AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.4.2 REACTIONS OF ACIDS (PACK 2)

SCORE	PERCENTAGE
/276	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

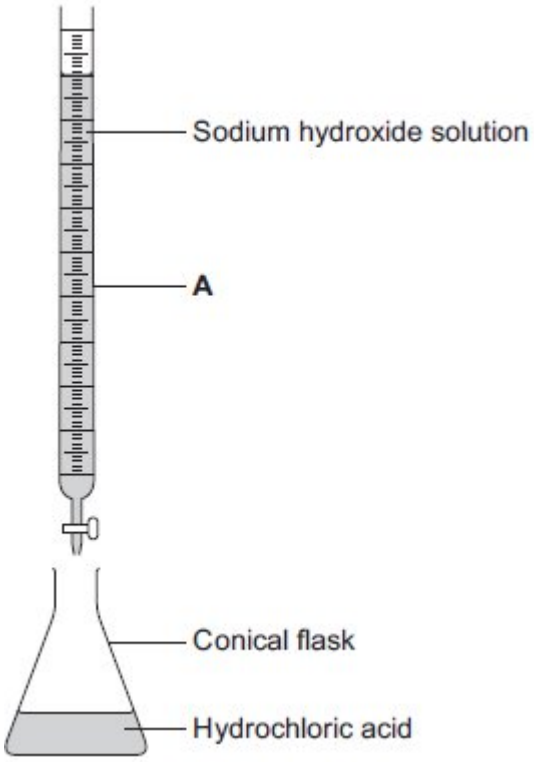
Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

(a) A student used the apparatus in the figure below to do a titration.



(i) What is the name of the piece of apparatus labelled **A**?

Draw a ring around the correct answer.

burette **measuring cylinder** **test tube**

(1)

(ii) What should the student add to the acid in the conical flask?

Draw a ring around the correct answer.

catalyst **indicator** **water**

(1)

(iii) What would the student see when the end point of the titration has been reached?

_____

(1)

(b) The student does the titration three times.

(i) State **one** variable that the student needs to keep the same to make it a fair test.

_____

STEMUP.CO.UK

(1)

(ii) The student's results are shown in the table below.

Titration	Volume of sodium hydroxide solution added in cm^3
1	22.40
2	22.20
3	22.30

Calculate the mean volume of sodium hydroxide solution added.

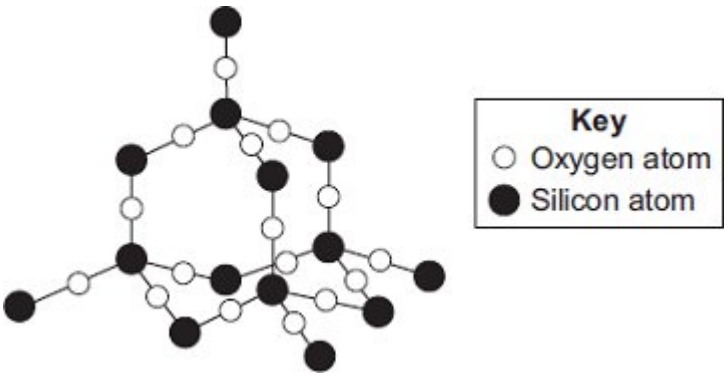
_____ cm^3

(1)

(Total 5 marks)

Q2.

The diagram shows a small part of the structure of silicon dioxide.



(a) Use the diagram above to answer the question.

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

In silicon dioxide, each silicon atom is bonded with [two / three / four] oxygen atoms.

The bonds in silicon dioxide are [ionic. / covalent. / metallic.]

(2)

STEMUP.CO.UK

(b)



© Oleksiy Mark/iStock

Silicon dioxide is used as the inside layer of furnaces.

Suggest why.

_____

_____

(1)

(c) Nanowires can be made from silicon dioxide.

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

The word 'nano' means the wires are very

brittle.
thick.
thin.

(1)

(Total 4 marks)

Q3.

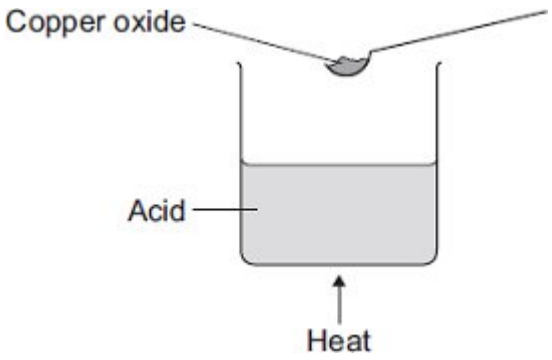
A student added copper oxide to an acid to make copper sulfate.

The student heated the acid.

The student added copper oxide until no more reacted.

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

STEMUP.CO.UK



(i) Complete the word equation.

Copper oxide + _____ acid → copper sulfate + water

(1)

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

Draw a ring around the correct answer.

1 **7** **11**

(1)

(iii) Why is the acid heated?

_____

_____

(1)

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

_____

_____

(1)

(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)

(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	

STEMUP.CO.UK

experiment.	
The student added too much copper oxide.	
The copper sulfate crystals were wet when they were weighed.	

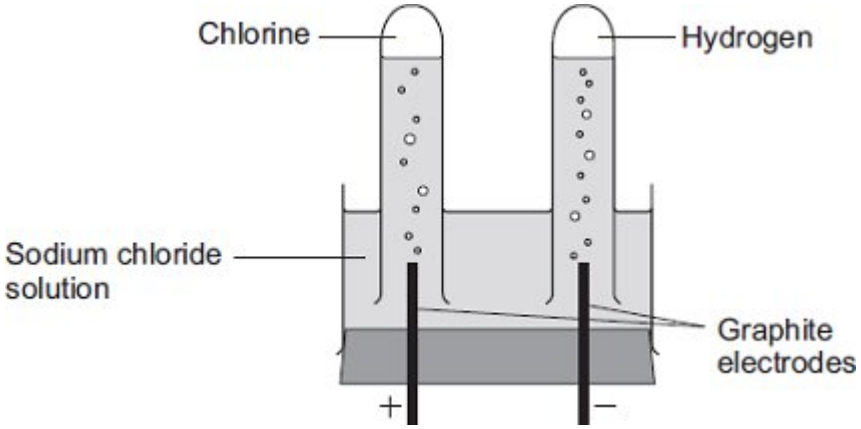
(1)

(Total 6 marks)

Q4.

The electrolysis of sodium chloride solution is an industrial process.

The diagram shows the apparatus used in a school experiment.



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

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

_____

_____

(1)

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

_____

_____

(1)

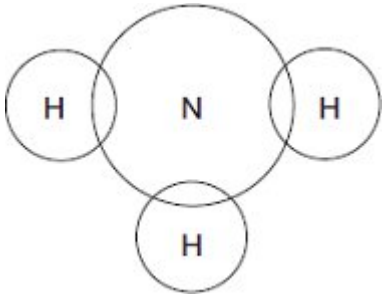
(b) Hydrogen is used to make ammonia (NH_3).

Complete the diagram to show the bonding in ammonia.

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

Show only outer shell electrons.

STEMUP.CO.UK



(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.

(i) Which ion makes the waste alkaline?

_____

(1)

(ii) This waste must be neutralised.

Write the ionic equation for the neutralisation reaction.

_____

(1)

(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.

STEMUP.CO.UK

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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 12 marks)

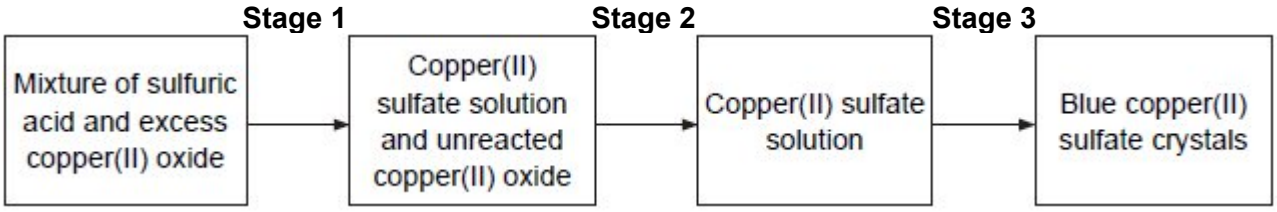
Q5.

This question is about compounds of copper.

(a) A student made some copper(II) sulfate crystals.

STEMUP.CO.UK

The flow diagram shows the stages of the preparation of copper(II) sulfate crystals.



