AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.4.2.4

The pH scale and neutralisation

Past-paper questions

Tier	**Foundation**
Question groups	**32**
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.

4.4.2.4 The pH scale and neutralisation

Question 01

January 2008 | CHY2F | Original Q3 | Legacy

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



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

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

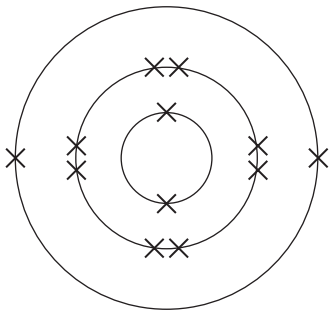
Complete the following sentence using the correct words from the box.

gives out heat	**stores heat**	**takes in heat**

An *exothermic* reaction is one which ..... .

(1 mark)

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



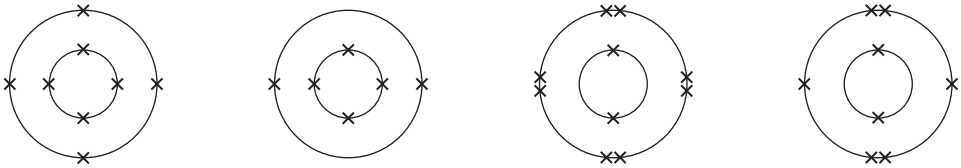
Magnesium atom

Question 01 · continued

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The atomic (proton) number of oxygen is 8.

Which diagram, **A**, **B**, **C** or **D**, shows the electronic structure of an oxygen atom?

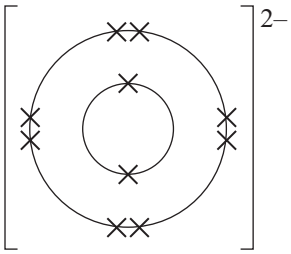


A **B** **C** **D**

Diagram .....

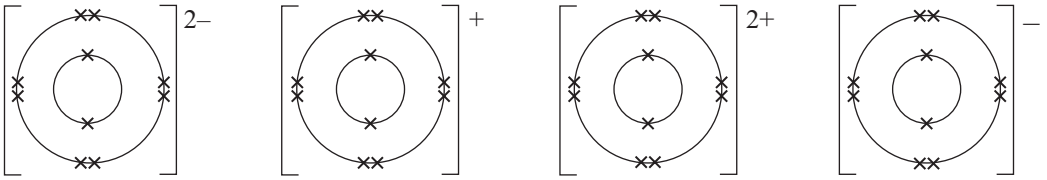
(1 mark)

(c) Magnesium ions and oxide ions are formed when magnesium reacts with oxygen. The diagram shows the electronic structure of an oxide ion.



Oxide ion

Which diagram, **J**, **K**, **L** or **M**, shows the electronic structure of a magnesium ion?



J **K** **L** **M**

Diagram .....

(1 mark)

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

Draw a ring around the name of the salt formed when magnesium oxide reacts with hydrochloric acid.

magnesium chloride **magnesium hydroxide** **magnesium sulfate**

(1 mark)

4

4.4.2.4 The pH scale and neutralisation

Question 02

June 2008 | CHY2F | Original Q1 | Legacy

1 This label was taken from a cola drink.



The pH of this drink is 2.5.

1 (a) (i) Which **one** of the ingredients in the cola drink causes the low pH?

.....

(1 mark)

1 (a) (ii) Draw a ring around the name of the ion that gives the cola drink its low pH.

chloride **hydrogen** **hydroxide** **sodium**

(1 mark)

4.4.2.4 The pH scale and neutralisation

Question 02 · continued

for mark

1 (b) The preservative used in the cola drink is sodium benzoate.
Sodium benzoate is made using two chemical reactions.

Reaction 1
Methylbenzene is reacted with oxygen, with the help of a catalyst, to form benzoic acid.

Reaction 2
Benzoic acid is neutralised by sodium hydroxide solution to form sodium benzoate and water.

1 (b) (i) How does the catalyst help **reaction 1**?

.....

.....

(1 mark)

1 (b) (ii) **Reaction 1** has a high atom economy.

The table lists several statements. Put a tick (✓) next to the **one** statement which best describes a high atom economy.

Statement	(✓)
All the atoms used are cheap.	
Most of the starting materials end up as useful products.	
Only a small number of atoms are used in the reaction.	

(1 mark)

1 (b) (iii) **Reaction 2** is a neutralisation reaction.

Complete the equation by writing the formula of the product.

$H^+ + OH^- \rightarrow$ .....

(1 mark)

5

4.4.2.4 The pH scale and neutralisation

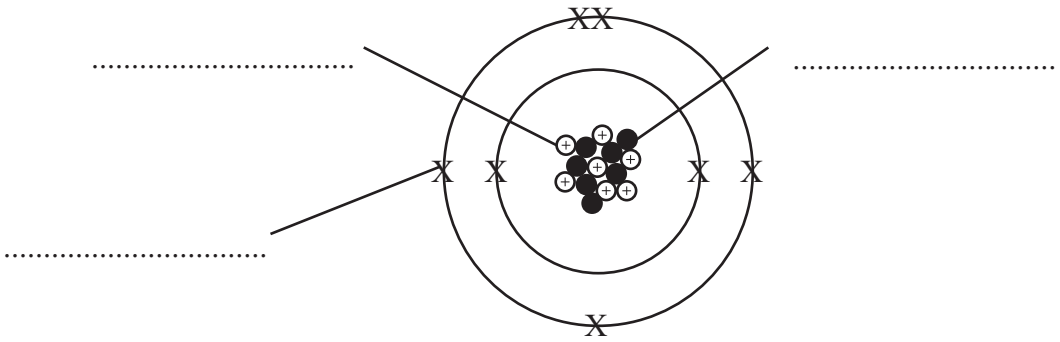
Question 03

June 2008 | CHY2F | Original Q5 | Legacy

5 (a) The diagram represents an atom of nitrogen.

5 (a) (i) Use words from the box to label the diagram.

electron	**neutron**	**nucleus**	**proton**



(2 marks)

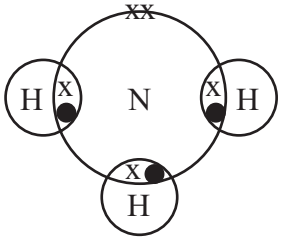
5 (a) (ii) Draw a ring around the mass number of this atom.

5 **7** **14** **21**

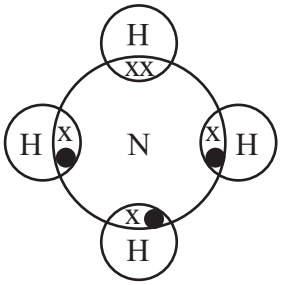
(1 mark)

5 (b) Nitrogen can react with hydrogen to make ammonia, NH_3.

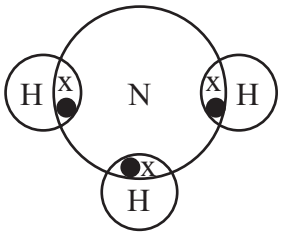
A



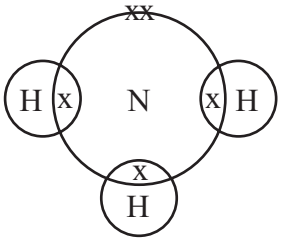
B



C



D



Which diagram, **A**, **B**, **C** or **D**, best represents an ammonia molecule?

(1 mark)

4.4.2.4 The pH scale and neutralisation

Question 03 · continued

for mark

5 (c) Ammonia is made using the Haber process. The word equation for this reaction is shown below.

nitrogen + hydrogen $\rightleftharpoons$ ammonia

5 (c) (i) Which **two** of the statements in the table do you know are true **only** by looking at the word equation?

Put a tick (✓) next to these **two** true statements.

Statement	(✓)
The reaction is very fast.	
Ammonia can break up to form nitrogen and hydrogen.	
Ammonia is made from nitrogen and hydrogen.	
The reaction that makes ammonia is endothermic.	

(2 marks)

5 (c) (ii) Draw a ring around the name of the raw material from which nitrogen is obtained.

air **methane** **oil** **water**

(1 mark)

5 (d) Some of the ammonia produced is neutralised by nitric acid to make a salt. This salt is used as a fertiliser.

Put a tick (✓) next to the name of the salt produced when ammonia is neutralised with nitric acid.

Name of salt	(✓)
ammonia nitrate	
ammonia nitride	
ammonium nitrate	
ammonium nitride	

(1 mark)

8

4.4.2.4 The pH scale and neutralisation

Question 04

6 (a) Nicotinic acid is a weak acid. It has the formula C_5H_4NCOOH.

Hydrochloric acid is a strong acid. It has the formula HCl.

6 (a) (i) Give the name or formula of the ion that makes solutions acidic.

.....

(1 mark)

6 (a) (ii) Weak acids contain fewer of these ions than strong acids of the same concentration.

Describe and give the results of an experiment to show that nicotinic acid is a weaker acid than hydrochloric acid of the same concentration.

.....

.....

.....

.....

(2 marks)

6 (b) Read the following information.

It's all in a name

Nicotinic acid is an important chemical. It is also known as niacin or vitamin B_3. It is found in many foods including eggs, meat, poultry, fish, leafy vegetables, carrots and cereals. It is also in tea and coffee.

A lack of nicotinic acid in our diet causes the disease pellagra. The symptoms of pellagra include diarrhoea, dermatitis and dementia. People can die. Pellagra is a common disease of malnutrition in Africa.

Nicotinic acid can be made by oxidising nicotine.

Nicotine is found in tobacco, tomatoes and potatoes. Smoking tobacco is said to cause the death of millions of people each year from cancer.

DC/AC (Dedicated Citizens Against Chemicals) is a pressure group that wants the government to ban nicotine and chemicals made from nicotine. Many people oppose such a ban and there is to be a televised debate.

4.4.2.4 The pH scale and neutralisation

Question 04 · continued

for mark

In the television programme, DC/AC and their opponents gave their reasons. You have to suggest what they were.

6 (b) (i) DC/AC said that nicotine and chemicals made from nicotine should be banned because

.....

.....

.....

.....

(2 marks)

6 (b) (ii) Their opponents said that nicotine and chemicals made from nicotine should **not** be banned because

.....

.....

.....

.....

(2 marks)

7

4.4.2.4 The pH scale and neutralisation

Question 05

2 Ammonium salts are used to help farmers grow crops.



2 (a) Use the correct word from the box to complete the sentence.

fertilisers	**insecticides**	**pesticides**

Ammonium salts contain nitrogen and are used by farmers as ..... to replace the nitrogen lost from the soil.

(1 mark)

2 (b) Ammonia is made by reacting nitrogen with hydrogen.

Draw a ring around the name of the raw material that provides the nitrogen.

air **crude oil** **water**

(1 mark)

2 (c) Methane and water react together to form the hydrogen.

methane and water → reactor containing a catalyst → hydrogen and carbon monoxide

2 (c) (i) Complete the word equation for this reaction.

methane + ... → hydrogen + ...

(1 mark)

4.4.2.4 The pH scale and neutralisation

Question 05 · continued

for mark

2 (c) (ii) How does the catalyst help this reaction?

.....

.....

(1 mark)

2 (d) The reaction between nitrogen and hydrogen to make ammonia can be represented by this equation.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Draw a ring around the meaning of the symbol, $\rightleftharpoons$

endothermic reaction **precipitation reaction** **reversible reaction**

(1 mark)

2 (e) A solution of ammonia in water is alkaline.

2 (e) (i) Which **one** of these values could be the pH of this ammonia solution?

Draw a ring around your answer.

4 **7** **10**

(1 mark)

2 (e) (ii) The ammonium salt called ammonium sulfate can be made by reacting ammonia solution with an acid.

