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

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

_____

(1)

(b) Calcium nitrate contains the ions Ca^{2+} and NO_3^-

Give the formula of calcium nitrate.

_____

(1)

(c) Describe a method to make pure, dry crystals of magnesium sulfate from a metal oxide and a dilute acid.

(6)

(Total 8 marks)

2. Calcium chloride ($CaCl_2$) is a soluble salt.

Calcium chloride can be made by reacting dilute hydrochloric acid with either solid calcium oxide or solid calcium carbonate.

(a) Name the type of reaction that takes place when dilute hydrochloric acid reacts with calcium oxide.

(1)

(b) Write a balanced symbol equation for the reaction of dilute hydrochloric acid with calcium oxide.

_____

(2)

(c) A student added solid calcium oxide to dilute hydrochloric acid in a beaker.

The student added solid calcium carbonate to dilute hydrochloric acid in another beaker.

Describe **one** difference between the two reactions that the student would **see**.

_____

_____

(1)

(d) Describe how crystals of calcium chloride can be made from calcium carbonate and dilute hydrochloric acid.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(e) A student dissolved some crystals of a salt in water.

The student added sodium hydroxide solution to the salt solution.

The student added sodium hydroxide solution until it was in excess.

(i) Describe what the student would **see** if the salt contained calcium ions.

_____

_____

_____

(2)

(ii) Why does the result you have described in part (e)(i) **not** prove that the salt contains calcium ions?

_____

_____

(1)

(iii) Describe an additional test the student could do that would prove the salt contains calcium ions.

_____

_____

_____

(2)

(Total 13 marks)

3. 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).

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

(i) Hydrochloric acid is acidic.

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

(1)

(ii) Sodium hydroxide solution is alkaline.

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

(1)

(b) Hydrochloric acid is a stronger acid than ethanoic acid.

When Universal Indicator is added to solutions of these acids at the same concentration the results are different.

Describe how the results would show that ethanoic acid is a weaker acid than hydrochloric acid.

_____

_____

_____

_____

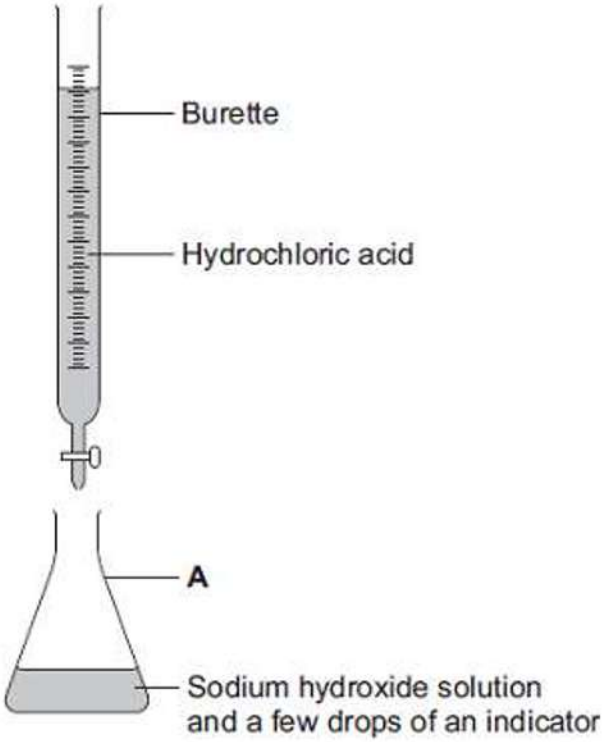
(2)

(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)

(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.



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

Draw a ring around your answer.

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

(1)

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

distillation **filtration** **titration**

(1)

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

(1)

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

_____

_____

(1)

(Total 8 marks)

4. Limestone is used as a building material. Acid rain erodes limestone.

(a) Limestone contains calcium carbonate.

The symbol equation for the reaction of calcium carbonate with hydrochloric acid is shown.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Describe a test to show that carbon dioxide is produced in this reaction.

Give the result of the test.