(i) The reaction mixture is heated in **Stage 1**.

Suggest why.

_____

_____

(1)

(ii) Complete the equation for this reaction.

CuO + _____ → $CuSO_4$ + _____

(2)

(iii) How would the student remove the unreacted copper(II) oxide in **Stage 2**?

_____

_____

(1)

(iv) How would the student obtain copper(II) sulfate crystals from the copper(II) sulfate solution in **Stage 3**?

_____

(1)

(v) The mass of crystals obtained was less than the student had calculated.

Suggest **one** reason why.

_____

_____

(1)

(b) The student heated the blue copper(II) sulfate crystals.

The word equation for the reaction is shown below.

hydrated copper(II) sulfate ⇌ anhydrous copper(II) sulfate + water

blue white

(i) What does the symbol ⇌ mean ?

_____

STEMUP.CO.UK

(1)

(ii) 300 J of energy are taken in when some blue copper(II) sulfate crystals are heated.

What is the energy change when an excess of water is added to the anhydrous copper(II) sulfate produced?

_____

_____

(2)

(c) A sample of copper nitride contains 3.81 g of copper and 0.28 g of nitrogen.

Calculate the empirical formula.

You **must** show all your working to get full marks.

Relative atomic masses (A_r): N = 14; Cu = 63.5.

_____

_____

_____

_____

_____

_____

_____

Empirical formula = _____

(4)

(Total 13 marks)

Q6.

Ammonium salts, such as ammonium sulfate, are used to help farmers grow crops.

STEMUP.CO.UK



© Artur Synenko/iStock

(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)

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

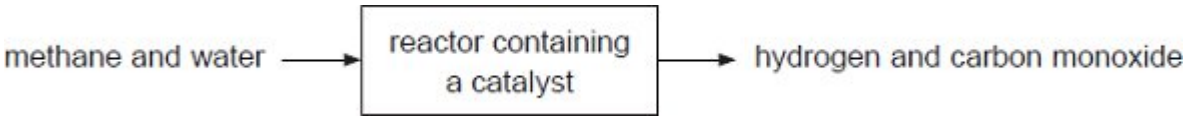
Which raw material provides nitrogen?

Draw a ring around your answer.

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

(1)

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



How does the catalyst help this reaction?

_____

(1)

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

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

STEMUP.CO.UK

What is the meaning of this symbol $\rightleftharpoons$?

Draw a ring around your answer.

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

(1)

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

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

Draw a ring around your answer.

4 **7** **10**

(1)

(ii) Ammonium sulfate can be made by reacting ammonia solution with sulfuric acid.

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

ammonium sulfate	**hydrogen**	**sulfuric**	**water**

During the reaction the hydrogen ions (H^+) from the acid react with hydroxide ions

(OH^-) from the alkali to make

_____ .

(1)

(Total 6 marks)

Q7.

Read the information below and then answer the questions that follow.

It was once thought that organic compounds could only be made in living organisms.
The living organisms were assumed to have a special life force.
This life force allowed them to make organic compounds.

Urea is an organic compound produced in animals. It is found in urine. In 1828, Friedrich Wöhler made urea from chemicals which were not obtained from living things.

Other famous scientists still believed in the idea of a life force. Wöhler made another organic compound in 1845. Most scientists then stopped believing that a life force was needed to make organic compounds.

(a) How did Wöhler prove that a life force is **not** needed to make organic compounds?

STEMUP.CO.UK

_____

_____

(1)

(b) In 1828 most scientists continued to believe that a life force was needed to produce an organic compound.

Suggest why.

_____

_____

(1)

(c) In 1845 most scientists stopped believing that a life force was needed to make an organic compound.

Suggest why.

_____

_____

(1)

(d) Some scientists repeated Wöhler's experiment.
These scientists used lead nitrate as one of their starting materials.

Lead nitrate solution can be made by reacting lead with an acid.

(i) Give the name of this acid _____

(1)

(ii) State how solid lead nitrate can be obtained from lead nitrate solution.

_____

_____

(1)

(Total 5 marks)

Q8.

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).

STEMUP.CO.UK

(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)

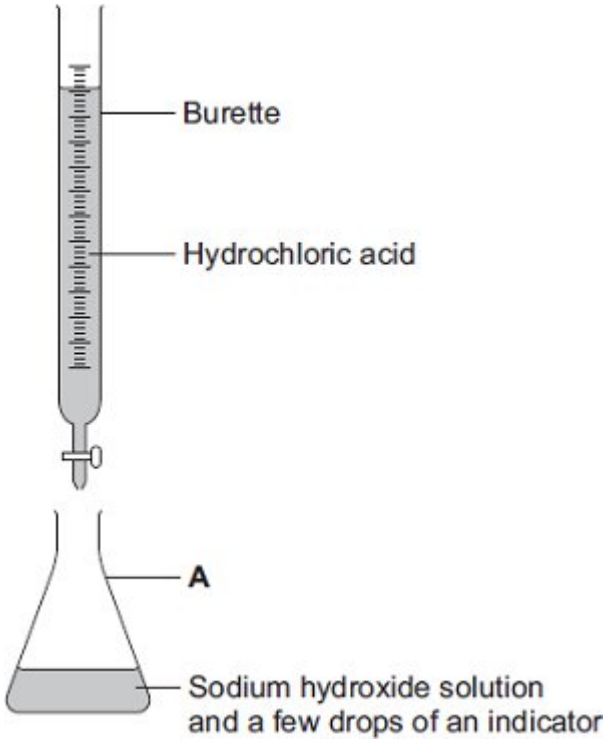
(c) Draw a ring around the correct answer to complete this sentence.

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.

STEMUP.CO.UK



(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)

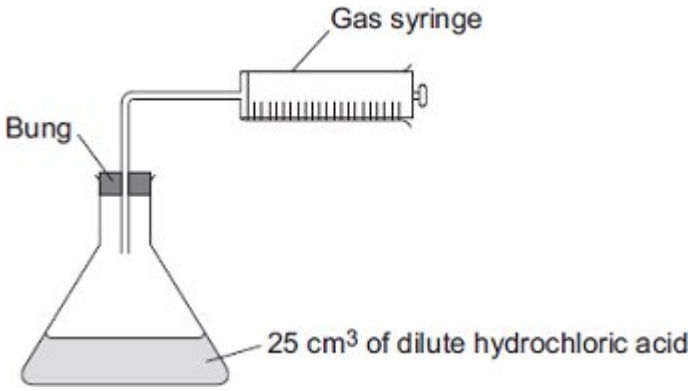
(Total 8 marks)

Q9.

A student investigated the reaction between magnesium metal and dilute hydrochloric acid.

The student placed 25 cm^3 of dilute hydrochloric acid in a conical flask and set up the apparatus as shown in the diagram.

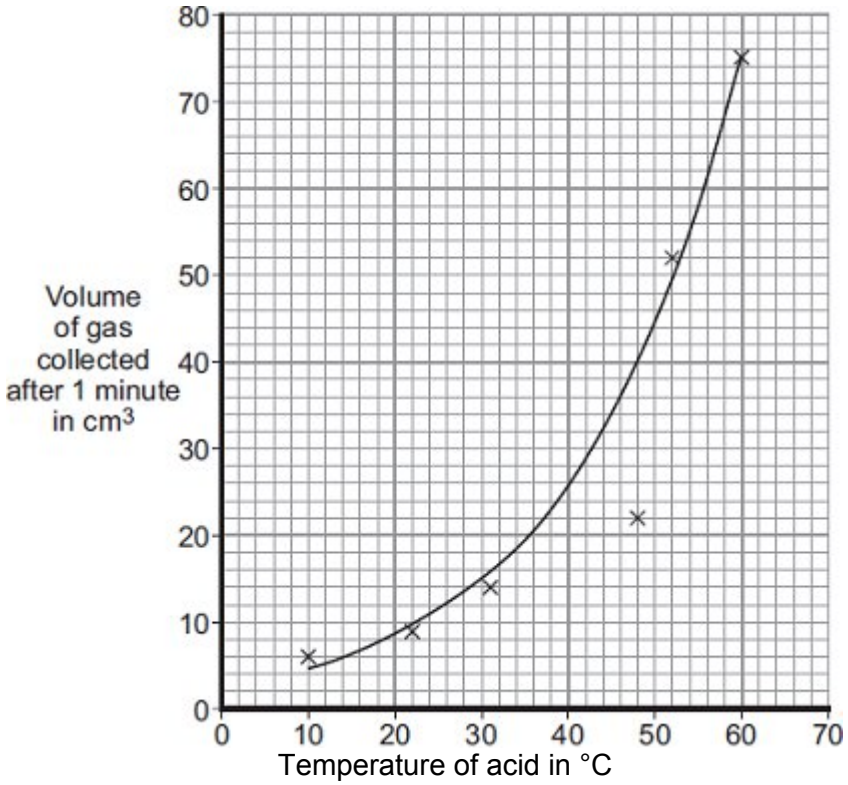
STEMUP.CO.UK



The student:

- took the bung out of the flask and added a single piece of magnesium ribbon 8 cm long
- put the bung back in the flask and started a stopwatch
- recorded the volume of gas collected after 1 minute
- repeated the experiment using different temperatures of acid.

