3 Soluble salts

Question 14 · continued

Suggest how much ammonium nitrate farmers should use per hectare.
Give reasons for your answer.
Use information from graphs **A**, **B** and **C**.

[6 marks]

Extra space

13

4.4.2.3 Soluble salts

Question 15

June 2017 | CH2HP | Original Q4 | Legacy

4 This question is about sulfuric acid (H_2SO_4) and ethene.

Sulfuric acid is used to produce copper sulfate ($CuSO_4$).

The equation for the reaction is:

$$CuO(s) + H_2SO_4(aq) \longrightarrow CuSO_4(aq) + H_2O(l)$$

4 (a) Describe a method for making copper sulfate crystals from copper oxide and sulfuric acid.

[4 marks]

4 (b) Calculate the mass of copper oxide required to produce 24.95 g of copper sulfate crystals ($CuSO_4.5H_2O$).

Relative formula mass (M_r) of copper sulfate crystals = 249.5

Relative atomic masses (A_r): O = 16; Cu = 63.5

[3 marks]

Mass of copper oxide = _____ g

4.4.2.3 Soluble salts

Question 15 · continued

4 (c) Ethene and sulfuric acid are used to make many substances.

4 (c) (i) **Table 1** shows data about wealth of countries, ethene production and sulfuric acid production.

Table 1

Country	Wealth of country in billions of dollars	Ethene production in kilotonnes	Sulfuric acid production in kilotonnes
A	4000	13 900	36 000
B	1300	4 400	6 600
C	1290	2 700	26 000
D	620	3 100	2 500
E	460	1 500	4 200
F	310	650	6 700

How does the wealth of countries relate to their production of ethene and sulfuric acid?

[2 marks]

4 (c) (ii) Suggest why the use of ethene has increased in the last 50 years.

[1 mark]

10

4.4.2.3 Soluble salts

Question 16

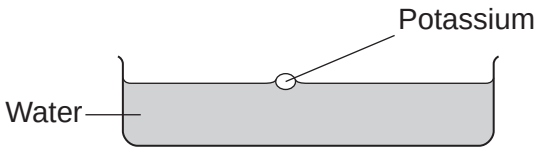
June 2017 | CH3HP | Original Q4 | Legacy

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]

_____

_____

_____

_____

4.4.2.3 Soluble salts

Question 16 · 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

4.4.2.3 Soluble salts

Question 17

June 2018 | 8462/1H | Original Q1

0 1 Soluble salts are formed by reacting metal oxides with acids.

0 1 . 1 Give **one** other type of substance that can react with an acid to form a soluble salt.

[1 mark]

0 1 . 2 Calcium nitrate contains the ions Ca^{2+} and NO_3^-

Give the formula of calcium nitrate.

[1 mark]

0 1 . 3 Describe a method to make pure, dry crystals of magnesium sulfate from a metal oxide and a dilute acid.

[6 marks]

4.4.2.3 Soluble salts

Question 18

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

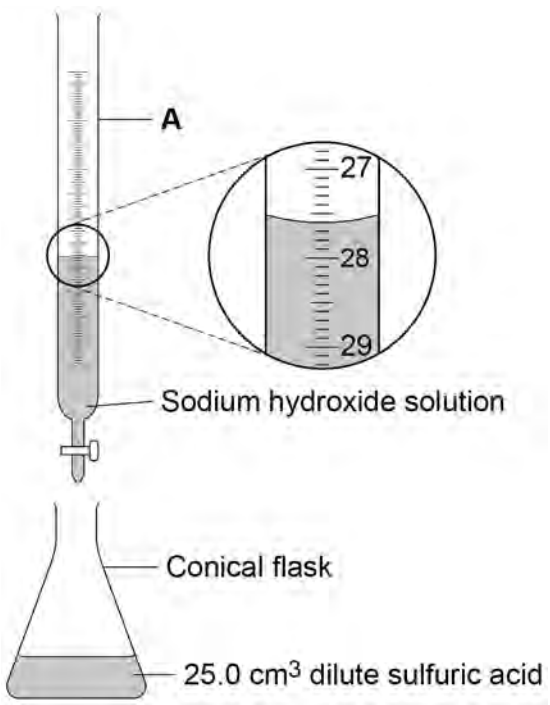
4.4.2.3 Soluble salts

Question 18 · 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

4.4.2.3 Soluble salts

Question 18 · 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

4.4.2.3 Soluble salts

Question 19

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.