Use the correct words from the box to complete the sentences.

hydrochloric	**hydrogen**	**sulfuric**	**water**

Ammonia solution is reacted with ..... acid to make ammonium sulfate.

During the reaction the hydrogen ions from the acid react with hydroxide

ions from the alkali to make..... .

(2 marks)

8

4.4.2.4 The pH scale and neutralisation

Question 06

June 2019 | CHY3F | Original Q1 | Legacy

1 The table shows some information about acids and alkalis.

Name of acid or alkali	Type	Ions produced in solution		pH	Effect on Universal Indicator
Hydrochloric acid	Strong acid	H^+	Cl^-	1	Goes red
Sodium hydroxide	Strong alkali	Na^+	OH^-	13	Goes purple

Use the information in the table to help you answer parts **(a)** and **(b)**.

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

1 (a) (i) Hydrochloric acid is acidic.

This is because it contains [Cl^- / H^+ / OH^-] ions.

(1 mark)

1 (a) (ii) Sodium hydroxide solution is alkaline.

This is because it contains [H^+ / Na^+ / OH^-] ions.

(1 mark)

1 (a) (iii) The pH of acids is [higher than / lower than / the same as] the pH of alkalis.

(1 mark)

4.4.2.4 The pH scale and neutralisation

Question 06 · continued

1 (b) Ethanoic acid is a weak acid.

Universal Indicator can be used to show that hydrochloric acid is a stronger acid than ethanoic acid of the same concentration.

Explain how.

.....

.....

.....

.....

(2 marks)

1 (c) Draw a ring around the correct answer to complete this sentence.

Strong acids and strong alkalis are | completely | not | partially | ionised in water.

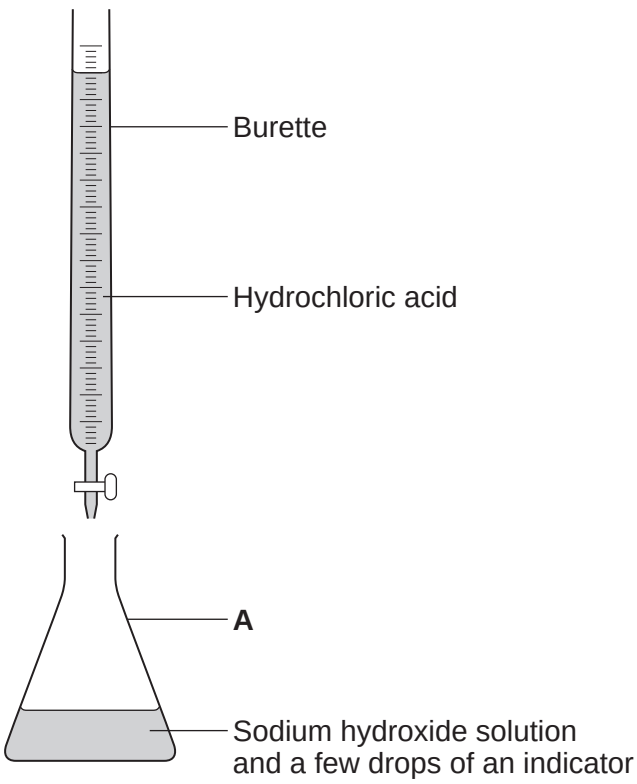
(1 mark)

Question 1 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 06 · continued

1 (d) The diagram shows the apparatus used to find the volume of hydrochloric acid that reacts with 25.0 cm^3 of sodium hydroxide solution.



1 (d) (i) Which **one** of the following is the correct name for **A**?

Draw a ring around your answer.

beaker **conical flask** **pipette**

(1 mark)

1 (d) (ii) Use the correct word from the box to complete the sentence.

distillation	**filtration**	**titration**

The method used to find the volume of acid that reacts with a known volume of alkali is ..... .

(1 mark)

1 (d) (iii) Suggest **one** way to make the results more reliable.

.....

(1 mark)

9

4.4.2.4 The pH scale and neutralisation

Question 07

3 This label was on a bottle of vinegar.



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

3 (a) Draw a ring around the correct answer to complete the sentences.

3 (a) (i) Ethanoic acid is an acid because it contains [hydrogen / hydroxide / oxide] ions.

(1 mark)

3 (a) (ii) Ethanoic acid is a *weak* acid because it is [completely / not / partially] ionised in water.

(1 mark)

3 (b) Magnesium ribbon can be used in a test to show that ethanoic acid is a weaker acid than hydrochloric acid.

3 (b) (i) State **one** way of making this test fair.

.....

.....

(1 mark)

3 (b) (ii) Give the results of this test.

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.....

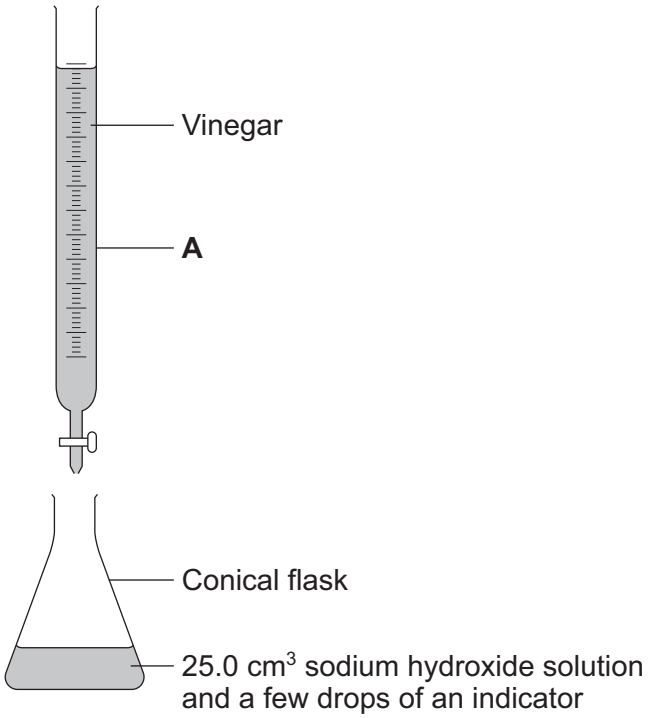
.....

(2 marks)

4.4.2.4 The pH scale and neutralisation

Question 07 · continued

3 (c) The diagram shows the apparatus a student used to find the volume of vinegar that reacts with 25.0 cm^3 of sodium hydroxide solution.



3 (c) (i) Choose the correct word from the box to complete the sentence.

filtration	**polymerisation**	**titration**

The name of this method is ..... .

(1 mark)

3 (c) (ii) Which **one** of the following is the correct name for apparatus **A**?

Draw a ring around **one** answer.

burette **measuring cylinder** **pipette**

(1 mark)

3 (c) (iii) State how the student knew when enough vinegar had been added.

.....

.....

(1 mark)

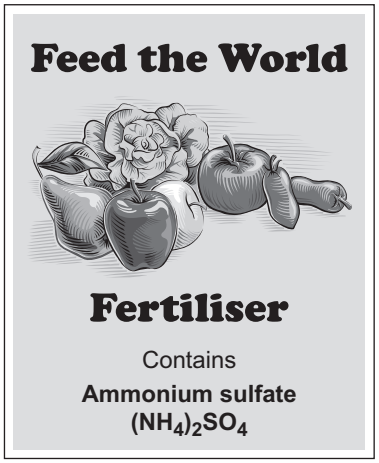
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4.4.2.4 The pH scale and neutralisation

Question 08

June 2011 | CHY3F | Original Q3 | Legacy

3 Ammonium sulfate is an artificial fertiliser.



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

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

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

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

A gas called ammonia was produced.

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

(2 marks)

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

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

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

(2 marks)

4.4.2.4 The pH scale and neutralisation

Question 08 · continued June 2011 | CHY3F | Original Q3 | Legacy

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

Sulfuric acid is a *strong* acid.

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

The word *strong* means that the acid is

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

(1 mark)

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

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

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

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

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

(1 mark)

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

The pH of stronger acids is

- higher than
- lower than
- the same as

the pH of weaker acids.

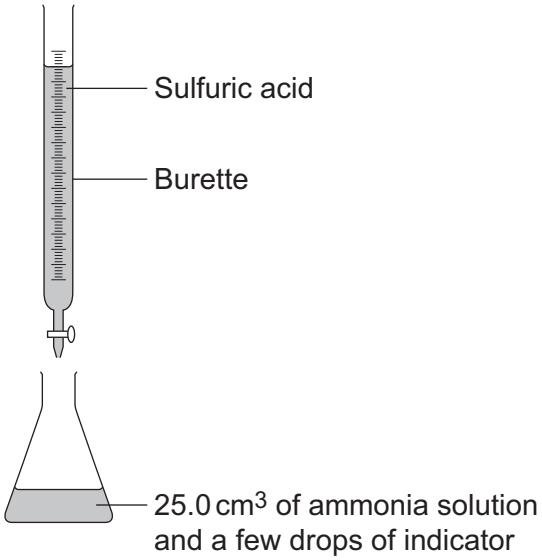
(1 mark)

4.4.2.4 The pH scale and neutralisation

Question 08 · continued

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

The diagram shows the apparatus used for the titration.



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

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

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

.....

.....

(1 mark)

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

Which result was anomalous? .....

(1 mark)

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

.....

.....

Mean volume = ... cm^3

(1 mark)

10

4.4.2.4 The pH scale and neutralisation

Question 09

June 2012 | CH2FP | Original Q7 | Legacy

7 (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 7 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 09 · continued June 2012 | CH2FP | Original Q7 | Legacy

7 (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)

7 (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.

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

.....

.....

(1 mark)

4.4.2.4 The pH scale and neutralisation

Question 09 · continued

7 (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.

.....

.....

.....

.....

(3 marks)

11

4.4.2.4 The pH scale and neutralisation

Question 10

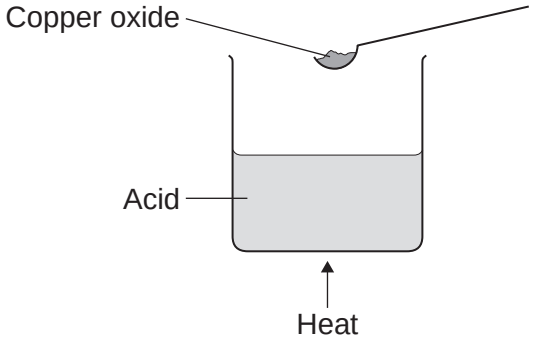
January 2013 | CH2FP | Original Q5 | Legacy

5 A student added copper oxide to an acid to make copper sulfate.

The student heated the acid.

The student added copper oxide until no more reacted.

5 (a) The diagram shows the first stage in the experiment.



5 (a) (i) Complete the word equation.

Copper oxide + ... acid → copper sulfate + water

(1 mark)

5 (a) (ii) Which **one** of these values could be the pH of the acid?

Draw a ring around the correct answer.

1 **7** **11**

(1 mark)

5 (a) (iii) Why is the acid heated?

.....

.....

(1 mark)

5 (b) After the reaction is complete, some solid copper oxide remains.
Why?

.....

.....

(1 mark)

4.4.2.4 The pH scale and neutralisation

Question 10 · continued

5 (c) The student removed the solid copper oxide from the solution.

Suggest what the student should do to the solution to form copper sulfate crystals.

.....

.....

(1 mark)

5 (d) The mass of copper sulfate crystals was less than the student expected.

Tick (✓) the **one** statement that explains why the mass of copper sulfate crystals was less than expected.

Statement	Tick (✓)
Some copper sulfate may have been lost during the experiment.	
The student added too much copper oxide.	
The copper sulfate crystals were wet when they were weighed.	