The student plotted his results on a graph.



(a) Write the correct state symbols in the equation.

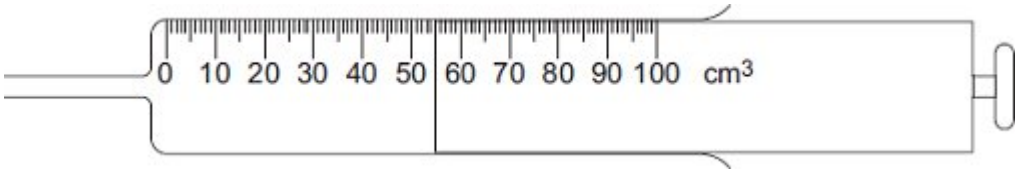
Choose from (s) for solid, (l) for liquid, (g) for gas and (aq) for aqueous.

Mg (_____) + 2 HCl (_____) $\longrightarrow$ $MgCl_2$ (_____) + H_2 (_____)

(2)

(b) The diagram shows a gas syringe after 1 minute.

STEMUP.CO.UK



(i) What volume of gas has been collected in the gas syringe after 1 minute?

Volume = _____ cm^3

(1)

(ii) Use the graph to determine the temperature of the acid used in this experiment.

Temperature = _____ °C

(1)

(iii) Calculate the average rate of reaction, in cm^3 of hydrogen made per second (cm^3/s), for this experiment.

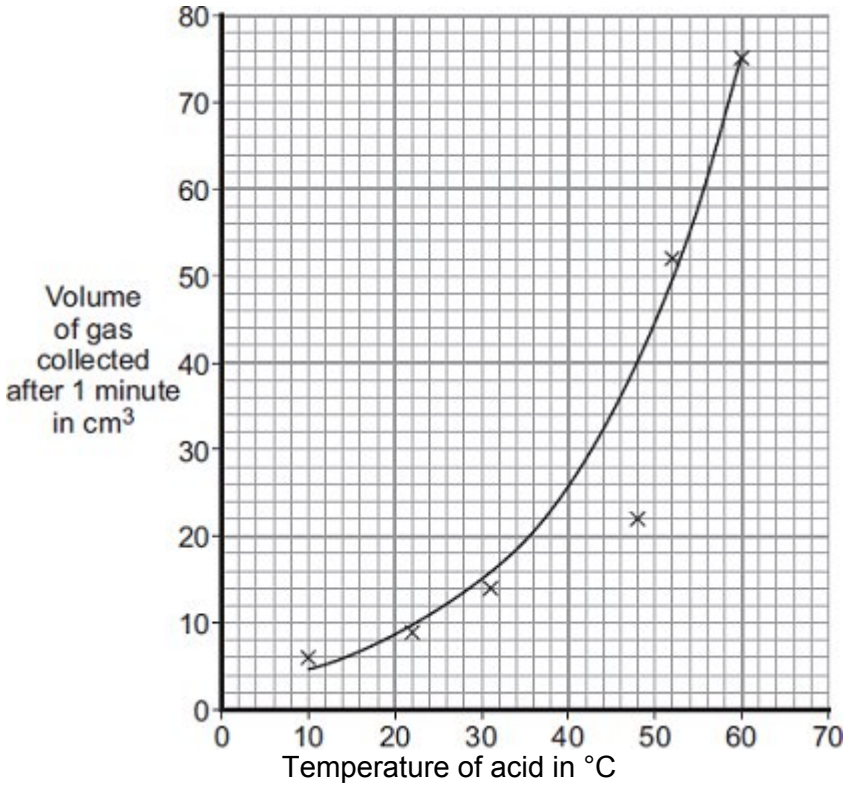
_____

_____

Rate of reaction = _____ cm^3/s

(2)

(c) The student's graph has been reprinted to help you answer this question.



One of the results on the graph is anomalous.

(i) Draw a circle on the graph around the anomalous point.

(1)

STEMUP.CO.UK

(ii) Suggest what may have happened to cause this anomalous result.

Explain your answer.

_____

_____

_____

_____

_____

_____

(2)

(d) Explain how the student could improve the accuracy of the volume of gas recorded at each temperature.

_____

_____

_____

_____

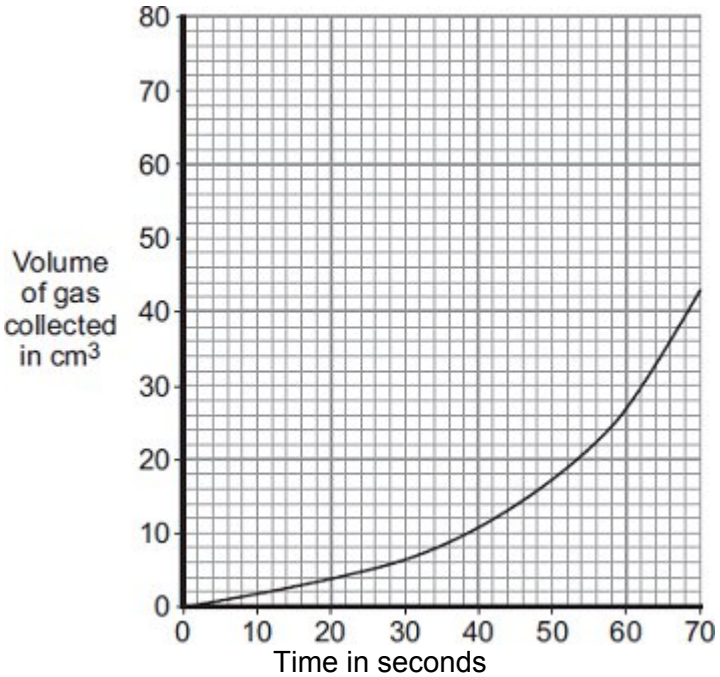
_____

_____

(3)

(e) The student then used the same apparatus to measure the volume of gas produced every 10 seconds at 40 °C.

The student's results are shown on the graph.



STEMUP.CO.UK

The rate at which the gas was produced got faster over the first 60 seconds.

The student's teacher gave two possible explanations of why the reaction got faster.

Explanation 1
There was a layer of magnesium oxide on the surface of the magnesium.
The layer of magnesium oxide prevented the magnesium reacting with the acid.
As the magnesium oxide reacted slowly with the acid, the magnesium was exposed to the acid and hydrogen gas was produced.

Explanation 2
The reaction is exothermic, and so the temperature of the acid increased during the reaction.

(i) Describe further experimental work the student could do to see if **Explanation 1** is correct.

_____

_____

_____

_____

_____

(2)

(ii) Describe further experimental work the student could do to see if **Explanation 2** is correct.

_____

_____

_____

_____

_____

(2)

(Total 16 marks)

Q10.

(a) A student had a colourless solution.

The student thought the solution was dilute hydrochloric acid.

(i) The student added universal indicator to this solution.

What colour would the universal indicator change to if the solution is hydrochloric acid?

_____

(1)

STEMUP.CO.UK

(ii) Describe how the student could show that there are chloride ions in this solution.