_____

_____

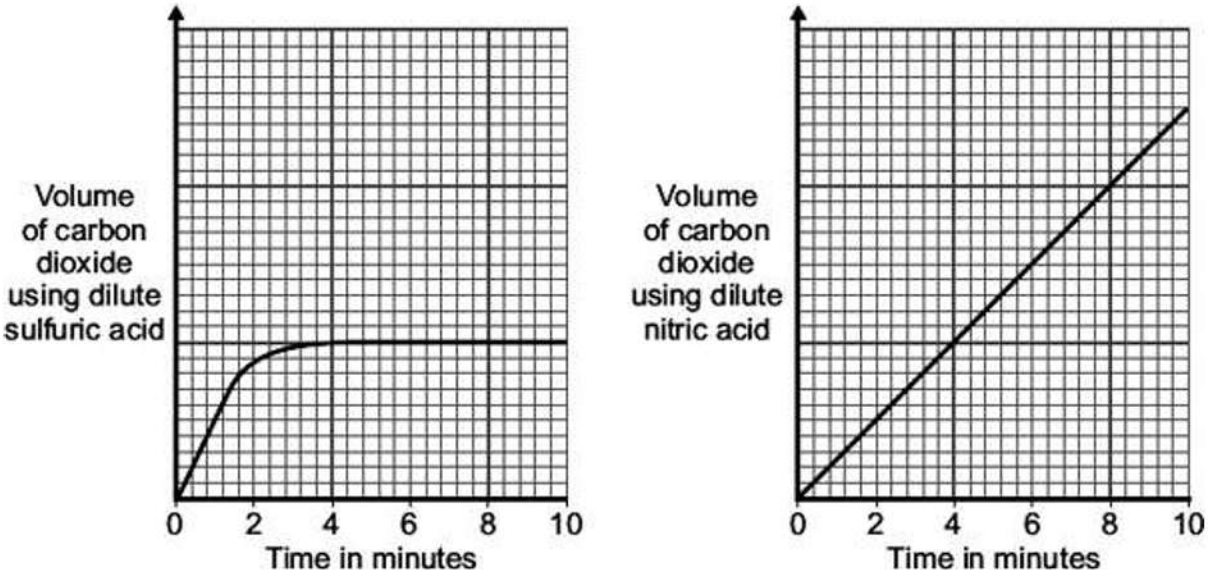
_____

_____

(2)

(b) Gases from vehicle exhausts produce sulfuric acid and nitric acid.

A student investigated the reaction of these two acids with calcium carbonate (limestone).
The type of acid was changed but all other variables were kept the same.
The student measured the volume of carbon dioxide produced each minute for a total of 10 minutes. He did this first for the reaction between dilute sulfuric acid and a cube of calcium carbonate (limestone).
The student repeated the experiment using dilute nitric acid in place of the dilute sulfuric acid.
The results are shown below.



(i) State **two** variables that must be kept the same for this investigation.

_____

_____

_____

_____

(2)

(i) Reacting calcium carbonate with sulfuric acid gave different results to nitric acid.

The symbol equations for the reaction of calcium carbonate with sulfuric acid and with nitric acid are shown below.

$CaCO_3(s) + H_2SO_4(aq) \rightarrow CaSO_4(s) + H_2O(l) + CO_2(g)$

$CaCO_3(s) + 2HNO_3(aq) \rightarrow Ca(NO_3)_2(aq) + H_2O(l) + CO_2(g)$

Describe how the results for sulfuric acid are different **and** use the symbol equations to explain this difference.

_____

_____

_____

_____

_____

_____

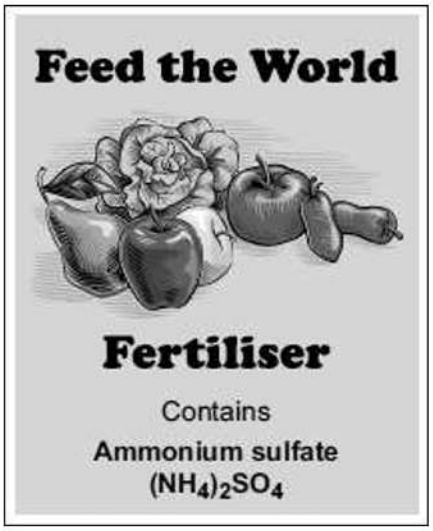
_____

_____

(3)

(Total 7 marks)

5. Ammonium sulfate is an artificial fertiliser.



(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.

(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)

(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)

(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)

(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.

(i) Sulfuric acid and ethanoic acid are both acids because

they contain [CH_3COO^- ions. / H^+ ions. / SO_4^{2-} ions.]

(1)

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

The pH of stronger acids is

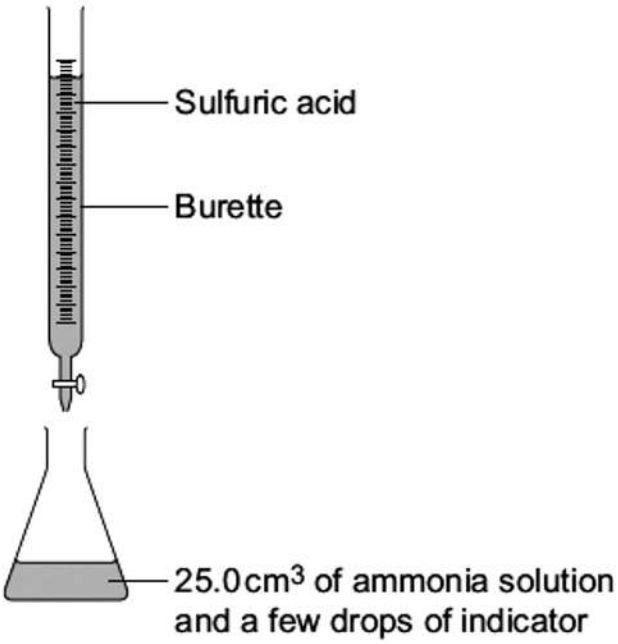
higher than
lower than
the same as

the pH of weaker acids.

(1)

(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

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

_____

_____

(1)

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

Which result was anomalous? _____

(1)

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

_____

_____

Mean volume = _____ cm^3

(1)

(Total 10 marks)

6. This question is about elements in Group 1.

A teacher burns sodium in oxygen.