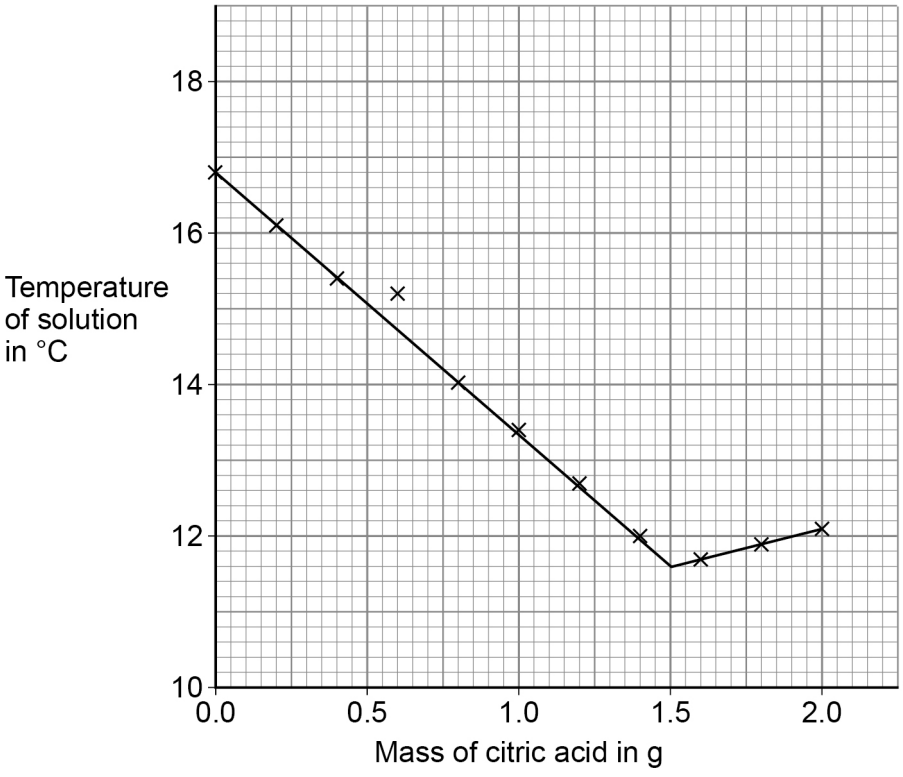
5. Measure the temperature of the solution.

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



4.4.2.3 Soluble salts

Question 19 · 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]

4.4.2.3 Soluble salts

Question 19 · 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]

4.4.2.3 Soluble salts

Question 19 · 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

4.4.2.3 Soluble salts

Question 20

November 2021 | 8462/1H | Original Q5

0 5 This question is about salts.

0 5 . 1 Name the salt produced by the neutralisation of hydrochloric acid with potassium hydroxide.

[1 mark]

_____

0 5 . 2 Write an ionic equation for the neutralisation of hydrochloric acid with potassium hydroxide.

[1 mark]

_____ + _____ → _____

0 5 . 3 Soluble salts can be produced by reacting dilute hydrochloric acid with an insoluble solid.

Copper, copper carbonate and copper oxide are insoluble solids.

Which of these insoluble solids can be used to make a copper salt by reacting the solid with dilute hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

- Copper and copper carbonate only ☐
- Copper and copper oxide only ☐
- Copper carbonate and copper oxide only ☐
- Copper, copper carbonate and copper oxide ☐

4.4.2.3 Soluble salts

Question 20 · continued

A student makes crystals of magnesium sulfate.

This is the method used.

1. Add sulfuric acid to a beaker.
2. Warm the sulfuric acid.
3. Add a spatula of magnesium oxide to the beaker.
4. Stir the mixture.
5. Repeat steps 3 and 4 until there is magnesium oxide remaining in the beaker.
6. Filter the mixture.
7. Evaporate the filtrate gently until crystals start to form.
8. Leave the solution to finish crystallising.

0 5 . 4 Give **one** reason for:

- step 2
- step 5
- step 6.

[3 marks]

Step 2 _____

_____

Step 5 _____

_____

Step 6 _____

_____

0 5 . 5 How should the filtrate be evaporated gently in **step 7**?

[1 mark]

_____

_____

4.4.2.3 Soluble salts

Question 20 · continued

0 5 . 6 Iron chloride is produced by heating iron in chlorine gas.

The equation for the reaction is:

$$2\,Fe + 3\,Cl_2 \rightarrow 2\,FeCl_3$$

Calculate the volume of chlorine needed to react with 14 g of iron.

You should calculate:

- the number of moles of iron used
- the number of moles of chlorine that react with 14 g of iron
- the volume of chlorine needed.