(1 mark)

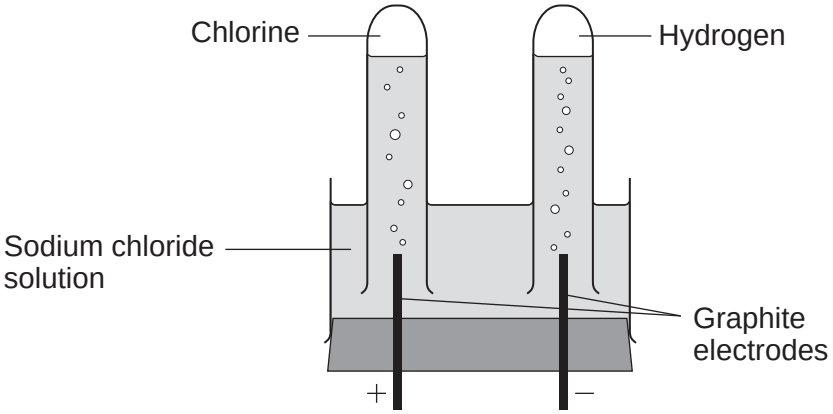
6

4.4.2.4 The pH scale and neutralisation

Question 11

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

The diagram shows the apparatus used in a school experiment.



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

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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

4.4.2.4 The pH scale and neutralisation

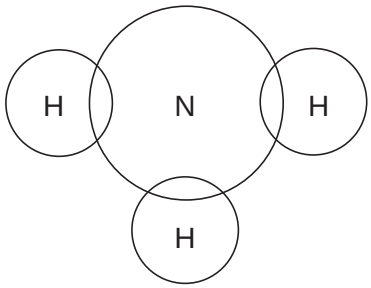
Question 11 · continued

8 (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)

8 (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.

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

.....

(1 mark)

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

Write the ionic equation for the neutralisation reaction.

.....

(1 mark)

Question 8 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 11 · continued

8 (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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4.4.2.4 The pH scale and neutralisation

Question 12

June 2013 | CH2FP | Original Q2 | Legacy

2 This question is about salts of ammonia and salts of lead.

2 (a) Ammonia dissolves in water to make an alkaline solution.

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

The pH of a solution of ammonia is

2.

7.

11.

(1 mark)

2 (b) Ammonia can be reacted with an acid to produce the salt ammonium nitrate.

2 (b) (i) Name the acid used to produce ammonium nitrate.

.....

(1 mark)

2 (b) (ii) Draw a ring around the correct answer to complete the sentence.

The reaction of ammonia with an acid is a

neutralisation

polymerisation

reduction

reaction.

(1 mark)

2 (c) Why do farmers use ammonium nitrate on their fields?

.....

.....

(1 mark)

4.4.2.4 The pH scale and neutralisation

Question 12 · continued June 2013 | CH2FP | Original Q2 | Legacy

2 (d) Lead iodide is a salt that can be produced without using an acid.

2 (d) (i) Lead iodide is produced by mixing two solutions.

Complete the word equation.

lead ..... + potassium ..... ⟶ lead iodide + potassium nitrate

(2 marks)

2 (d) (ii) The lead iodide is produced as a solid.

Complete the sentence.

A solid that is produced when two solutions are mixed is called a ..... .

(1 mark)

2 (d) (iii) How could the solid lead iodide be separated from the solution?

.....

(1 mark)

2 (d) (iv) A student mixed two solutions to make sodium chloride.

The equation for the reaction the student used is:

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

How could the student obtain solid sodium chloride from the solution?

.....

(1 mark)

9

4.4.2.4 The pH scale and neutralisation

Question 13

June 2014 | CH2FP | Original Q4 | Legacy

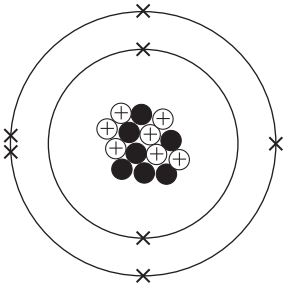
4 Fertilisers contain elements that plants need.

AQAGROW
Plant Fertiliser

Contains:
- Nitrogen
- Phosphorus
- Potassium

4 (a) **Figure 5** represents a nitrogen atom.

Figure 5



Complete each sentence.

4 (a) (i) The mass number of this nitrogen atom is ..... .

[1 mark]

4 (a) (ii) Atoms of nitrogen with different numbers of neutrons are called ..... .

[1 mark]

4 (a) (iii) Compared with a proton, the mass of an electron is ..... .

[1 mark]

4.4.2.4 The pH scale and neutralisation

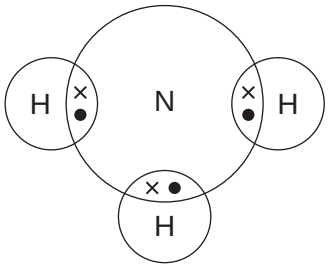
Question 13 · continued

4 (b) Fertilisers can be made from ammonia.

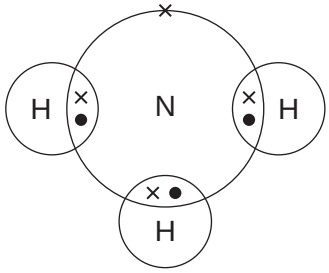
4 (b) (i) Which diagram, **A**, **B**, or **C**, represents the electronic structure of an ammonia molecule?

[1 mark]

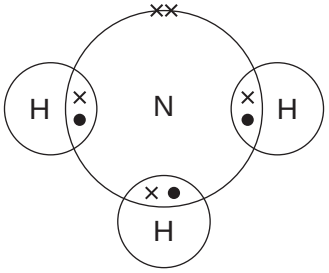
A



B



C



The electronic structure of an ammonia molecule is shown in diagram ☐

4 (b) (ii) What is the correct formula of ammonia?

Draw a ring around the correct answer.

[1 mark]

N_3H **NH_3** **NH^3**

Question 4 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 13 · continued

4 (c) A student made ammonium nitrate by reacting ammonia solution with an acid.

4 (c) (i) Name the acid used to make ammonium nitrate.

[1 mark]

.....

4 (c) (ii) Complete the sentence.

[1 mark]

The student added a few drops of ....., which changed colour when the ammonia solution had neutralised the acid.

4 (c) (iii) The student added charcoal and filtered the mixture.

This produced a colourless solution of ammonium nitrate.

How is solid ammonium nitrate obtained from the solution?

[1 mark]

.....

4 (c) (iv) A farmer put ammonium nitrate fertiliser onto a field of grass.

Suggest what would happen to the grass.

[1 mark]

.....

.....

4.4.2.4 The pH scale and neutralisation

Question 13 · continued

4 (d) Some fertilisers contain potassium chloride.

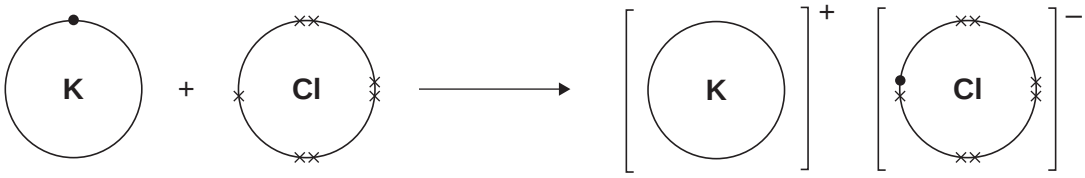
Potassium reacts with chlorine to produce potassium chloride.

Figure 6 shows how this happens.

The dots (•) and crosses (x) represent electrons.

Only the outer shell is shown.

Figure 6



Use **Figure 6** to help you answer this question.

Describe, as fully as you can, what happens when potassium reacts with chlorine to produce potassium chloride.

[4 marks]

.....

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.....

13

4.4.2.4 The pH scale and neutralisation

Question 14

June 2014 | CH2FP | Original Q6 | Legacy

6 The label shows the ingredients in a drink called Cola.

Cola

Ingredients:

Carbonated water
Sugar
Colouring
Phosphoric acid
Flavouring
Caffeine

6 (a) (i) The pH of carbonated water is 4.5.

The pH of Cola is 2.9.

Name the ingredient on the label that lowers the pH of Cola to 2.9.

[1 mark]

.....

6 (a) (ii) Which ion causes the pH to be 2.9?

[1 mark]

.....

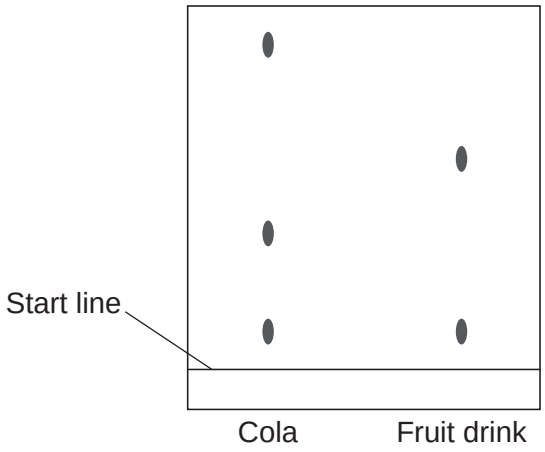
4.4.2.4 The pH scale and neutralisation

Question 14 · continued

6 (b) A student investigated the food colouring in Cola and in a fruit drink using paper chromatography.

The chromatogram in **Figure 8** shows the student's results.

Figure 8



6 (b) (i) Complete the sentence.

The start line should be drawn with a ruler and ..... .

Give a reason for your answer.

[2 marks]

.....

.....

6 (b) (ii) Suggest **three** conclusions you can make from the student's results.

[3 marks]

.....

.....

.....

.....

.....

.....

4.4.2.4 The pH scale and neutralisation

Question 14 · continued

6 (c) Caffeine can be separated from the other compounds in the drink by gas chromatography.

Why do different compounds separate in a gas chromatography column?

[1 mark]

.....

.....

6 (d) Caffeine is a stimulant.

Large amounts of caffeine can be harmful.

6 (d) (i) Only **one** of the questions in the table **can** be answered by science alone.

Tick (✓) **one** question.

[1 mark]

Question	Tick (✓)
Should caffeine be an ingredient in drinks?	
Is there caffeine in a certain brand of drink?	
How much caffeine should people drink?	

6 (d) (ii) Give **two** reasons why the other questions **cannot** be answered by science alone.

[2 marks]

Reason 1 .....

.....

Reason 2 .....

.....

11

4.4.2.4 The pH scale and neutralisation

Question 15

June 2015 | CH1FP | Original Q5 | Legacy

5 Limestone is used to make many different materials.

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

Complete the sentences.

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

[1 mark]

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

[1 mark]

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

[1 mark]

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

[1 mark]

Question 5 continues on the next page

Question 15 · continued

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

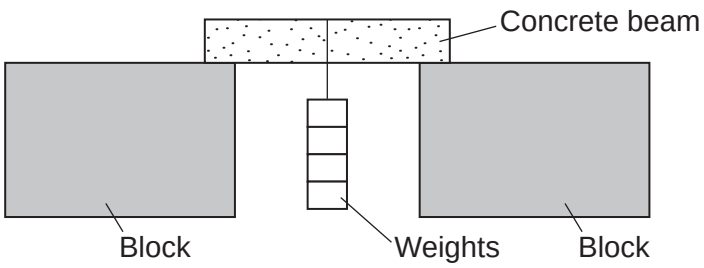
Concrete is made by mixing cement with water, sand and aggregate (small pieces of rock).