_____

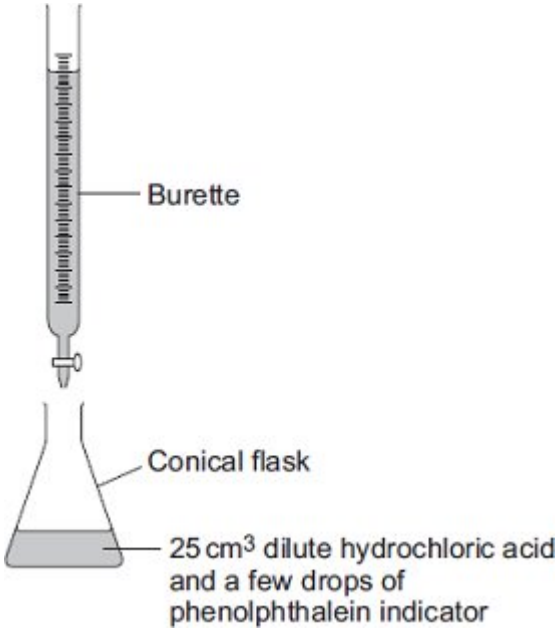
_____

_____

_____

(2)

(b) The results of a titration can be used to find the concentration of an acid.



Describe how to use the apparatus to do a titration using 25 cm^3 of dilute hydrochloric acid.

In your answer you should include:

- how you will determine the end point of the titration
- how you will make sure the result obtained is accurate.

_____

_____

_____

_____

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

_____

(4)

(c) Hydrochloric acid is a strong acid.

Ethanoic acid is a *weak acid*.

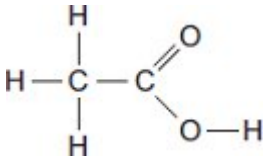
What is meant by the term *weak acid*?

_____

_____

(1)

(d) The displayed formula of ethanoic acid is:



(i) On the formula, draw a circle around the functional group in ethanoic acid.

(1)

(ii) Ethanoic acid and ethanol react together to make the ester ethyl ethanoate.

Draw the **displayed** formula of ethyl ethanoate.

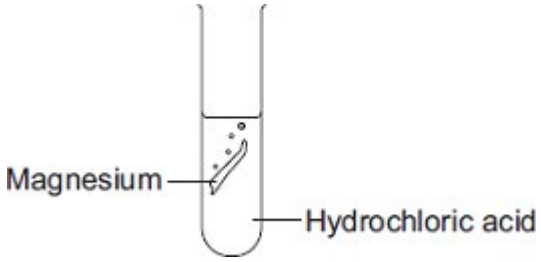
(2)

(Total 11 marks)

Q11.

A student investigated the reaction between magnesium and hydrochloric acid.

STEMUP.CO.UK



The equation for the reaction is:

Mg(s) magnesium	+	2 HCl(aq) hydrochloric acid	⟶	$MgCl_2$(aq) magnesium chloride	+	H_2(g) hydrogen

(a) Give **two** observations the student could make during the reaction.

1. _____

_____

2. _____

_____

(2)

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

The student investigated how the rate of this reaction changed when the concentration of hydrochloric acid was changed.

Write a plan the student could use.

In your plan you should:

- describe how you would carry out the investigation and make it a fair test
- describe the measurements you would make.

_____

_____

_____

_____

_____

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

_____

_____

_____

(6)

(Total 8 marks)

Q12.

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.

_____

_____

_____

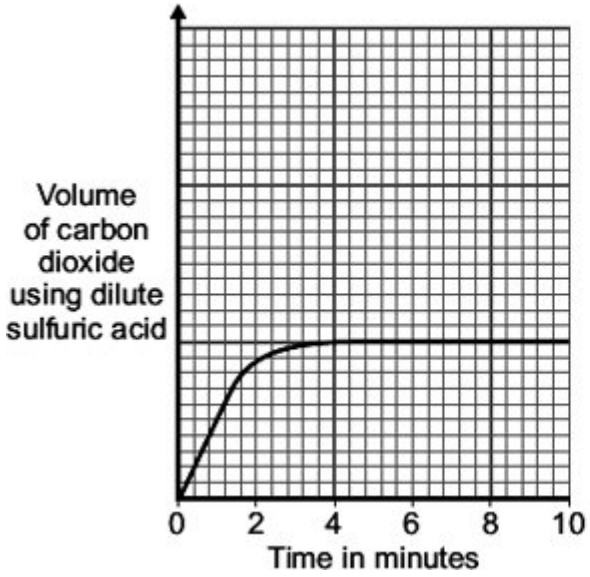
_____

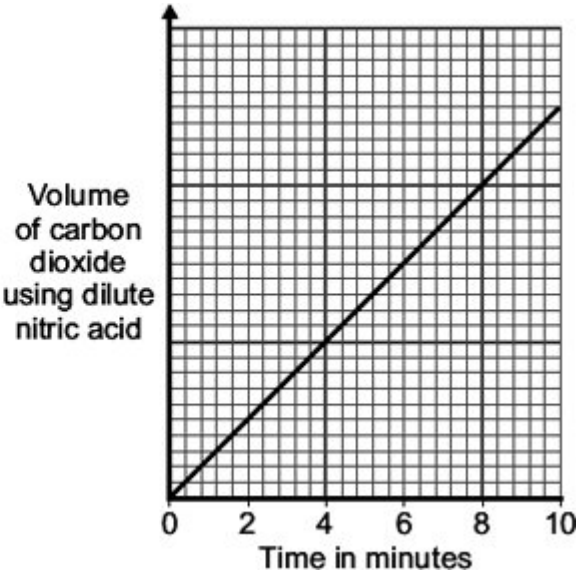
(2)

(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.

STEMUP.CO.UK





(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)

STEMUP.CO.UK

(Total 7 marks)

Q13.

(a) Ammonia solution is used in cleaning products to remove grease from kitchen surfaces.



Ammonia solution is alkaline.

(i) Draw a ring around the number most likely to be the pH of ammonia solution.

1 **3** **7** **10**

(1)

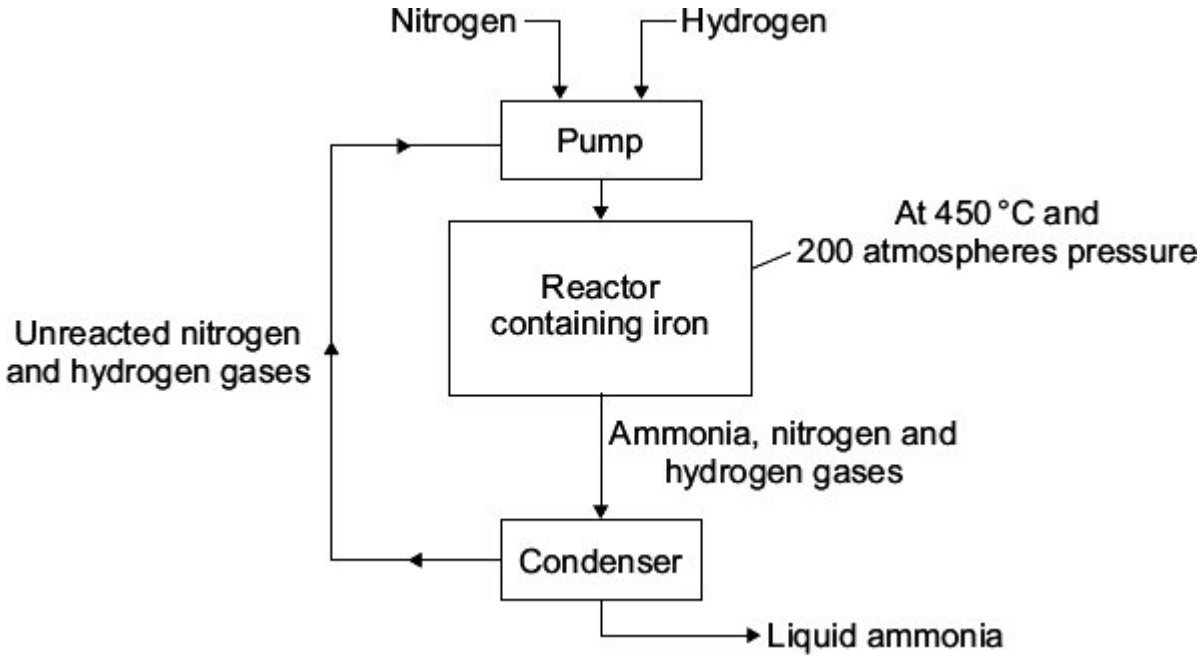
(ii) Draw a ring around the ion in ammonia solution which makes it alkaline.

Cl^- **H^+** **Na^+** **OH^-**

(1)

(b) Ammonia is made using the Haber process.

STEMUP.CO.UK



(i) Where does the nitrogen used in the Haber process come from?

Draw a ring around your answer.

air **natural gas** **water**

(1)

(ii) A high temperature of 450 °C is used in the reactor.

Tick (✓) **two** reasons in the table which explain why high temperatures make reactions faster.