Relative atomic mass (A_r): Fe = 56

The volume of 1 mole of gas = 24 dm^3

[3 marks]

Volume of chlorine = _____ dm^3

10

4.4.2.3 Soluble salts

Question 21

November 2021 | 8462/1H | Original Q7

0 7 This question is about chemical reactions and electricity.

0 7 . 1 Electrolysis and chemical cells both involve chemical reactions and electricity.

Explain the difference between the processes in electrolysis and in a chemical cell.

[2 marks]

0 7 . 2 A teacher demonstrates the electrolysis of molten lead bromide.

Bromine is produced at the positive electrode.

Complete the half equation for the production of bromine.

You should balance the half equation.

[2 marks]

$$Br^- \rightarrow \quad + \quad$$

0 7 . 3 Two aqueous salt solutions are electrolysed using inert electrodes.

Complete **Table 4** to show the product at each electrode.

[3 marks]

Table 4

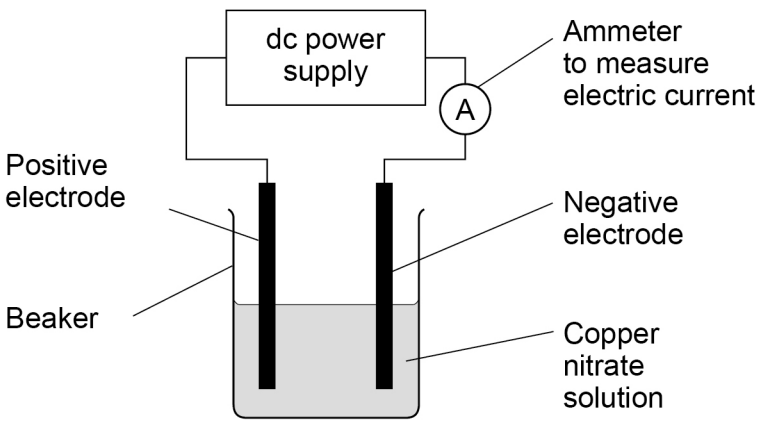
Salt solution	Product at positive electrode	Product at negative electrode
Copper nitrate		copper
Potassium iodide		

Question 21 · continued

Some students investigated the electrolysis of copper nitrate solution using inert electrodes.

Figure 4 shows the apparatus.

Figure 4



The students investigated how the mass of copper produced at the negative electrode varied with:

- time
- current.

This is the method used.

1. Weigh the negative electrode.
2. Set up the apparatus shown in **Figure 4**.
3. Adjust the power supply until the ammeter shows a current of 0.3 A
4. Switch off the power supply after 5 minutes.
5. Rinse the negative electrode with water and allow to dry.
6. Reweigh the negative electrode.
7. Repeat steps 1 to 6 for different times.
8. Repeat steps 1 to 7 at different currents.

4.4.2.3 Soluble salts

Question 21 · continued

0 7 . 4 Some of the copper produced did not stick to the negative electrode but fell to the bottom of the beaker.

Suggest how the students could find the total mass of copper produced.

[4 marks]

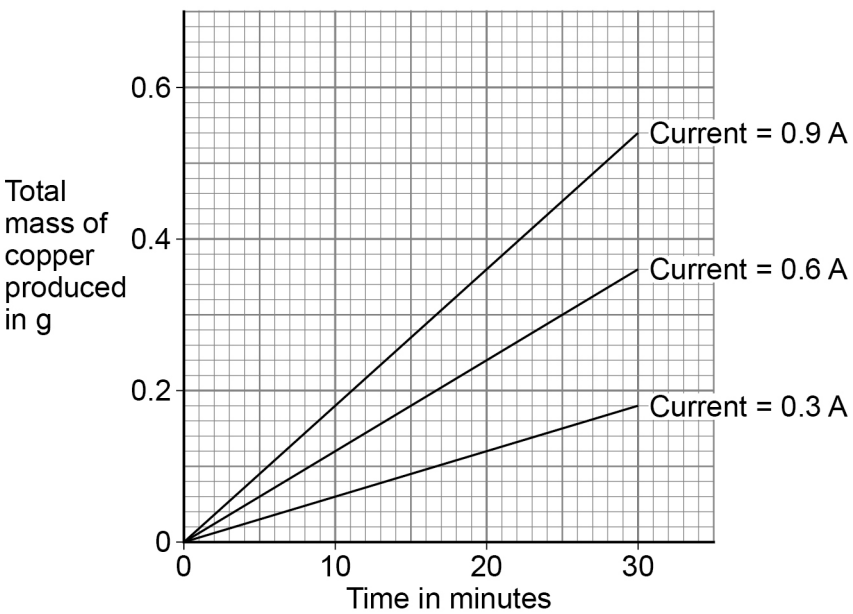
Question 7 continues on the next page

Question 21 · continued

The students plotted their results on a graph.