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

The students used this method:

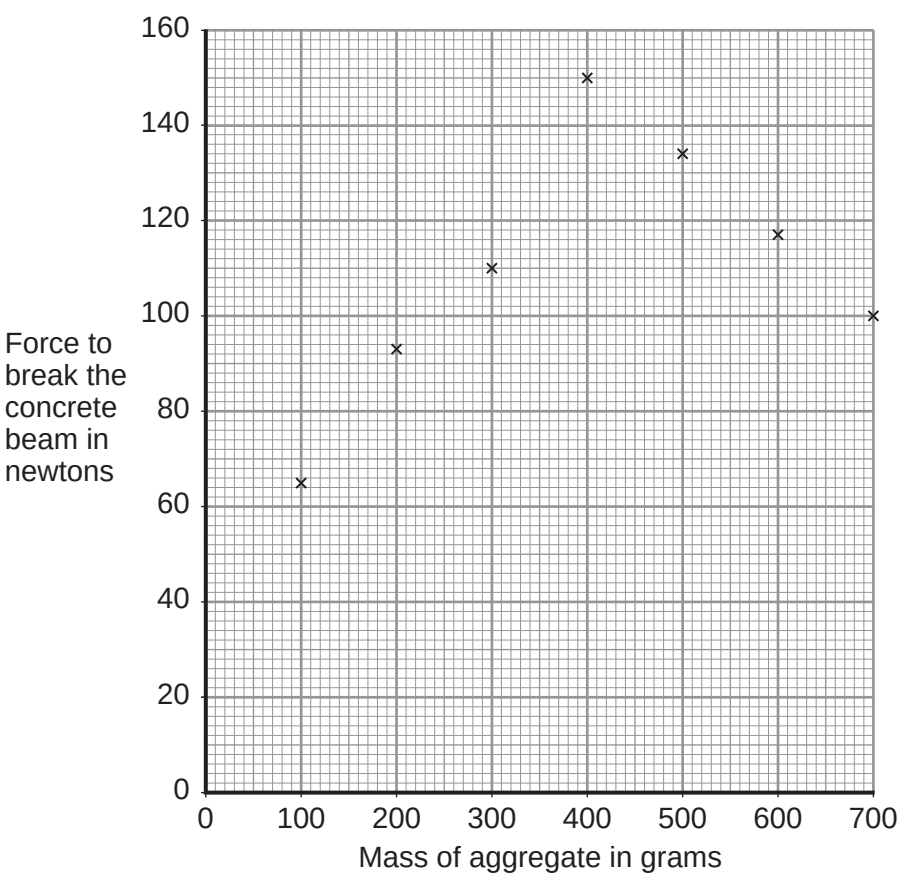
- use the same mass of cement and the same mass of sand but change the mass of aggregate to make seven different concrete mixtures
- use the different concrete mixtures to make beams of the same size
- add weights, as shown in **Figure 7**, until the concrete beam breaks.

Figure 7



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

Figure 8



4.4.2.4 The pH scale and neutralisation

Question 15 · continued

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

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

[2 marks]

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

[2 marks]

.....

.....

.....

.....

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

Show your working on the graph.

[2 marks]

Force = ... newtons

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

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

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

[3 marks]

.....

.....

.....

.....

.....

.....

13

4.4.2.4 The pH scale and neutralisation

Question 16

7 Some pollutants cause acid rain.

A student tested 25.0 cm^3 samples of three types of rainwater, **P**, **Q** and **R**.
The student titrated the samples with sodium hydroxide solution (an alkali).

The student recorded the volume of sodium hydroxide solution needed to neutralise the rainwater. The student's results are shown in **Table 1**.

Table 1

	Volume of sodium hydroxide needed to neutralise the rainwater in cm^3				
Type of rainwater	**Titration 1**	**Titration 2**	**Titration 3**	**Titration 4**	**Mean value**
P	18.0	15.5	14.5	15.0	15.0
Q	13.0	10.0	11.0	10.5	10.5
R	23.0	19.5	18.5	19.0	19.0

7 (a) (i) The student calculated the mean value for rainwater **R** as 19.0 cm^3.

Show how the student calculated the mean value for rainwater **R**.

[2 marks]

.....

.....

.....

.....

7 (a) (ii) Write down **P**, **Q** and **R** in order of their acidity.

[2 marks]

Most acidic .....

.....

Least acidic .....

4.4.2.4 The pH scale and neutralisation

Question 16 · continued

7 (b) A second student repeated the experiment and recorded the results in **Table 2**.

Table 2

	Volume of sodium hydroxide needed to neutralise the rainwater in cm^3	
Type of rainwater	**Titration 1**	**Titration 2**
P	17	15
Q	11	9
R	20	18

Use **Table 1** and **Table 2** to suggest **two** improvements the second student could make to obtain more accurate results.

[2 marks]

.....

.....

.....

.....

7 (c) The results of the two students show that the experiment is reproducible.

Give the reason why.

[1 mark]

.....

.....

7

4.4.2.4 The pH scale and neutralisation

Question 17

June 2016 | CH2FP | Original Q6 | Legacy

6 This question is about ammonia and fertilisers.

6 (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 _____ .

6 (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 = _____%

4.4.2.4 The pH scale and neutralisation

Question 17 · continued June 2016 | CH2FP | Original Q6 | Legacy

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

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

[1 mark]

pH _____

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

[1 mark]

Tick (✓) **one** box.

$H^+ + OH^- \longrightarrow H_2O$ ☐

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

$H^+ + Cl^- \longrightarrow HCl$ ☐

$H^+ + H_2O \longrightarrow H_3O^+$ ☐

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

[1 mark]

_____

Question 6 continues on the next page

Question 17 · continued

6 (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.

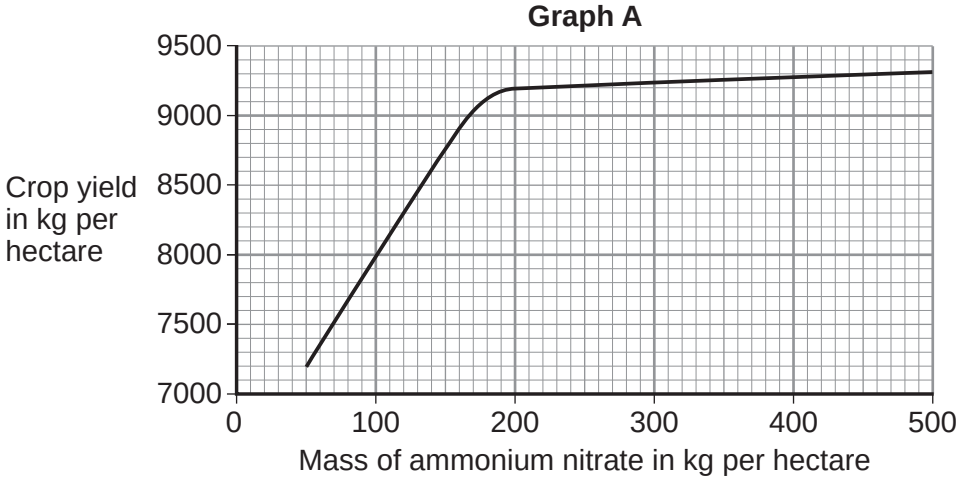
Rainwater dissolves ammonium nitrate in the soil.

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

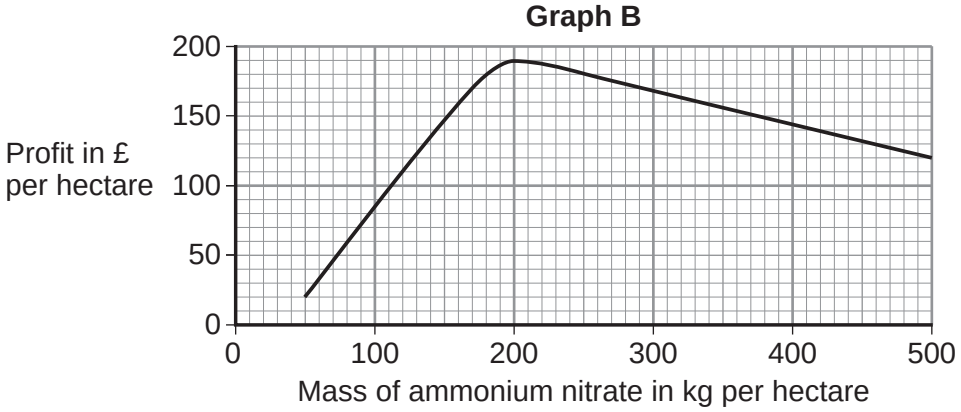
Figure 12 shows three graphs **A**, **B** and **C**. The graphs show information about the use of ammonium nitrate as a fertiliser. A hectare is a measurement of an area of land.

Figure 12

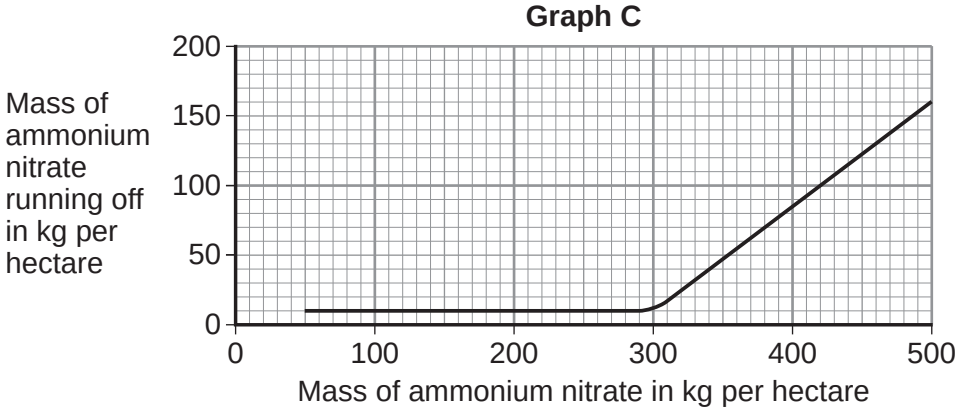
Graph A



Graph B



Graph C



4.4.2.4 The pH scale and neutralisation

Question 17 · 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

4.4.2.4 The pH scale and neutralisation

Question 18

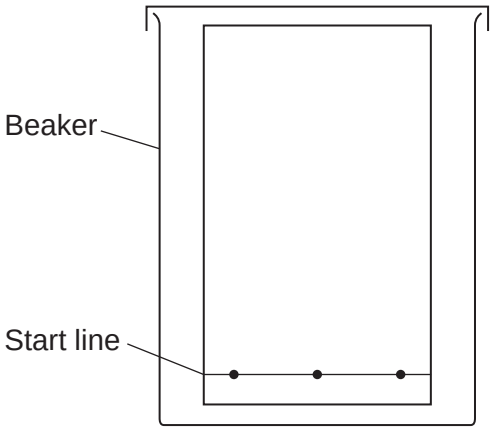
June 2017 | CH2FP | Original Q1 | Legacy

1 This question is about methods of analysis.

1 (a) A student used paper chromatography to identify colours in an ink.

Figure 1 shows the apparatus the student used.

Figure 1



1 (a) (i) Why should the student use a pencil and not a pen to draw the start line?

[1 mark]

_____

1 (a) (ii) The student put water in the beaker.

Use the correct answer from the box to complete the sentence.

[1 mark]

above	**below**	**on**

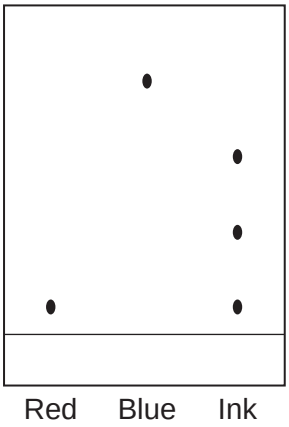
The water level should be _____ the start line drawn by the student.

4.4.2.4 The pH scale and neutralisation

Question 18 · continued

1 (a) (iii) **Figure 2** shows the student's results.

Figure 2



Give **two** conclusions about the colours in the ink.

[2 marks]

Question 1 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 18 · continued

1 (b) Gas chromatography is an instrumental method of analysis.

1 (b) (i) Use the correct answer from the box to complete the sentence.