Reasons	**Tick (✓)**
Particles move faster	
Particles are closer together	
Particles collide more often	
Particles have less energy	

(2)

(iii) The iron in the reactor speeds up the reaction but is not used up.

What is the name given to substances that speed up the chemical reaction but which are not used up during the reaction?

_____

(1)

STEMUP.CO.UK

(c) Complete the sentence.

The condenser separates the ammonia from the unreacted nitrogen and hydrogen

by turning the ammonia into a _____

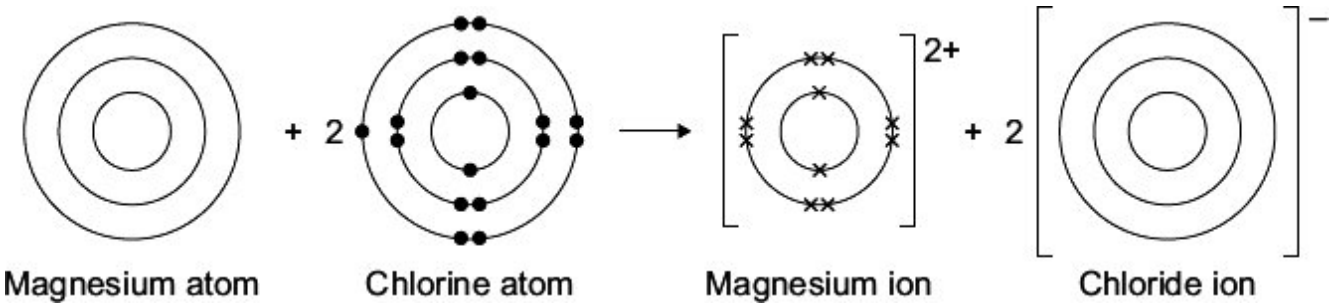
(1)

(Total 7 marks)

Q14.

Magnesium reacts with chlorine to make the ionic compound called magnesium chloride.

(a) Complete the diagram by adding the electronic structures of the magnesium atom and the chloride ion.



(2)

(b) Magnesium metal can be extracted from sea water.
Sea water contains magnesium chloride, $MgCl_2$

(i) Calcium hydroxide, $Ca(OH)_2$, is added to the sea water.
Magnesium hydroxide, $Mg(OH)_2$, is produced.

$$MgCl_2(aq) + Ca(OH)_2(aq) \rightarrow Mg(OH)_2(s) + CaCl_2(aq)$$

Name a method that could be used to separate magnesium hydroxide from the solution.

_____

(1)

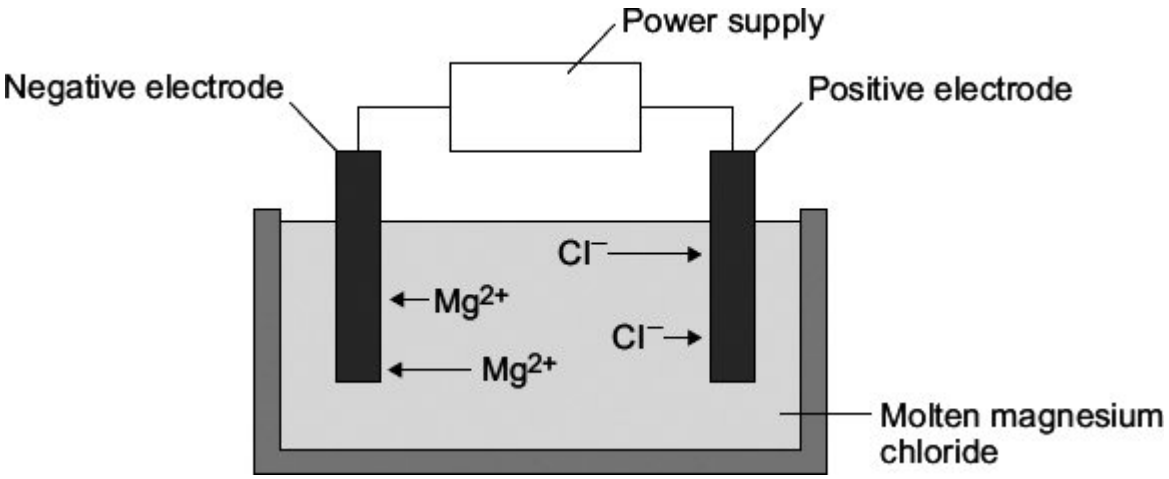
(ii) An acid is then added to the magnesium hydroxide to make magnesium chloride.

Name this acid. _____

(1)

(c) Electrolysis is used to extract magnesium metal from magnesium chloride.

STEMUP.CO.UK



(i) Why must the magnesium chloride be molten?

_____

_____

(1)

(ii) The equation shows the reaction that takes place at the positive electrode.

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

Why is this reaction an oxidation reaction?

_____

(1)

(iii) Complete the equation for the reaction at the negative electrode.

$$Mg^{2+} \rightarrow Mg$$

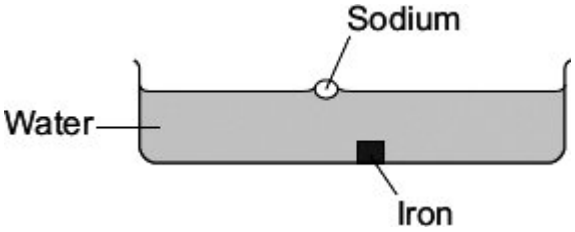
(1)

(Total 7 marks)

Q15.

How a metal is used depends on its properties.

A teacher demonstrated some of the properties of sodium (an alkali metal) and iron (a transition element) by placing a small cube of each metal into water.



A student observed that:

STEMUP.CO.UK

Sodium	Iron
floated on the surface of the water	sank to the bottom of the water
melted to form a molten ball of sodium	did not melt
reacted to produce a gas	did not react
no sodium was left after 5 minutes	the cube of iron remained after 5 minutes

(a) Tick (✓) **two** properties of sodium compared with iron that are shown by the student's observations.

Sodium compared with iron	Tick(✓)
sodium has a higher boiling point	
sodium has a lower density	
sodium is harder	
sodium is more reactive	
sodium is softer	

(2)

(b) Draw a ring around the correct answer to complete the word equation.

sodium + water → sodium hydroxide + [carbon dioxide / hydrogen / oxygen]

(1)

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

Sodium hydroxide is an alkali because it produces [$H^+(aq)$ / $OH^-(aq)$ / $Na^+(aq)$] ions

in aqueous solution.

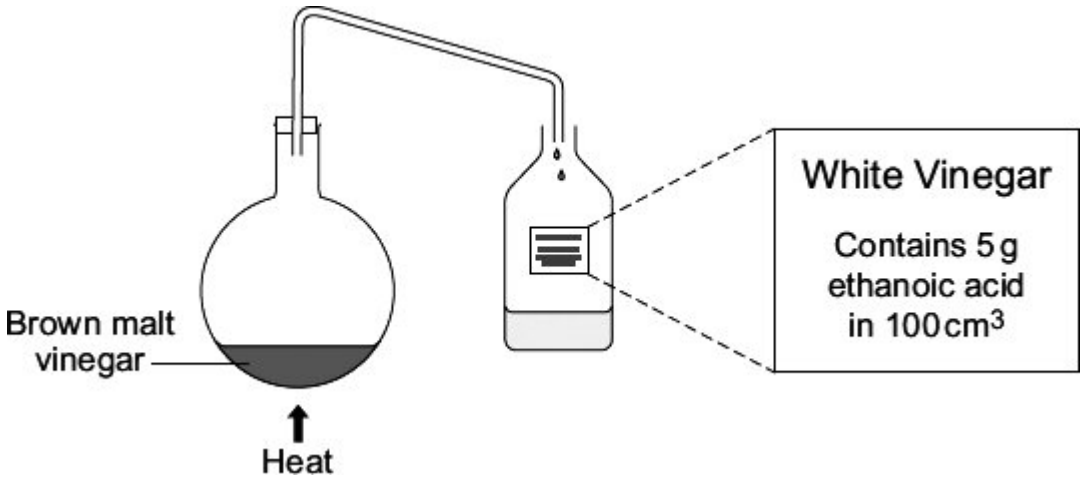
(1)

(Total 4 marks)

STEMUP.CO.UK

Q16.

White vinegar can be made by distillation of brown malt vinegar.



(a) White vinegar contains only water (boiling point 100 °C) and ethanoic acid (boiling point 118 °C).