Figure 5 shows the graph.

Figure 5



A student correctly concluded that the total mass of copper produced is directly proportional both to the time and to the current.

0 7 . 5 How do the results in **Figure 5** support the conclusion that the total mass of copper produced is directly proportional to the time?

[1 mark]

0 7 . 6 How do the results in **Figure 5** support the conclusion that the total mass of copper produced is directly proportional to the current?

Use data from **Figure 5** in your answer.

[1 mark]

4.4.2.3 Soluble salts

Question 21 · continued

0 7 . 7 Copper nitrate solution is blue.

Suggest why the blue colour of the copper nitrate solution fades during the electrolysis.

[1 mark]

0 7 . 8 Determine the number of atoms of copper produced when copper nitrate solution is electrolysed for 20 minutes at a current of 0.6 A

Give your answer to 3 significant figures.

Use **Figure 5**.

Relative atomic mass (A_r): Cu = 63.5

The Avogadro constant = 6.02×10^{23} per mole

[3 marks]

Number of atoms (3 significant figures) = _____

17

4.4.2.3 Soluble salts

Question 22

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 ☐

4.4.2.3 Soluble salts

Question 22 · 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

4.4.2.3 Soluble salts

Question 22 · 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

4.4.2.3 Soluble salts

Question 23

November 2021 | 8462/2H | Original Q5

0 5 This question is about fertilisers.

Some fertilisers are described as NPK fertilisers because they contain three elements needed for healthy plant growth.

0 5 . 1 Which **two** compounds each contain **two** of these elements?

[2 marks]

Tick (✓) **two** boxes.

- Ammonium nitrate ☐
- Ammonium phosphate ☐
- Calcium chloride ☐
- Calcium phosphate ☐
- Potassium chloride ☐
- Potassium nitrate ☐

0 5 . 2 Rocks containing calcium phosphate are treated with acid to produce soluble salts that can be used as fertilisers.

Name the soluble salts produced when calcium phosphate reacts with:

- nitric acid
- phosphoric acid.

[2 marks]

Nitric acid _____

Phosphoric acid _____

4.4.2.3 Soluble salts

Question 23 · continued

0 5 . 3 Ammonium sulfate is a compound in fertilisers.

Ammonium sulfate can be made using an industrial process or in the laboratory.

In the industrial process, the following steps are used.

1. React streams of ammonia solution and sulfuric acid together.
2. Evaporate the water by passing the solution down a warm column.
3. Collect dry crystals continuously at the bottom of the column.

In the laboratory, the following steps are used.

1. React ammonia solution and sulfuric acid in a conical flask.
2. Evaporate water from the solution until crystals start to form.
3. Leave to cool and crystallise further.
4. Separate the crystals using filtration.
5. Dry the crystals between pieces of filter paper.

Evaluate the two methods for producing a large mass of ammonium sulfate.

[4 marks]

8

4.4.2.3 Soluble salts

Question 24

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]

4.4.2.3 Soluble salts

Question 24 · 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

4.4.2.3 Soluble salts

Question 24 · continued

Another student titrated sulfuric acid with barium hydroxide solution.

The equation for the reaction is:

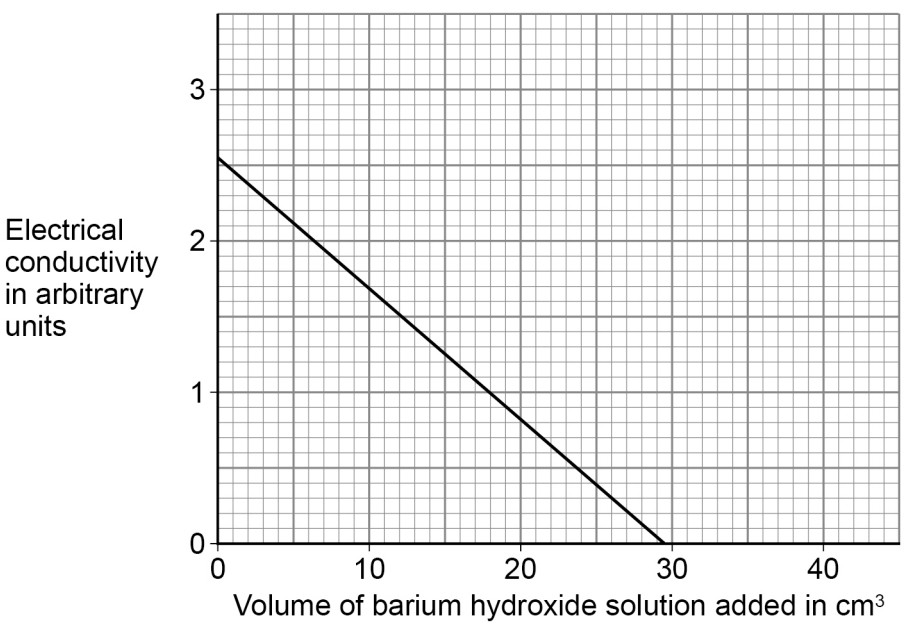
$$H_2SO_4(aq) + Ba(OH)_2(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$$