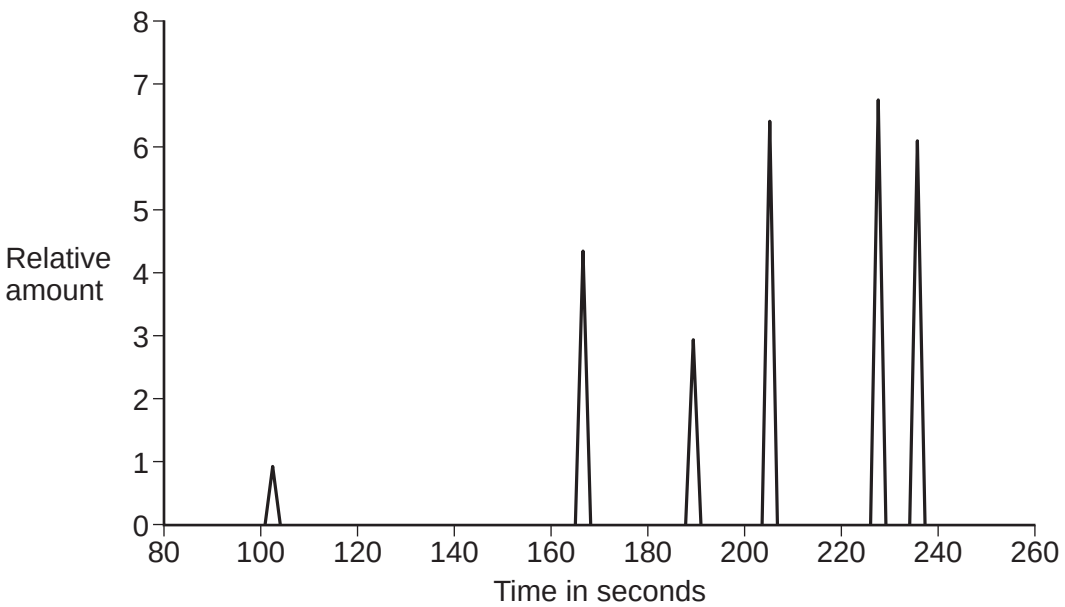
[1 mark]

neutralised	**reduced**	**separated**

The mixture of compounds in gas chromatography is _____ .

1 (b) (ii) **Figure 3** shows the results from a gas chromatograph.

Figure 3



How many compounds were in the sample?

[1 mark]

_____

1 (b) (iii) Give **one** advantage of using instrumental methods of analysis.

[1 mark]

_____

7

4.4.2.4 The pH scale and neutralisation

Question 19

June 2017 | CH2FP | Original Q2 | Legacy

2 This question is about sulfuric acid, copper sulfate and ethene.

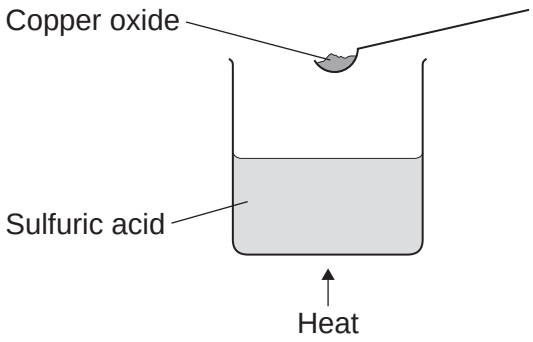
2 (a) A student added copper oxide to sulfuric acid to make copper sulfate.

The word equation for the reaction is:

sulfuric acid + copper oxide ⟶ copper sulfate + water

Figure 4 shows the first stage of the student's method.

Figure 4



2 (a) (i) The state symbol for CuO is missing from the equation below.

Use the correct answer from the box to complete the equation.

[1 mark]

aq	g	l	s

H_2SO_4 (aq) + CuO (___) ⟶ $CuSO_4$ (aq) + H_2O (l)

2 (a) (ii) Why is the sulfuric acid heated?

[1 mark]

_____

_____

Question 2 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 19 · continued

2 (a) (iii) Which of these values could be the pH of sulfuric acid?

[1 mark]

Tick (✓) **one** box.

1 ☐

7 ☐

11 ☐

14 ☐

2 (a) (iv) Why does the student continue to add copper oxide until some is left at the end of the reaction?

[1 mark]

Tick (✓) **one** box.

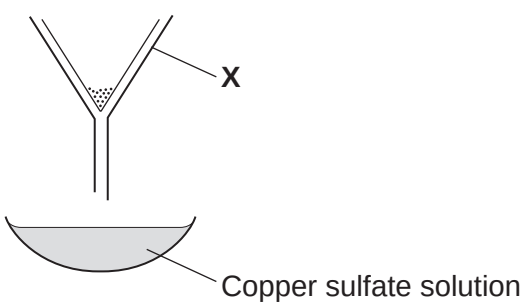
To make bigger copper sulfate crystals. ☐

To make sure all the copper oxide has reacted. ☐

To make sure all the sulfuric acid has reacted. ☐

2 (b) **Figure 5** shows the second stage of the student's method.

Figure 5



4.4.2.4 The pH scale and neutralisation

Question 19 · continued

2 (b) (i) Name the apparatus labelled **X** on **Figure 5**.

[1 mark]

_____

2 (b) (ii) What could the student do to the copper sulfate solution to get copper sulfate crystals?

[1 mark]

_____

_____

2 (c) The student weighed the copper sulfate crystals.

Why was the mass of the copper sulfate crystals less than the student expected?

[1 mark]

Tick (✓) **one** box.

The student added too much copper oxide. ☐

The student left some copper sulfate crystals in the apparatus. ☐

The student weighed the copper sulfate crystals when they were wet. ☐

2 (d) The equation shows the reaction when blue hydrated copper sulfate crystals are heated.

hydrated copper sulfate $\rightleftharpoons$ anhydrous copper sulfate + water

2 (d) (i) What colour is anhydrous copper sulfate?

[1 mark]

_____

2 (d) (ii) What would you see if water is added to anhydrous copper sulfate?

[1 mark]

_____

4.4.2.4 The pH scale and neutralisation

Question 19 · continued

2 (e) Ethene and sulfuric acid are used to make many substances.

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	460	1 500	2 500

2 (e) (i) Use the correct answer from the box to complete the sentence.

[1 mark]

alloys	chlorine	graphite	polymers

Ethene is used to make _____ .

2 (e) (ii) Describe the relationship, if any, between the wealth of a country and the production of ethene.

[1 mark]

_____

_____

2 (e) (iii) Describe the relationship, if any, between the wealth of a country and the production of sulfuric acid.

[1 mark]

_____

_____

12

4.4.2.4 The pH scale and neutralisation

Question 20

June 2018 | 8462/1F | Original Q7

0 7 This question is about elements in Group 1.

A teacher burns sodium in oxygen.

0 7 . 1 Complete the word equation for the reaction.

[1 mark]

sodium + oxygen → _____

0 7 . 2 What is the name of this type of reaction?

[1 mark]

Tick **one** box.

- Decomposition ☐
- Electrolysis ☐
- Oxidation ☐
- Precipitation ☐

0 7 . 3 The teacher dissolves the product of the reaction in water and adds universal indicator.

The universal indicator turns purple.

What is the pH value of the solution?

[1 mark]

Tick **one** box.

1	☐	4	☐	7	☐	13	☐

4.4.2.4 The pH scale and neutralisation

Question 20 · continued

0 7 . 4 The solution contains a substance with the formula NaOH

Give the name of the substance.

[1 mark]

_____

0 7 . 5 All alkalis contain the same ion.

What is the formula of this ion?

[1 mark]

Tick **one** box.

H^+ ☐

Na^+ ☐

OH^- ☐

O^{2-} ☐

0 7 . 6 A solution of NaOH had a concentration of 40 g/dm^3

What mass of NaOH would there be in 250 cm^3 of the solution?

[2 marks]

_____

_____

_____

_____

Mass = _____ g

4.4.2.4 The pH scale and neutralisation

Question 20 · continued

0 7 . 7 The melting points of the elements in Group 1 show a trend.

Table 6 shows the atomic numbers and melting points of the Group 1 elements.

Table 6

Element	Atomic number	Melting point in °C
Lithium	3	181
Sodium	11	98
Potassium	19	63
Rubidium	37	**X**
Caesium	55	29

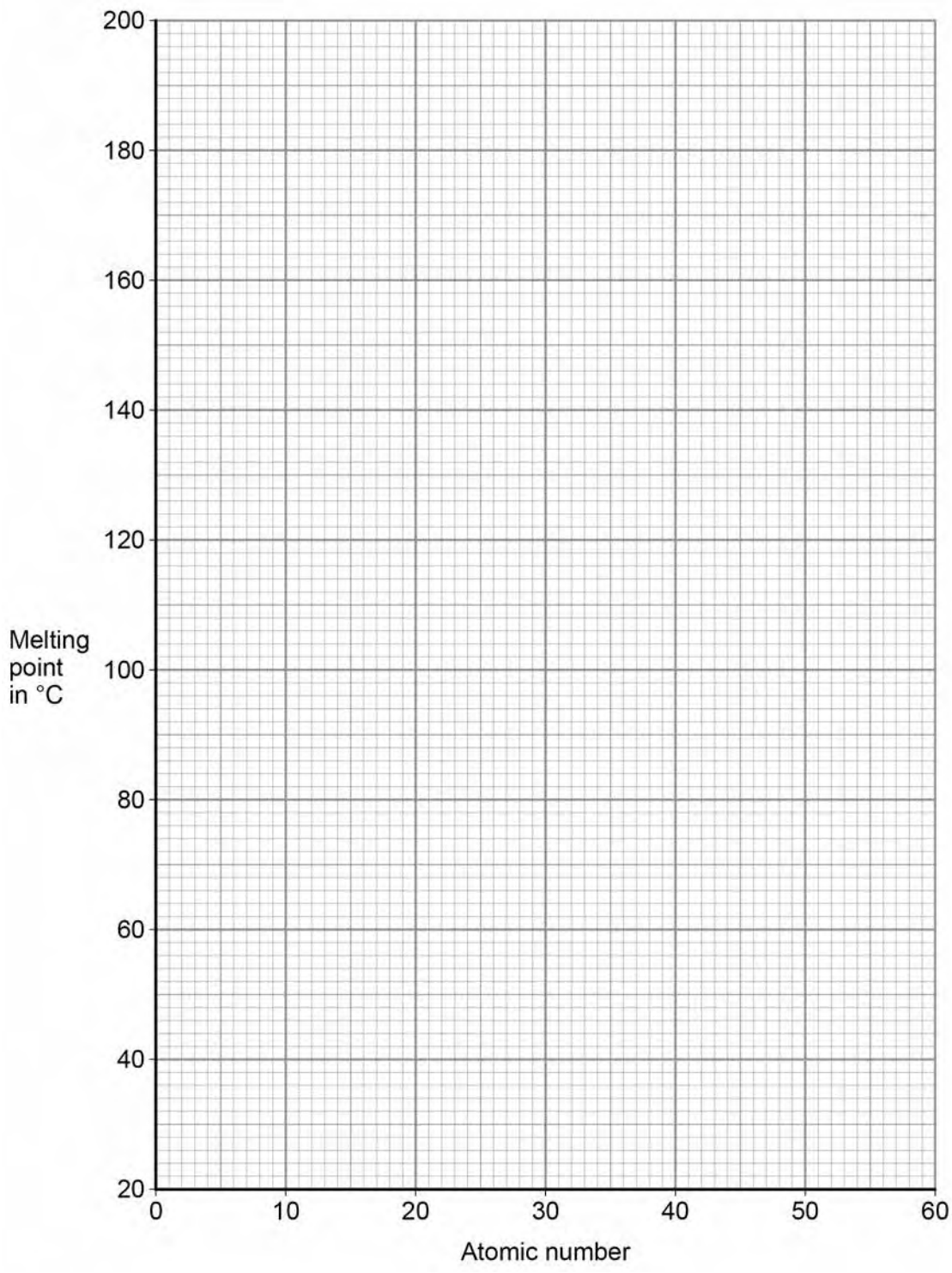
Plot the data from **Table 6** on **Figure 11**.