Suggest why the brown colour remains in the flask during the distillation.

_____

_____

(1)

(b) Ethanoic acid is a weak acid.

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

Weak acids are [completely / not / partially] ionised in water.

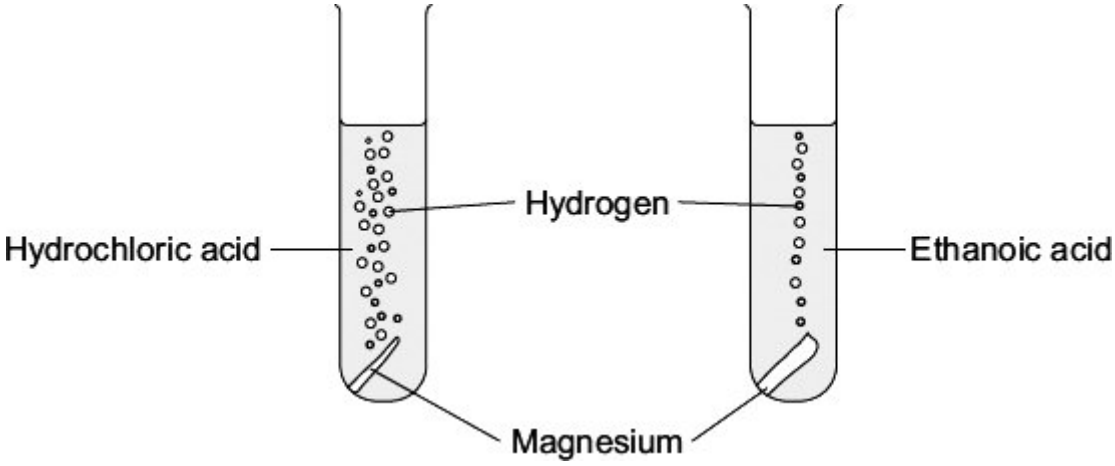
(1)

(ii) Hydrochloric acid and ethanoic acid were reacted with magnesium metal to produce hydrogen gas.

At the start:

- both acids were the same concentration
- both pieces of magnesium were the same size.

STEMUP.CO.UK



Give **two** observations which show that ethanoic acid is a weaker acid than hydrochloric acid.

1. _____

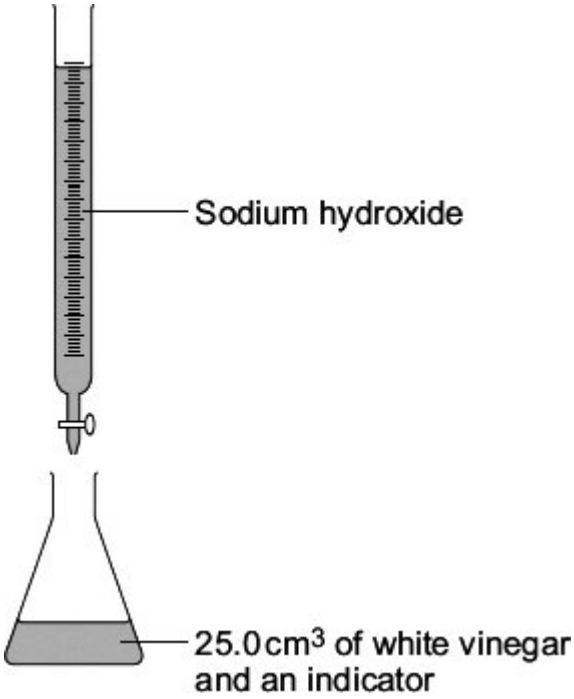
_____

2. _____

_____

(2)

(c) A student did a titration to find out if the white vinegar contains 5 g of ethanoic acid in 100 cm^3.



(i) Choose the correct words from the box to complete the sentences.
Use each word once or not at all.

burette	**conical flask**	**pipette**	**thermometer**

STEMUP.CO.UK

To do this titration 25.0 cm^3 of the white vinegar is measured

using a _____ .

The 25.0 cm^3 of white vinegar is then run into a

_____ .

An indicator is added to the white vinegar.

Sodium hydroxide solution is added to the white vinegar

from a _____ .

(3)

(ii) How does the student know when to stop adding the sodium hydroxide solution?

_____

_____

_____

_____

(2)

(d) The titration is repeated three more times. The results are shown in the table.

Titration	**1**	**2**	**3**	**4**
Volume of sodium hydroxide in cm^3	23.5	20.1	19.9	20.0

(i) The student decided that the mean of these results was 20.0 cm^3.

Explain why.
Use the figures from the table in your explanation.

_____

_____

_____

_____

(2)

(ii) From the results, the student calculated that the concentration of the ethanoic acid was 48 g per cubic decimetre.

Did the white vinegar contain 5 g of ethanoic acid in 100 cm^3 ?
Explain your answer.

_____

_____

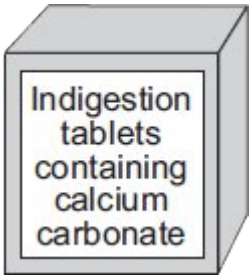
STEMUP.CO.UK

(1)

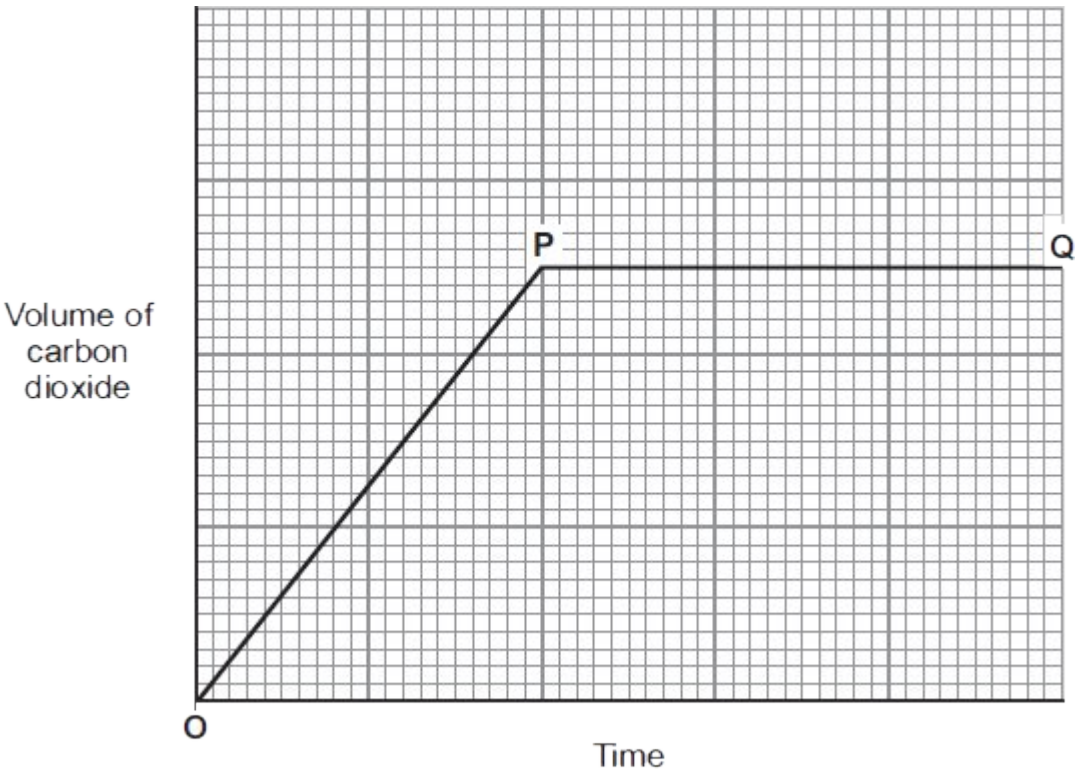
(Total 12 marks)

Q17.

Human stomachs contain hydrochloric acid.
Stomach ache can be caused by too much acid in the stomach.
Indigestion tablets can be used to reduce the amount of acid in the stomach.



(a) The graph shows how the volume of carbon dioxide produced changes with time, after some calcium carbonate is added to hydrochloric acid.



(i) Complete the sentence to explain what happens between **O**and **P**.

Between **O** and **P** the calcium carbonate and hydrochloric acid _____

(1)

(ii) Complete the sentence to explain what happens at **P**.