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]

4.4.2.3 Soluble salts

Question 24 · continued

June 2022 | 8462/1H | Original Q8

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

4.4.2.3 Soluble salts

Question 25

June 2023 | 8462/1H | Original Q3

0 3 This question is about making a soluble salt.

0 3 . 1 Plan a method to make pure, dry crystals of zinc chloride from zinc carbonate and a dilute acid.

[6 marks]

0 3 . 2 Name **two** other substances that can each be reacted with a dilute acid to make zinc chloride.

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

[2 marks]

1 _____

2 _____

8

4.4.2.3 Soluble salts

Question 26

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 _____

Question 26 · 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

4.4.2.3 Soluble salts

Question 26 · 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

4.4.2.3 Soluble salts

Question 27

June 2023 | 8462/2H | Original Q10

1 0 This question is about fertilisers.

Compounds of nitrogen (N), phosphorus (P) and potassium (K) are used as fertilisers to improve agricultural productivity.

Table 4 shows information about three compounds, **A**, **B** and **C**, that can be used as fertilisers.

Table 4

	Compound A	Compound B	Compound C
Name	potassium chloride	ammonium nitrate	diammonium hydrogen phosphate
Formula	KCl	NH_4NO_3	$(NH_4)_2HPO_4$
Percentage (%) of N, P and K by mass	**K**: 52%	**N**: 35%	**N**: 21% **P**: 23%
Cost in £/kg	0.24	0.23	0.35

1 0 . 1 A scientist analysed the percentages of nitrogen, phosphorus and potassium in a soil.

The percentages of nitrogen and of potassium in the soil were lower than the percentages needed for high agricultural productivity.

There was sufficient phosphorus in the soil for high agricultural productivity.

Evaluate the use of the compounds in **Table 4** to improve the agricultural productivity of this soil.

[4 marks]

4.4.2.3 Soluble salts

Question 27 · continued

10.2 How is potassium chloride (compound **A**) obtained from the Earth?

[1 mark]

10.3 Name **one** other compound that could be used instead of potassium chloride (compound **A**) to give a similar improvement in agricultural productivity.

[1 mark]

10.4 Nitric acid is needed to produce ammonium nitrate (compound **B**).

Name a compound needed to produce nitric acid.

[1 mark]

10.5 Phosphate rock contains phosphorus compounds.

Plants absorb phosphorus from compounds dissolved in rainwater.

Suggest why phosphate rock **cannot** be used directly as a fertiliser.

[1 mark]

10.6 Phosphate rock can be treated with different acids to produce salts useful as fertilisers.

Name the salts which are produced by treating phosphate rock with:

- sulfuric acid
- phosphoric acid.

[2 marks]

Sulfuric acid _____

Phosphoric acid _____

10

4.4.2.3 Soluble salts

Question 28

June 2024 | 8462/1H | Original Q1

0 1 A student produced a salt by reacting copper carbonate with sulfuric acid.

This is the method used.

1. Measure 50 cm^3 of sulfuric acid into a beaker.
2. Add copper carbonate powder.
3. Stir the mixture.
4. Repeat steps 2 and 3 until copper carbonate is in excess.
5. Filter the mixture.
6. Warm the filtrate gently until crystals start to appear.
7. Leave the solution to cool and crystallise.

0 1 . 1 Complete the word equation for the reaction.

[2 marks]

copper carbonate + sulfuric acid → _____ + _____ + carbon dioxide

0 1 . 2 Give **one** observation the student could make during **Step 4** which shows that the copper carbonate is in excess.

[1 mark]

_____

_____

0 1 . 3 Give **one** reason for filtering the mixture in **Step 5**.

[1 mark]

_____

_____

4.4.2.3 Soluble salts

Question 28 · continued

0 1 . 4 Name the equipment that can be used to warm the filtrate **gently** in **Step 6**.

[1 mark]

0 1 . 5 The maximum theoretical mass of the salt that could be produced using 50 cm^3 of the sulfuric acid is 12.5 g.