[2 marks]

4.4.2.4 The pH scale and neutralisation

Question 20 · continued

Figure 11



0 7 . 8 Predict the melting point, **X**, of rubidium, atomic number 37

Use **Figure 11**.

[1 mark]

Melting point = _____ °C

10

4.4.2.4 The pH scale and neutralisation

Question 21

June 2019 | 8462/1F | Original Q9

0 9 This question is about acids and alkalis.

0 9 . 1 Which ion do all acids produce in aqueous solution?

[1 mark]

Tick (✓) **one** box.

H^+ ☐

H^- ☐

O^{2-} ☐

OH^- ☐

0 9 . 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 9 continues on the next page

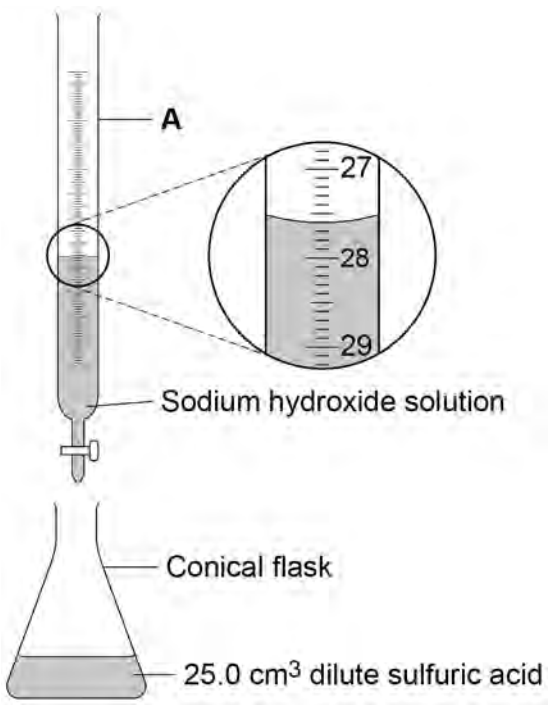
4.4.2.4 The pH scale and neutralisation

Question 21 · continued

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

Figure 12 shows the apparatus the student uses.

Figure 12



Use **Figure 12** to answer Questions **09.3** and **09.4**

0 9 . 3 Name apparatus **A**.

[1 mark]

0 9 . 4 What is the reading on apparatus **A**?

[1 mark]

_____ cm^3

4.4.2.4 The pH scale and neutralisation

Question 21 · continued

0 9 . 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]

4.4.2.4 The pH scale and neutralisation

Question 22

June 2019 | 8462/2F | Original Q1

0 1 This question is about drinking water.

There are two main steps in producing drinking water from fresh water.

0 1 . 1 Draw **one** line from each step to the reason for the step.

[2 marks]

Step	Reason for step
	Desalination
Filtration	Improve taste
	Increase pH
Sterilisation	Kill bacteria
	Remove solids

0 1 . 2 Which **two** substances are used to sterilise fresh water?

[2 marks]

Tick (✓) **two** boxes.

- Ammonia ☐
- Chlorine ☐
- Hydrogen ☐
- Nitrogen ☐
- Ozone ☐

4.4.2.4 The pH scale and neutralisation

Question 22 · continued June 2019 | 8462/2F | Original Q1

A large amount of aluminium sulfate was accidentally added to the drinking water supply at a water treatment works.

0 1 . 3 Scientists tested a sample of the drinking water to show that it contained dissolved solids.

Which **two** methods show the presence of dissolved solids in the sample of drinking water?

[2 marks]

Tick (✓) **two** boxes.

- Add damp litmus paper to the sample. ☐
- Evaporate all water from the sample. ☐
- Measure the sample's boiling point. ☐
- Test the sample with a glowing splint. ☐

4.4.2.4 The pH scale and neutralisation

Question 22 · continued June 2019 | 8462/2F | Original Q1

0 1 . 4 Scientists tested two water samples from the drinking water supply.

The scientists tested one sample for aluminium ions and the other sample for sulfate ions.

Draw **one** line from each ion to the compound needed to identify the ion.

[2 marks]

Ion	**Compound needed to identify ion**
	Barium chloride
Aluminium ion	Copper sulfate
	Silver nitrate
Sulfate ion	Sodium hydroxide
	Sulfuric acid

0 1 . 5 How could pure water be produced from drinking water that contained dissolved solids?

[1 mark]

Tick (✓) **one** box.

- Chromatography ☐
- Cracking ☐
- Distillation ☐
- Sedimentation ☐

9

4.4.2.4 The pH scale and neutralisation

Question 23

November 2020 | 8462/1F | Original Q7

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

Zinc nitrate is a salt.

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

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

[1 mark]

Tick (✓) **one** box.

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

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

[1 mark]

Tick (✓) **one** box.

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

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

[1 mark]

_____

4.4.2.4 The pH scale and neutralisation

Question 23 · continued

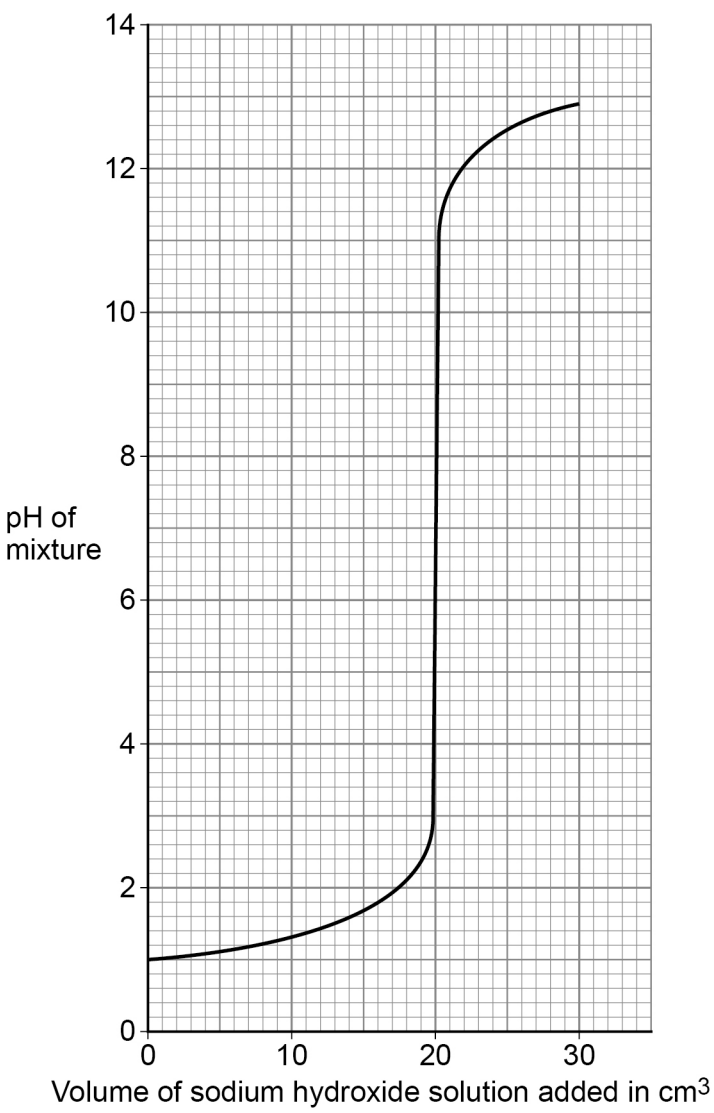
A student investigated how pH changes during a titration.

This is the method used.

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

Figure 10 shows the student's results.

Figure 10



4.4.2.4 The pH scale and neutralisation

Question 23 · continued

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

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

[3 marks]

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

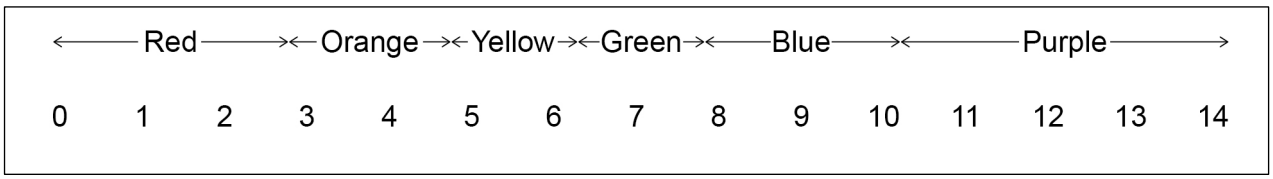
Use **Figure 10**.

[1 mark]

Volume = _____ cm^3

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

Figure 11



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

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

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

[1 mark]

Colour = _____

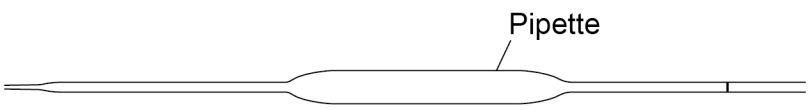
4.4.2.4 The pH scale and neutralisation

Question 23 · continued

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

Figure 12 shows a pipette.

Figure 12



The pipette is labelled 25.0 ± 0.06 cm^3

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

Use the equation:

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

[2 marks]

Percentage uncertainty = _____ %

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

[1 mark]

11

4.4.2.4 The pH scale and neutralisation

Question 24

November 2021 | 8462/1F | Original Q5

0 5 This question is about acids and alkalis.

0 5 . 1 Which ion do acids produce in aqueous solution?

[1 mark]

Tick (✓) **one** box.

H^+ ☐ OH^- ☐ O^{2-} ☐

0 5 . 2 Acids react with alkalis.

What is the name of this type of reaction?

[1 mark]

Tick (✓) **one** box.

Decomposition ☐

Electrolysis ☐

Neutralisation ☐

Redox ☐

0 5 . 3 Balance the equation for the reaction between sulfuric acid and potassium hydroxide.

[1 mark]

$$H_2SO_4 + ____ KOH \rightarrow K_2SO_4 + ____ H_2O$$

0 5 . 4 Universal indicator turns purple in potassium hydroxide solution.

What is the pH of the solution?

[1 mark]

Tick (✓) **one** box.

1 ☐ 4 ☐ 7 ☐ 14 ☐

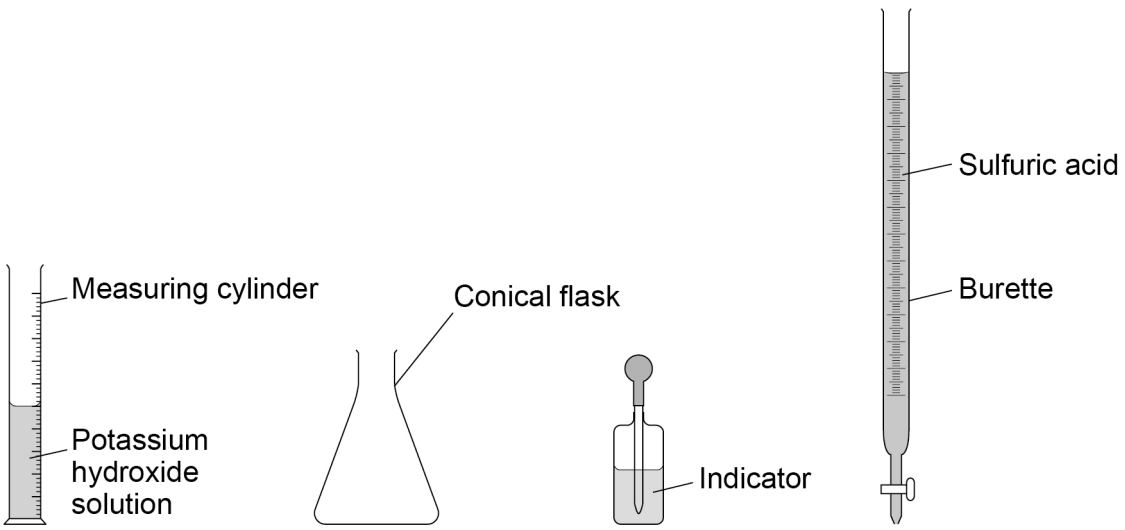
4.4.2.4 The pH scale and neutralisation

Question 24 · continued

A student does a titration to find the volume of sulfuric acid that reacts with 25 cm^3 of potassium hydroxide solution.