(a) Complete the word equation for the reaction.

sodium + oxygen ⟶ _____

(1)

(b) What is the name of this type of reaction?

Tick **one** box.

Decomposition ☐

Electrolysis ☐

Oxidation ☐

Precipitation ☐

(1)

(c) 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?

Tick **one** box.

1 ☐ 4 ☐ 7 ☐ 13 ☐

(1)

(d) The solution contains a substance with the formula NaOH

Give the name of the substance.

_____

(1)

(e) All alkalis contain the same ion.

What is the formula of this ion?

Tick **one** box.

H^+ ☐

Na^+ ☐

OH^- ☐

O^{2-} ☐

(1)

(f) 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?

_____

_____

_____

_____

Mass = _____ g

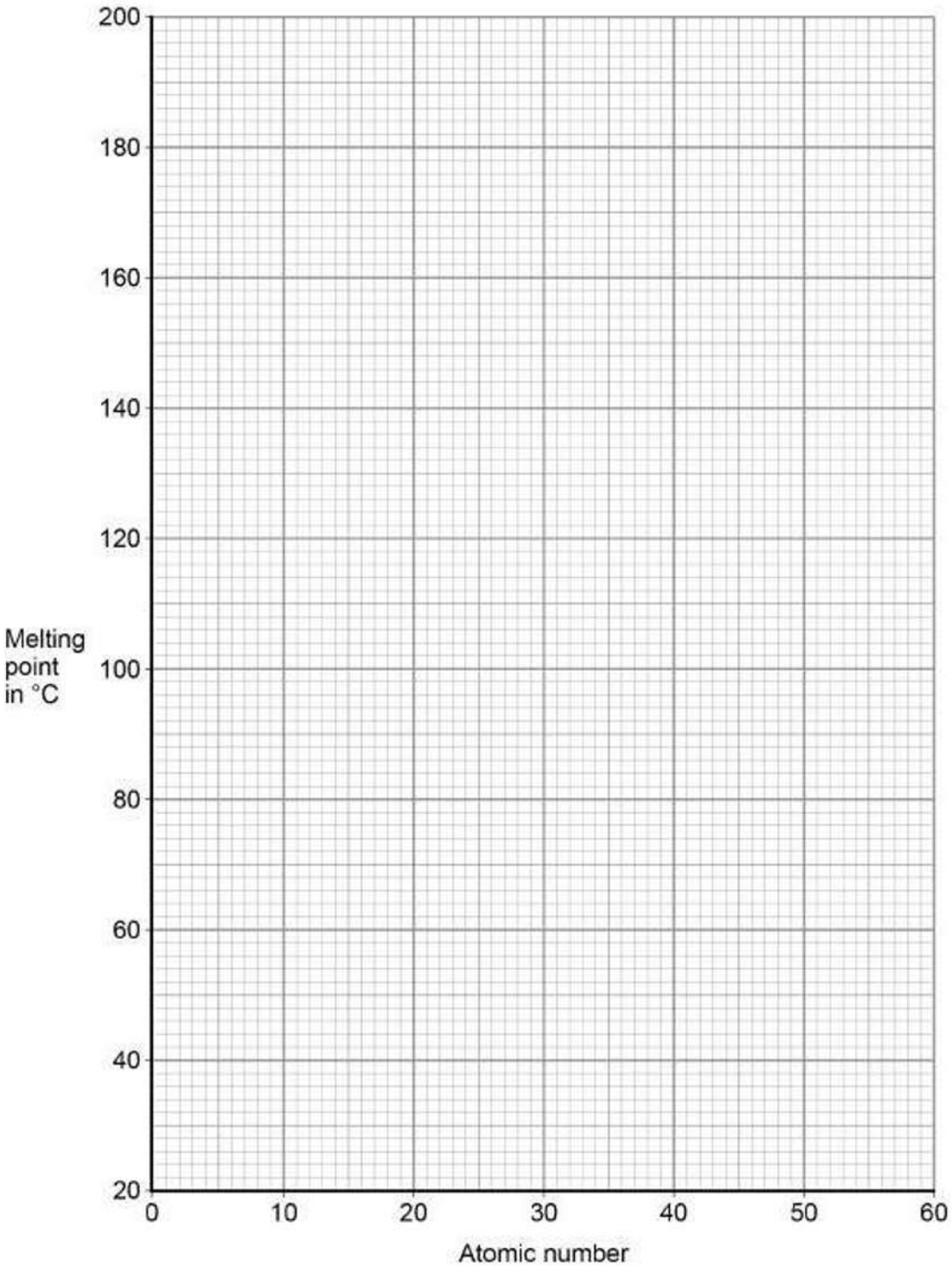
(2)

(g) The melting points of the elements in Group 1 show a trend.

The table below shows the atomic numbers and melting points of the Group 1 elements.

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 the table on the graph below.



(2)

(h) Predict the melting point, **X**, of rubidium, atomic number 37

Use the graph above.

Melting point = _____ °C

(1)

(Total 10 marks)