The percentage yield of the salt is 92.8%.

Calculate the mass of salt actually produced.

Use the equation:

$$\% \text{ yield} = \frac{\text{mass of salt actually produced}}{\text{maximum theoretical mass of salt that could be produced}} \times 100$$

[3 marks]

Mass of salt actually produced = _____ g

Question 1 continues on the next page

4.4.2.3 Soluble salts

Question 28 · continued

0 1 . 6 Some salts can be produced by reacting sulfuric acid with a metal.

Neither copper nor sodium is used to produce a salt with sulfuric acid.

Give **one** reason why each metal is **not** used.

[2 marks]

Copper _____

_____

Sodium _____

_____

1(

4.4.2.3 Soluble salts

Question 29

June 2024 | 8462/1H | Original Q2

0 2 This question is about the periodic table.

Sodium and potassium are in Group 1 of the periodic table.

0 2 . 1 Give **one** similarity and **one** difference between the electronic structures of sodium and potassium.

[2 marks]

Similarity _____

_____

Difference _____

_____

Group 1 elements react with water.

0 2 . 2 Give **two** observations made when potassium reacts with water.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 3 Potassium hydroxide solution is produced when potassium reacts with water.

What is the colour of universal indicator when added to potassium hydroxide solution?

Give **one** reason for your answer.

[2 marks]

Colour of universal indicator _____

Reason _____

_____

Question 29 · continued

Table 1 shows the densities of some of the elements in Group 0 of the periodic table.

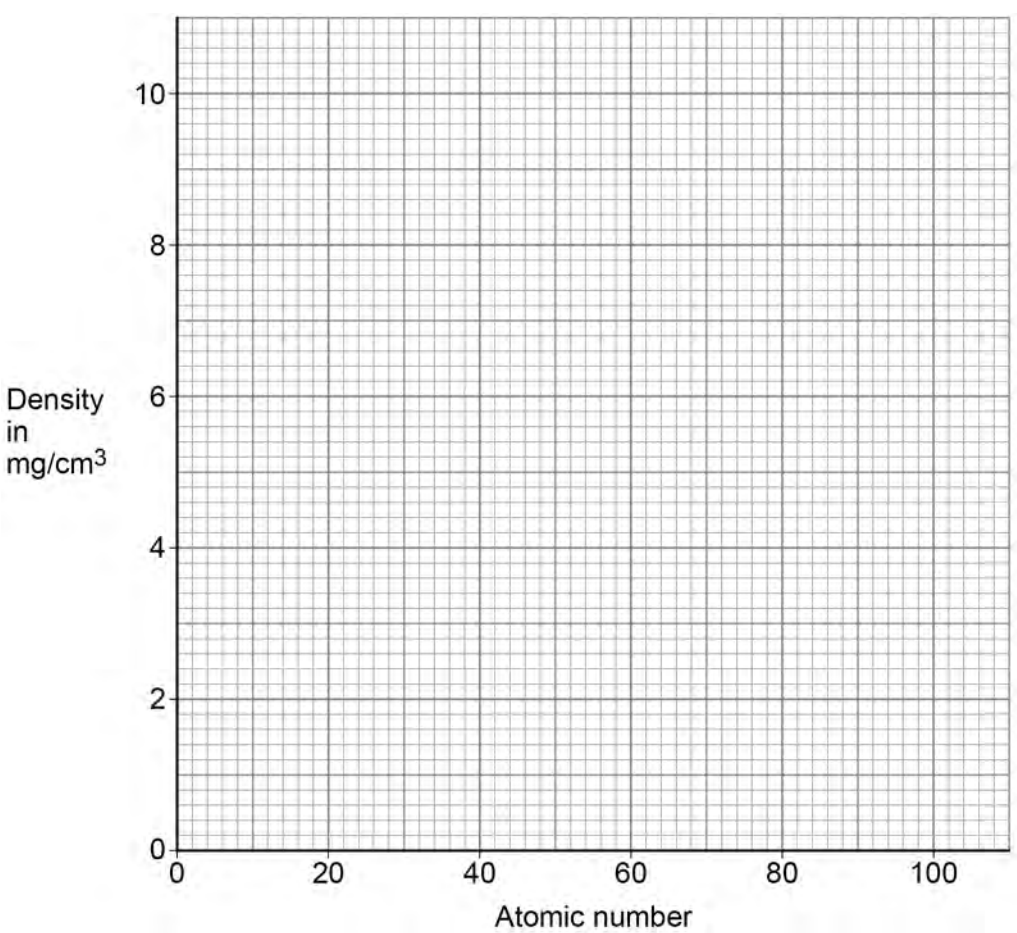
Table 1

Element	Atomic number	Density in mg/cm^3
Helium	2	0.2
Neon	10	0.8
Argon	18	1.6
Krypton	36	**X**
Xenon	54	5.4
Radon	86	9.1

0 2 . 4 Plot the data from **Table 1** on **Figure 1**.