Figure 7 shows the equipment used.

Figure 7



0 5 . 5 The 25 cm^3 of potassium hydroxide solution is measured with the measuring cylinder.

Which piece of equipment could the student use to measure the 25 cm^3 of potassium hydroxide solution more accurately?

[1 mark]

Tick (✓) **one** box.

- Beaker ☐
- Evaporating basin ☐
- Pipette ☐
- Test tube ☐

4.4.2.4 The pH scale and neutralisation

Question 24 · continued

0 5 . 6 Describe how the student would use the equipment in **Figure 7** to complete the titration.

[5 marks]

10

4.4.2.4 The pH scale and neutralisation

Question 25

November 2021 | 8462/2F | Original Q2

0 2 This question is about water.

A student investigated the concentration of salt in sea water.

This is the method used.

1. Filter the sea water to remove sand.
2. Measure the mass of an empty evaporating dish.
3. Measure 50 cm^3 of sea water into the evaporating dish.
4. Heat the evaporating dish and sea water.
5. Evaporate the sea water to dryness.
6. Measure the mass of the evaporating dish and salt.

0 2 . 1 What equipment should the student use to measure:

- the mass of the evaporating dish
- the volume of sea water?

[2 marks]

Mass of evaporating dish _____

Volume of sea water _____

Question 25 · continued

0 2 . 2 **Table 2** shows the student's results.

Table 2

	Mass in g
Evaporating dish	30.44
Evaporating dish and salt	30.49

The student used 50 cm^3 of sea water.

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

[3 marks]

Mass of salt = _____ g

0 2 . 3 The salt must be completely dry.

Which **two** extra steps are needed to show that the salt is completely dry?

[2 marks]

Tick (✓) **two** boxes.

- Filter the sea water again. ☐
- Heat the evaporating dish and salt again. ☐
- Measure the 50 cm^3 of sea water again. ☐
- Measure the mass of the empty evaporating dish again. ☐
- Measure the mass of the evaporating dish and salt again. ☐

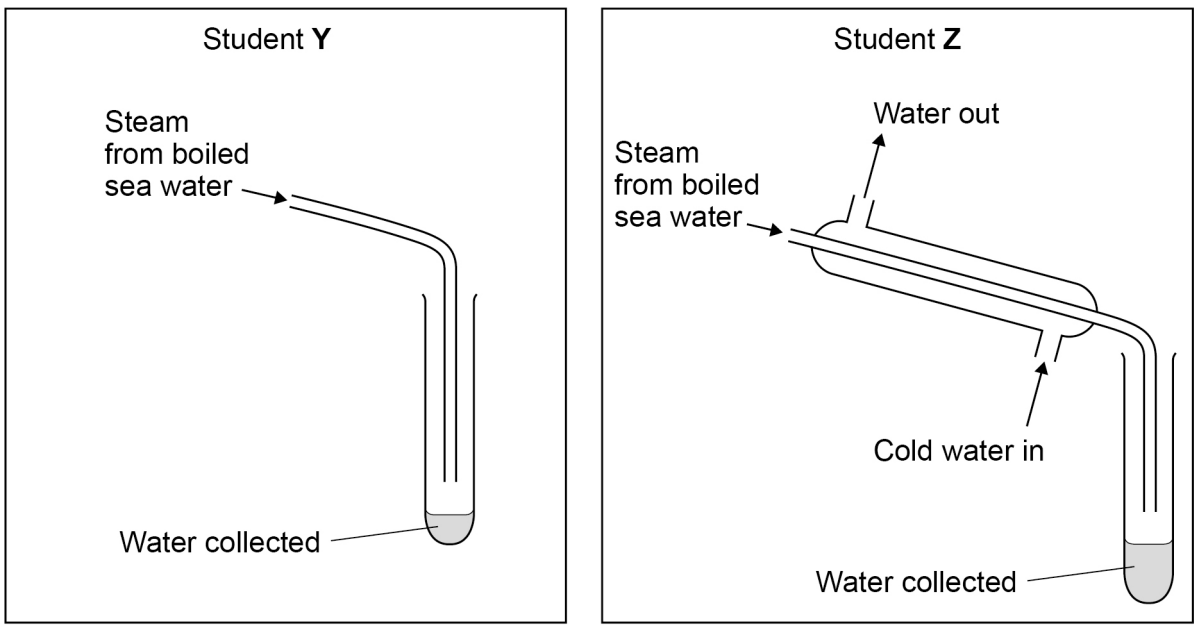
4.4.2.4 The pH scale and neutralisation

Question 25 · continued

Two students, **Y** and **Z**, distil sea water to collect water.

Figure 1 shows the apparatus used by each student to collect the water.

Figure 1



0 2 . 4 Students **Y** and **Z** boil the same volume of sea water for the same period of time.

Explain why student **Y** collects a smaller volume of water than student **Z**.

[2 marks]

0 2 . 5 Water obtained by distillation does **not** need to be sterilised and is safe to drink.

Suggest why.

[1 mark]

4.4.2.4 The pH scale and neutralisation

Question 25 · continued

Fresh water needs to be sterilised before it is safe to drink.

0 2 . 6 How is fresh water sterilised?

[2 marks]

Tick (✓) **two** boxes.

- Using ammonia ☐
- Using chlorine ☐
- Using chromatography ☐
- Using filtration ☐
- Using ozone ☐

0 2 . 7 A student tests the pH of fresh water using universal indicator solution.

When added to the fresh water, the colour of the universal indicator solution is green.

What is the pH of this fresh water?

[1 mark]

pH = _____

13

4.4.2.4 The pH scale and neutralisation

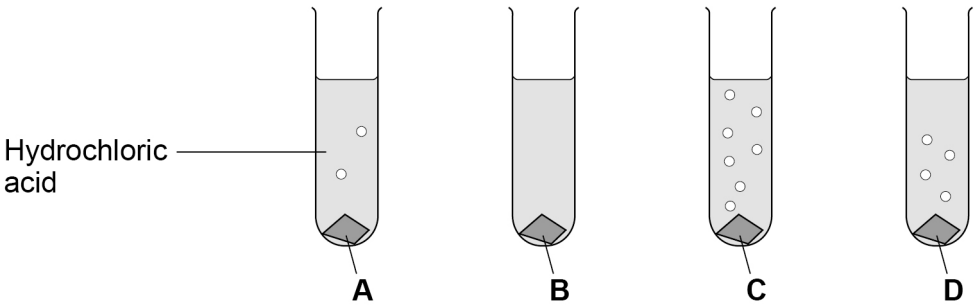
Question 26

0 3 This question is about acids.

A student added four metals, **A**, **B**, **C** and **D** to hydrochloric acid.

Figure 4 shows the rate of bubbling in each tube.

Figure 4



Use **Figure 4** to answer questions **03.1** and **03.2**.

0 3 . 1 Which metal is copper?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 3 . 2 Which metal is the most reactive?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 3 . 3 A metal oxide reacts with an acid to produce zinc sulfate and water.

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

[2 marks]

Name of metal oxide _____

Name of acid _____

4.4.2.4 The pH scale and neutralisation

Question 26 · continued June 2022 | 8462/1F | Original Q3

0 3 . 4 Universal indicator is used to measure the pH of a solution.

Draw **one** line from each pH to the colour of universal indicator in a solution with that pH.

[2 marks]

pH	Colour of universal indicator
	Blue
1	Green
	Purple
7	Red
	Yellow

Question 3 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 26 · continued

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

0 3 . 5 What is the type of reaction when an acid reacts with an alkali?

[1 mark]

Tick (✓) **one** box.

- Combustion ☐
- Decomposition ☐
- Neutralisation ☐

0 3 . 6 **Figure 5** shows a piece of equipment used to measure the volume of the acid in the titration.

Figure 5



What is the name of this piece of equipment?

[1 mark]

Tick (✓) **one** box.

- Burette ☐
- Pipette ☐
- Syringe ☐
- Tube ☐

8

4.4.2.4 The pH scale and neutralisation

Question 27

June 2022 | 8462/2F | Original Q1

0 1 This question is about water.

A student investigated pure water.

The student measured:

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

0 1 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

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

Pure water has a boiling point of _____ °C.

Pure water has a pH of _____.

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

[1 mark]

_____

_____

4.4.2.4 The pH scale and neutralisation

Question 27 · continued June 2022 | 8462/2F | Original Q1

A different student investigated sea water.

Sea water contains dissolved solids.

This is the method used.

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

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

[2 marks]

Tick (✓) **two** boxes.

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

Question 1 continues on the next page

Question 27 · continued

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

Table 1

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

Calculate the mean mass of solid that remained.

[2 marks]

Mean mass = _____ g

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

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

[2 marks]

Mass = _____ g

4.4.2.4 The pH scale and neutralisation

Question 27 · continued

Sodium chloride is a dissolved solid in sea water.

Sodium chloride contains sodium ions and chloride ions.

0 1 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

crimson	**lilac**	**yellow**

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

The colour of the flame was _____.

0 1 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

brown	**green**	**white**

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

The colour of the precipitate formed was _____.

11

4.4.2.4 The pH scale and neutralisation

Question 28

June 2023 | 8462/1F | Original Q2

0 2 This question is about acids and alkalis.

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

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

[2 marks]

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

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

[1 mark]

Tick (✓) **one** box.

- Acidic ☐
- Alkaline ☐
- Neutral ☐

Question 2 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 28 · continued June 2023 | 8462/1F | Original Q2

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

This is the method used.

1. Measure 25.0 cm^3 of the sodium hydroxide solution.

2. Add the sodium hydroxide solution to a conical flask.

3. Add 3 drops of indicator to the sodium hydroxide solution.

4. Add the hydrochloric acid drop by drop until the indicator changes colour.

5. Record the volume of the hydrochloric acid added.

6. Repeat steps 1 to 5 three more times.

0 2 . 3 Which piece of equipment should be used to measure 25.0 cm^3 of the sodium hydroxide solution in step 1?

[1 mark]

Tick (✓) **one** box.

- Beaker ☐
- Pipette ☐
- Ruler ☐

0 2 . 4 Which piece of equipment should be used to add the hydrochloric acid drop by drop in step 4?

[1 mark]

Tick (✓) **one** box.

- Balance ☐
- Burette ☐
- Measuring cylinder ☐

4.4.2.4 The pH scale and neutralisation

Question 28 · continued

Table 1 shows the results.