At **P** the calcium carbonate and hydrochloric acid _____

because _____

(2)

STEMUP.CO.UK

(iii) Describe the test for carbon dioxide gas.

Test _____

Result of the test _____

(2)

(b) Calcium carbonate is found in limestone.
Limestone is removed from the ground by quarrying.



Photograph supplied by Stockbyte/Thinkstock

Tick (✓) **one** advantage and tick (✓) **one** disadvantage of quarrying limestone.

Statement	Advantage Tick (✓)	Disadvantage Tick (✓)
Quarrying limestone destroys the shells and skeletons of marine organisms that formed the limestone.		
Quarrying limestone releases dust, and lorries release carbon dioxide from burning diesel fuel.		
Quarrying limestone provides building materials, employment and new road links.		
Quarrying limestone removes ores from the ground.		

(2)

(Total 7 marks)

Q18.

STEMUP.CO.UK

(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.

(6)

(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.

STEMUP.CO.UK

ammonia + _____ acid → ammonium nitrate

(1)

(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.

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

_____

_____

(1)

(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.

_____

_____

_____

_____

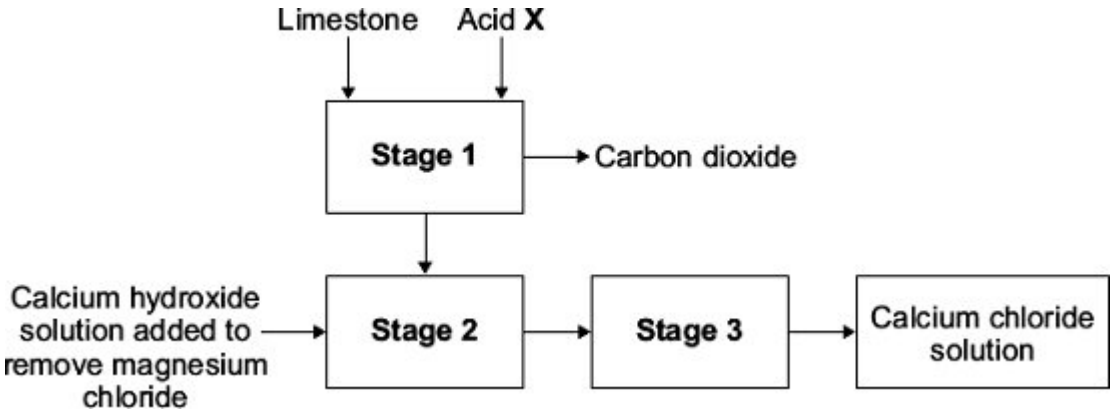
(3)

(Total 11 marks)

Q19.

(a) Calcium chloride is made from limestone. Limestone contains mainly calcium carbonate and a small amount of magnesium carbonate.

STEMUP.CO.UK



(i) In **stage 1** calcium carbonate reacts with acid **X** to form calcium chloride.

Draw a ring around the name of acid **X**.

hydrochloric **nitric** **sulfuric**

(1)

(ii) **Stage 1** produces a concentrated solution of calcium chloride.
The solution also contains magnesium chloride.

Calcium hydroxide solution is added in **stage 2** to remove the magnesium chloride.

The equation for this reaction is:

$$MgCl_2(aq) + Ca(OH)_2(aq) \rightarrow Mg(OH)_2(s) + CaCl_2(aq)$$

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

In **stage 2** a precipitate is made because

magnesium hydroxide is [dissolved / insoluble / soluble] in water.

In **stage 3** the solid magnesium hydroxide can be separated from the calcium chloride solution using [chromatography. / electrolysis. / filtration.]

(2)

(iii) What method can be used to change the calcium chloride solution into solid calcium chloride?
Draw a ring around your answer.

STEMUP.CO.UK

crystallisation **electrolysis** **reduction**

(1)

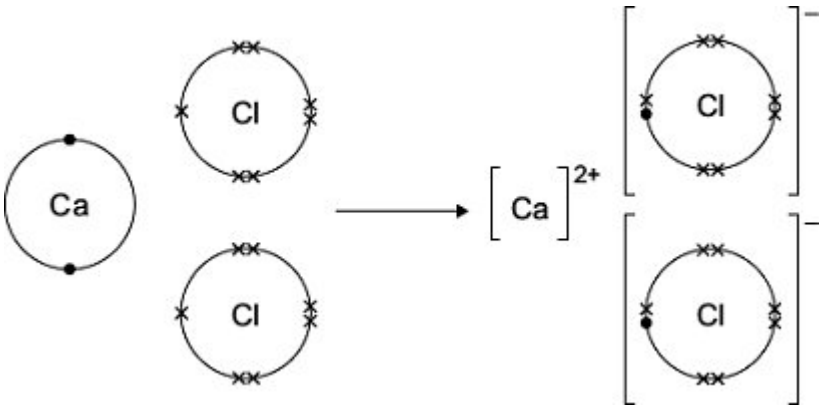
(b) Calcium chloride can also be made by reacting calcium with chlorine:

calcium + chlorine → calcium chloride

The diagram shows what happens to atoms of calcium and chlorine in this reaction.

The dots (●) and crosses (x) are used to represent electrons.

Only the outer electrons are shown.



Use the diagram to help you to answer this question.

Describe, as fully as you can, what happens when calcium reacts with chlorine to make calcium chloride.

_____

_____

_____

_____

_____

_____

_____

_____

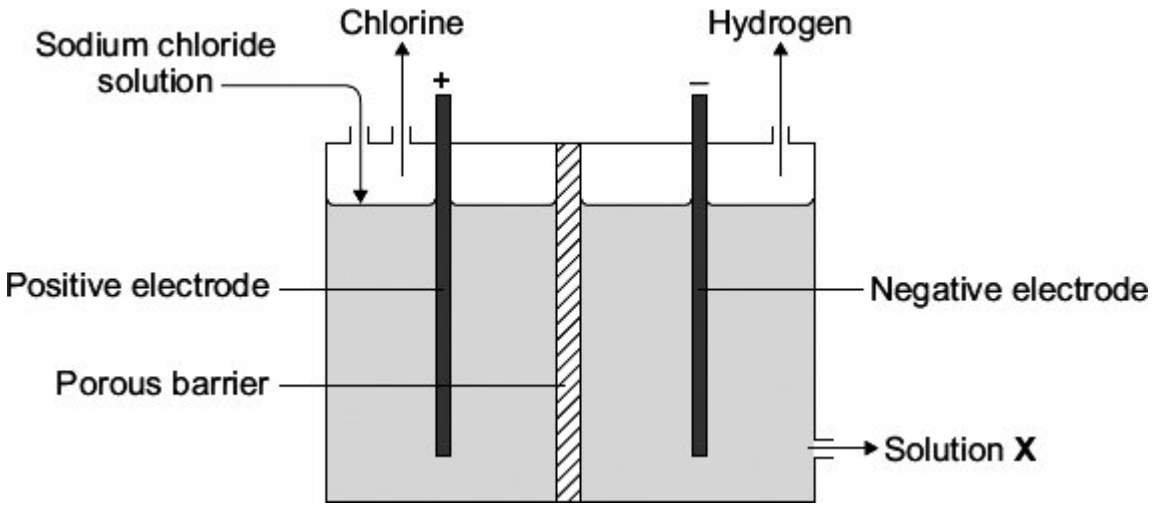
(4)

(Total 8 marks)

Q20.

The electrolysis of sodium chloride solution is an industrial process.

STEMUP.CO.UK



(a) Why do chloride ions move to the positive electrode?

_____

(1)

(b) Sodium chloride solution contains two types of positive ions, sodium ions (Na^+) and hydrogen ions (H^+).

Tick (✓) the reason why hydrogen is produced at the negative electrode and **not** sodium.

Reason	Tick (✓)
Hydrogen is a gas.	
Hydrogen is less reactive than sodium.	
Hydrogen is a non-metal.	
Hydrogen ions travel faster than sodium ions.	

(1)

(c) Solution **X** is alkaline.

Which ion makes solution **X** alkaline?

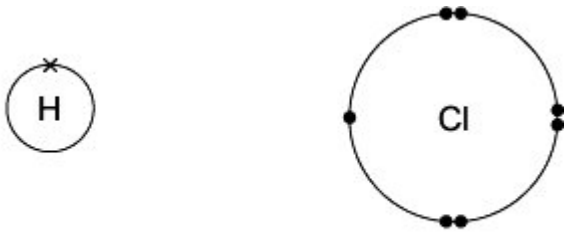
_____

(1)

(d) Electrolysis of sodium chloride solution produces hydrogen and chlorine.
The hydrogen and chlorine can be used to make hydrogen chloride.