[2 marks]

Figure 1



4.4.2.3 Soluble salts

Question 29 · continued

0 2 . 5 Estimate the density (**X**) of krypton.

Use **Figure 1** and **Table 1**.

[1 mark]

Density = _____ mg/cm^3

0 2 . 6 The elements in Group 7 are called the halogens.

A more reactive halogen can displace a less reactive halogen from a solution of its salt.

Which combination of solutions will produce a reaction when mixed?

[1 mark]

Tick (✓) **one** box.

- Chlorine and potassium fluoride ☐
- Chlorine and potassium bromide ☐
- Bromine and potassium fluoride ☐
- Bromine and potassium chloride ☐

0 2 . 7 Which of the following describes the trends going down Group 7?

[1 mark]

Tick (✓) **one** box.

- Relative molecular mass decreases and boiling point decreases. ☐
- Relative molecular mass decreases and boiling point increases. ☐
- Relative molecular mass increases and boiling point decreases. ☐
- Relative molecular mass increases and boiling point increases. ☐

11

4.4.2.3 Soluble salts

Question 30

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

4.4.2.3 Soluble salts

Question 30 · 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

4.4.2.3 Soluble salts

Question 30 · 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

4.4.2.3 Soluble salts

Question 31

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 _____

_____

4.4.2.3 Soluble salts

Question 31 · 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

4.4.2.3 Soluble salts

Question 31 · 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

4.4.2.3 Soluble salts

Question 32

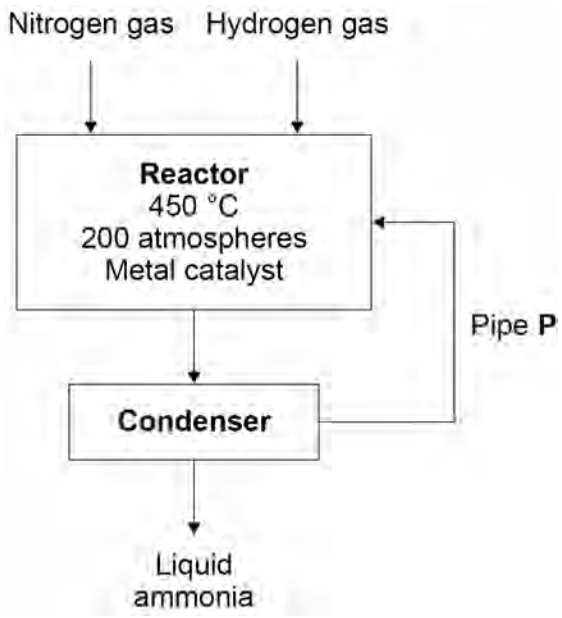
June 2024 | 8462/2H | Original Q2

0 2 This question is about ammonia and nitric acid.

In the Haber process ammonia is produced from nitrogen and hydrogen.

Figure 1 represents the Haber process.

Figure 1



0 2 . 1 Pipe **P** links the condenser to the reactor.

Why is the condenser linked to the reactor?

Use **Figure 1**.

[1 mark]

0 2 . 2 Which metal is used as a catalyst in this reaction?

[1 mark]

Question 32 · continued

Nitric acid is produced by reacting ammonia with oxygen.

The word equation for the production of nitric acid is:

ammonia + oxygen → water + nitric acid

Platinum is a catalyst in this reaction.

0 2 . 3 Describe the test for oxygen gas.

Give the result if oxygen gas is present.

[2 marks]