Table 1

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

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

[1 mark]

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

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

[1 mark]

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

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

1 dm^3 = 1000 cm^3

[3 marks]

Mass = _____ g

10

4.4.2.4 The pH scale and neutralisation

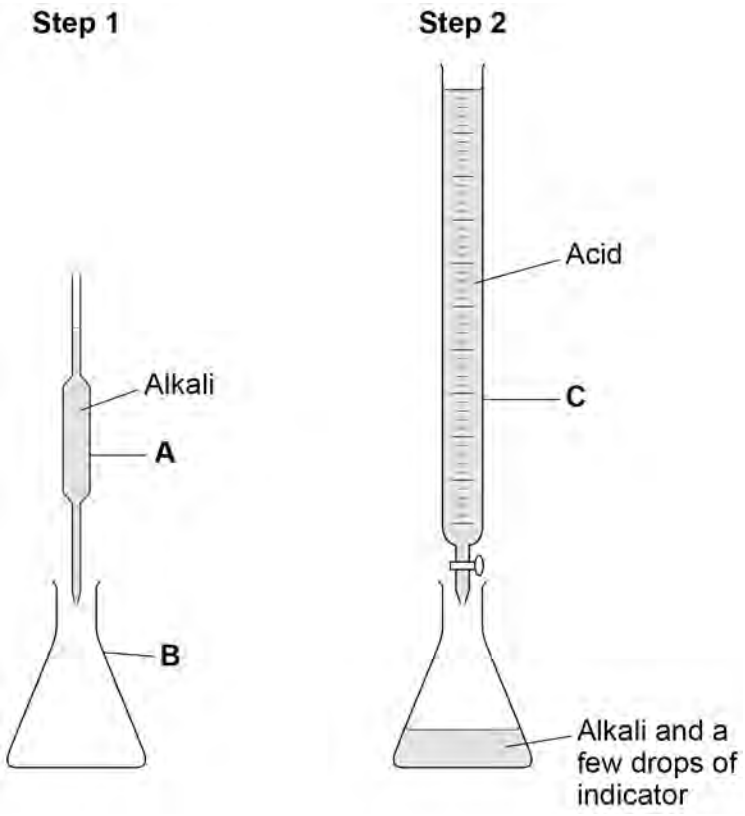
Question 29

June 2024 | 8462/1F | Original Q2

0 2 A titration measures the volumes of an acid and an alkali that neutralise each other.

Figure 4 shows the apparatus used.

Figure 4



0 2 . 1 Name the pieces of equipment labelled **A**, **B** and **C** in **Figure 4**.

Choose answers from the box.

[3 marks]

beaker	**burette**	**conical flask**
measuring cylinder	**pipette**	**test tube**

A _____

B _____

C _____

4.4.2.4 The pH scale and neutralisation

Question 29 · continued

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

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

0 2 . 2 Name a suitable indicator for use in **Step 2** of the titration.

[1 mark]

0 2 . 3 Give **one** observation that shows the alkali is neutralised.

[1 mark]

0 2 . 4 Give **two** ways to make sure that the volume of acid added is accurate.

[2 marks]

1

2

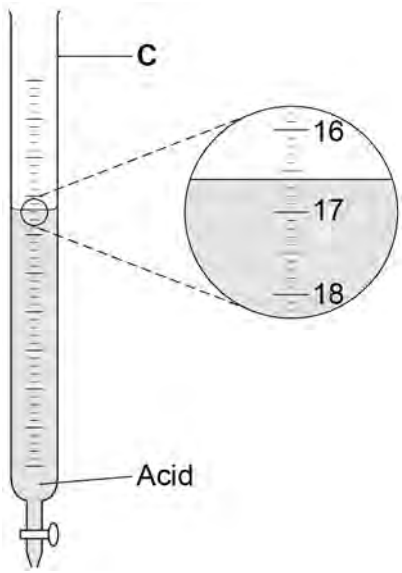
Question 2 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 29 · continued

0 2 . 5 **Figure 5** shows the reading on equipment **C** at the end of **Step 2**.

Figure 5



What is the reading on equipment **C** in **Figure 5**?

[1 mark]

Tick (✓) **one** box.

16.4 cm^3 ☐

16.6 cm^3 ☐

17.4 cm^3 ☐

17.6 cm^3 ☐

4.4.2.4 The pH scale and neutralisation

Question 29 · continued June 2024 | 8462/1F | Original Q2

0 2 . 6 A student did a different titration.

Table 1 shows the results.

Table 1

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

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

[1 mark]

Tick (✓) **one** box.

Trial 1 and Trial 2 ☐

Trial 1 and Trial 3 ☐

Trial 2 and Trial 3 ☐

0 2 . 7 A salt is produced when an acid neutralises an alkali.

Barium chloride is a salt containing the ions Ba^{2+} and Cl^-

What is the formula of barium chloride?

[1 mark]

Tick (✓) **one** box.

BaCl ☐ $BaCl_2$ ☐ Ba_2Cl ☐ Ba_2Cl_2 ☐

10

4.4.2.4 The pH scale and neutralisation

Question 30

June 2024 | 8462/1F | Original Q9

0 9 This question is about the periodic table.

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

0 9 . 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 9 . 2 Give **two** observations made when potassium reacts with water.

[2 marks]

1 _____

_____

2 _____

_____

0 9 . 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 _____

_____

4.4.2.4 The pH scale and neutralisation

Question 30 · continued

Table 4 shows the densities of some of the elements in Group 0 of the periodic table.

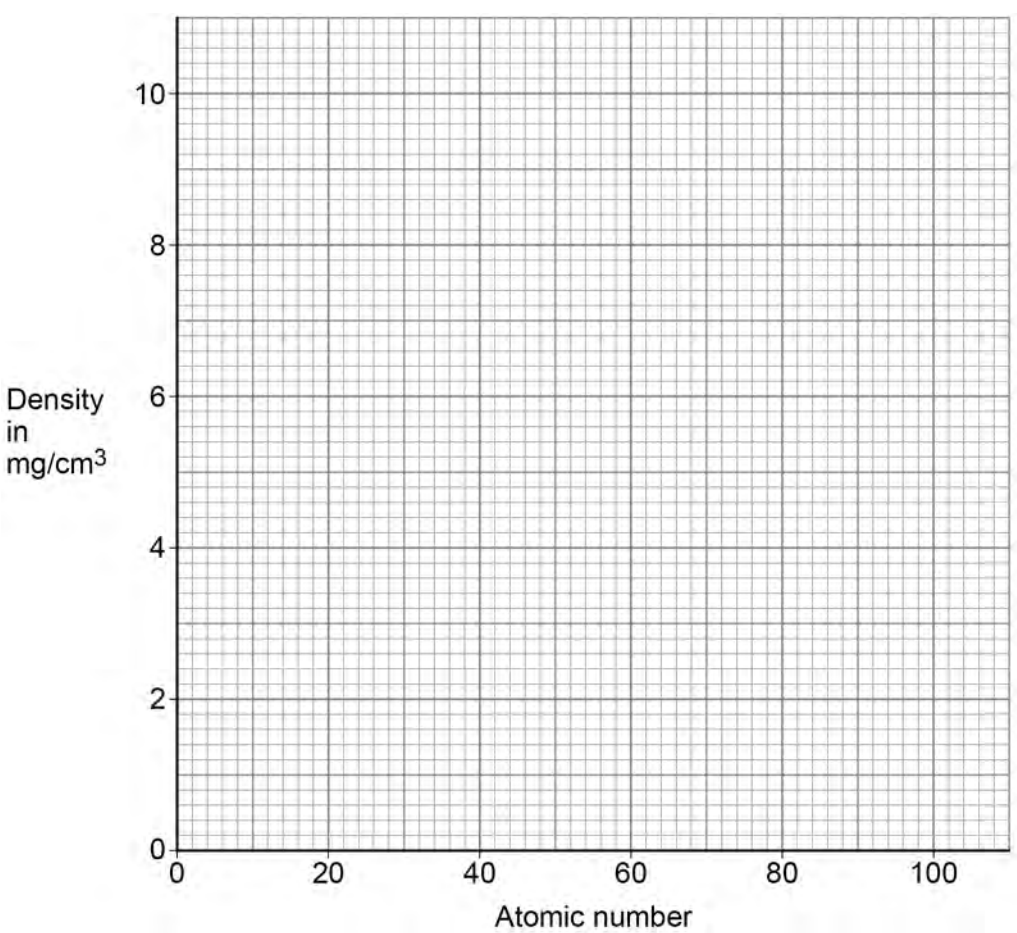
Table 4

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 9 . 4 Plot the data from **Table 4** on **Figure 15**.

[2 marks]

Figure 15



4.4.2.4 The pH scale and neutralisation

Question 30 · continued

0 9 . 5 Estimate the density (**X**) of krypton.

Use **Figure 15** and **Table 4**.

[1 mark]

Density = _____ mg/cm^3

0 9 . 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 9 . 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

4.4.2.4 The pH scale and neutralisation

Question 31

June 2024 | 8462/2F | Original Q7

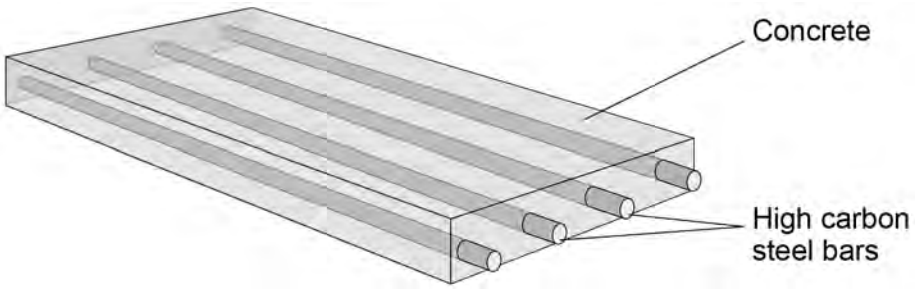
0 7 This question is about materials.

Pre-stressed concrete is a composite material.

The concrete is strengthened using high carbon steel bars.

Figure 8 shows the structure of a piece of pre-stressed concrete.

Figure 8



0 7 . 1 Which **two** words describe the high carbon steel bars?

[2 marks]

Tick (✓) **two** boxes.

- Alloy ☐
- Binder ☐
- Matrix ☐
- Ore ☐
- Reinforcement ☐

4.4.2.4 The pH scale and neutralisation

Question 31 · continued

Limestone is mainly calcium carbonate.

Limestone is a raw material used in the production of concrete.

0 7 . 2 In the first part of the production of concrete:

- air is heated by burning methane
- the hot air is used to heat limestone
- the limestone decomposes.

The equation for the decomposition of limestone is:

calcium carbonate → calcium oxide + carbon dioxide

Give **two** ways in which a greenhouse gas is released in this process.

[2 marks]

1 _____

_____

2 _____

_____

0 7 . 3 How could a sample of limestone be tested to show the presence of carbonate ions?

Complete the sentences.

Choose answers from the box.

[2 marks]

barium chloride	**hydrochloric acid**	**limewater**
sodium hydroxide		**universal indicator**

The substance added to the limestone is _____.

The gas produced is identified using _____.

Question 7 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 31 · continued

Table 4 gives some information about plain concrete and pre-stressed concrete.

Table 4

	Plain concrete	Pre-stressed concrete
Cost in £ per m^3	75	225
Density in kg per m^3	2300	2500
Strength in arbitrary units	600	3000

0 7 . 4 Explain why pre-stressed concrete rather than plain concrete is used to make bridges that carry heavy lorries.

Use **Table 4**.

[2 marks]

4.4.2.4 The pH scale and neutralisation

Question 31 · continued

0 7 . 5 **Figure 9** shows a garden path made of plain concrete slabs.

Figure 9



Suggest **two** reasons why plain concrete rather than pre-stressed concrete is used to make slabs for garden paths.

Use **Table 4**.

[2 marks]

1 _____

_____

2 _____

_____

10

4.4.2.4 The pH scale and neutralisation

Question 32

June 2025 | 8462/1F | Original Q4

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

This is the method used.

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

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

[1 mark]

Tick (✓) **one** box.

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

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

What type of substance is **X**?

[1 mark]

_____

4.4.2.4 The pH scale and neutralisation

Question 32 · continued

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

[1 mark]

Tick (✓) **one** box.

Beaker ☐

Burette ☐

Test tube ☐

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

[1 mark]

_____

_____

Question 4 continues on the next page

4.4.2.4 The pH scale and neutralisation

Question 32 · continued

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

Table 3

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

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

Give your answer to 3 significant figures.

Do **not** include the anomalous result.

[4 marks]

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

4.4.2.4 The pH scale and neutralisation

Question 32 · continued

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

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

[2 marks]

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

10