Test _____

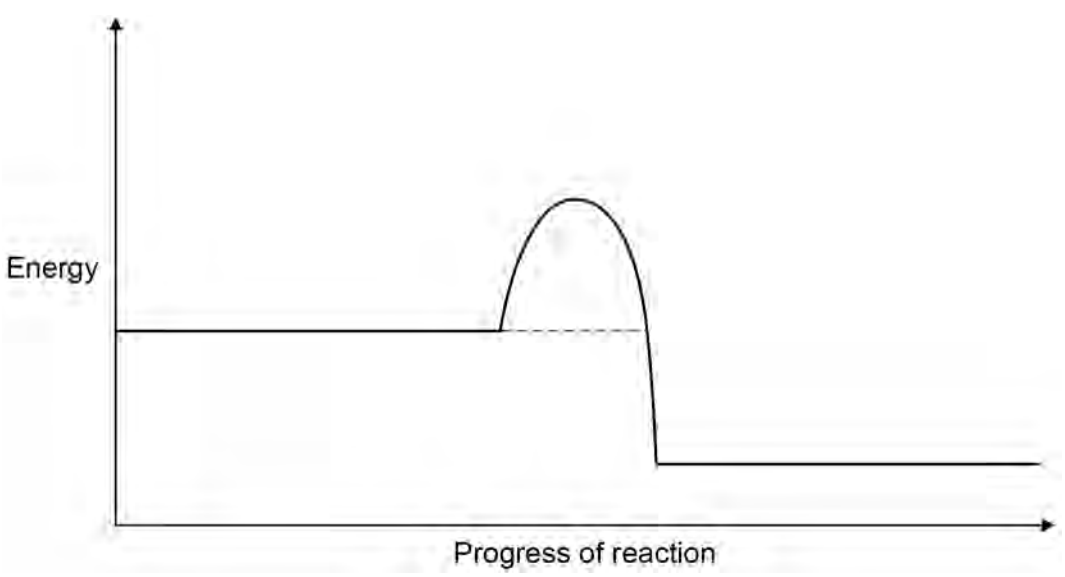
_____

Result _____

_____

Figure 2 represents the reaction profile of the catalysed reaction between ammonia and oxygen.

Figure 2



4.4.2.3 Soluble salts

Question 32 · continued

0 2 . 4 Complete the reaction profile for the catalysed reaction in **Figure 2**.

You should:

- label the activation energy
- label the reactants and products, using the names of the reactants and products.

[2 marks]

0 2 . 5 How would **Figure 2** be different if **no** catalyst was used?

[1 mark]

Tick (✓) **one** box.

The final energy level would be higher. ☐

The final energy level would be lower. ☐

The line would reach a higher peak. ☐

The line would reach a lower peak. ☐

0 2 . 6 Ammonia and nitric acid react to produce the salt, ammonium nitrate.

Ammonium ions and nitrate ions both contain nitrogen.

Suggest **one** use of ammonium nitrate.

[1 mark]

_____

_____

8

4.4.2.3 Soluble salts

Question 33

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 _____

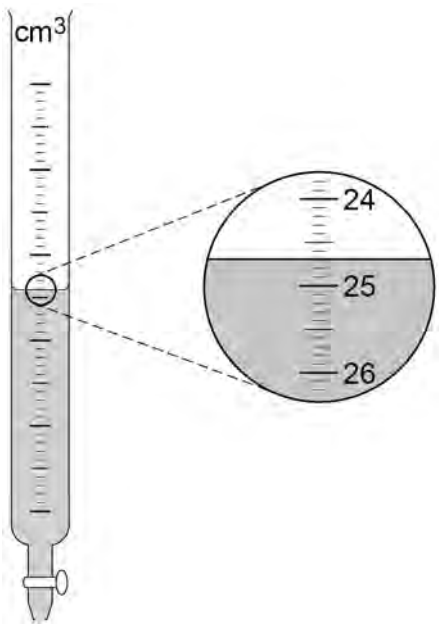
_____

4.4.2.3 Soluble salts

Question 33 · continued

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

Figure 9



What is the reading on the burette?

[1 mark]

_____ cm^3

4.4.2.3 Soluble salts

Question 33 · 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

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

4.4.2.3 Soluble salts

Question 34

June 2025 | 8462/1H | Original Q9

0 9 Zinc reacts with iodine to produce the salt zinc iodide.

The reaction is done in a solution using ethanol as the solvent.

Ethanol is a flammable liquid with a boiling point of 78 °C.

Table 5 shows the solubility of zinc, iodine and zinc iodide in ethanol.

Table 5

	Zinc	Iodine	Zinc iodide
Solubility in ethanol	Insoluble	Soluble	Soluble

0 9 . 1 Plan a method to obtain crystals of zinc iodide from zinc and iodine.

[6 marks]

Extra space

4.4.2.3 Soluble salts

Question 34 · continued

0 9 . 2 A student used 6.35 g of iodine in the reaction.

6.29 g of zinc iodide was produced.

The equation for the reaction is:

$$Zn + I_2 \longrightarrow ZnI_2$$

Calculate the percentage yield of zinc iodide.

Give your answer to 3 significant figures.

Relative formula masses (M_r): $I_2 = 254$ $ZnI_2 = 319$

[5 marks]

Percentage yield (3 significant figures) = _____ %

11