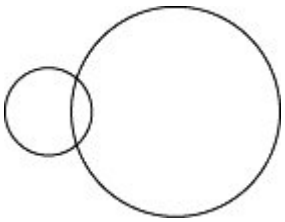
(i) The diagrams show how the outer electrons are arranged in atoms of hydrogen and chlorine.

STEMUP.CO.UK



Hydrogen atom Chlorine atom

Complete the diagram to show how the electrons are arranged in a molecule of hydrogen chloride (HCl).



(1)

(ii) Name the type of bond between the hydrogen and the chlorine atoms in a molecule of hydrogen chloride.

_____

(1)

(iii) Some hydrogen chloride was bubbled into water. This made a solution with a pH of 1.

Which ion gave the solution a pH of 1?

_____

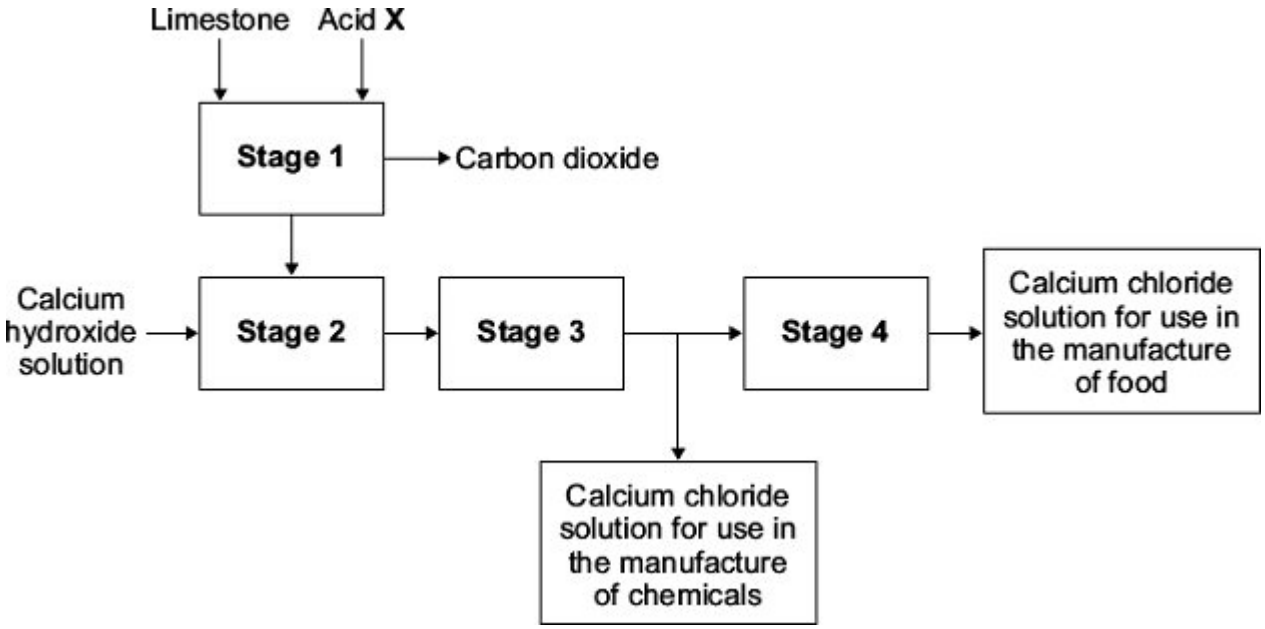
(1)

(Total 6 marks)

Q21.

(a) Calcium chloride is made from limestone. The limestone used contains mainly calcium carbonate and a small amount of magnesium carbonate.

STEMUP.CO.UK



(i) In **stage 1** calcium carbonate reacts with acid **X** to form calcium chloride.

Name acid **X**.

_____

(1)

(ii) **Stage 1** produces a concentrated solution of calcium chloride.
The solution also contains magnesium chloride.

Calcium hydroxide solution is added to remove the magnesium chloride:

$$MgCl_2(aq) + Ca(OH)_2(aq) \rightarrow Mg(OH)_2(s) + CaCl_2(aq)$$

This is an example of a *precipitation* reaction.

What is the meaning of the term *precipitation* reaction?

_____

_____

(1)

(iii) The magnesium hydroxide can be separated from the calcium chloride solution.

State how.

_____

_____

(1)

(iv) Suggest why **stage 4** is needed.

_____

STEMUP.CO.UK

_____

(1)

(v) Name a method that can be used to change calcium chloride solution into solid calcium chloride.

_____

(1)

(b) Calcium chloride can also be made by reacting calcium with chlorine.

Calcium chloride is an ionic compound. It contains calcium ions (Ca^{2+}).

(i) Complete the equation for the formation of calcium ions.

$$Ca \rightarrow Ca^{2+} + _____$$

(1)

(ii) Why can the formation of calcium ions from calcium atoms be described as oxidation?

_____

_____

(1)

(Total 7 marks)

Q22.

Vinegar can be added to food.

Vinegar is a solution of ethanoic acid in water.



(a) Ethanoic acid is a *weak* acid.

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

(i) When dissolved in water, an acid forms a solution containing

carbonate ions.

hydrogen ions.

STEMUP.CO.UK

hydroxide ions.

(1)

(ii) Ethanoic acid is a *weak* acid because in water it is

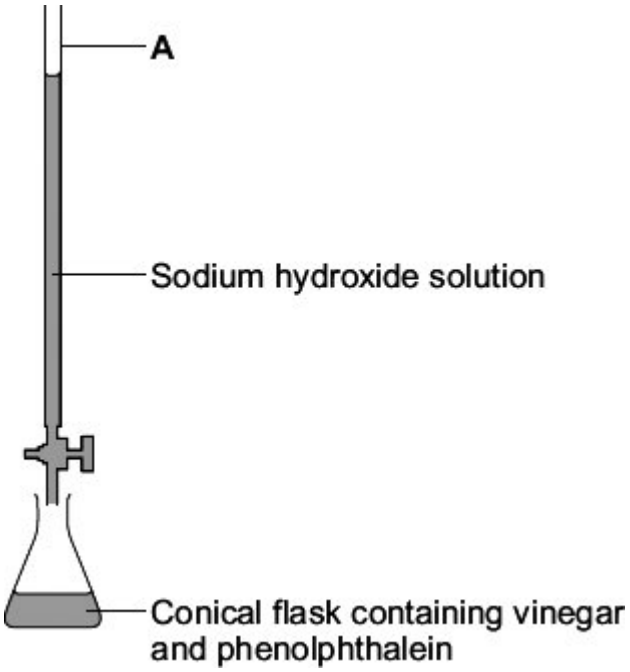
completely ionised.

not ionised.

partially ionised.

(1)

(b) The diagram shows the apparatus used to investigate the amount of ethanoic acid in vinegar.



(i) Draw a ring around the name of the piece of apparatus labelled **A** on the diagram.

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

(1)

(ii) Phenolphthalein is added to the vinegar in the conical flask so that the end point of the titration can be seen.

What type of substance is phenolphthalein?

Draw a ring around the correct answer.

alkali **catalyst** **indicator**

(1)

(iii) How would you know that the end point of the titration has been reached?

STEMUP.CO.UK

_____

_____

(1)

(c) The results of the titration are shown in the table.

	Rough titration	**Accurate titrations**		
		1	**2**	**3**
Final reading in cm^3	22	21.30	22.50	24.40
Initial reading in cm^3	0	1.00	2.00	4.00
Volume used in cm^3	22	20.30	20.50	20.40

Calculate the best value of the mean volume from these titrations.

_____

_____

_____

Mean volume used = _____ cm^3

(2)

(d) 25.0 cm^3 of this vinegar contained 1.25 g of ethanoic acid.

Calculate the mass of ethanoic acid in 1 litre (1000 cm^3) of this vinegar.

_____

_____

_____

Mass = _____ g

(2)

(Total 9 marks)

Q23.

Vinegar can be added to food. Vinegar is an aqueous solution of ethanoic acid.

STEMUP.CO.UK



Ethanoic acid is a *weak* acid.

(a) Which ion is present in aqueous solutions of all acids?

_____

(1)

(b) What is the difference between the pH of a *weak* acid compared to the pH of a strong acid of the same concentration?

Give a reason for your answer.

_____

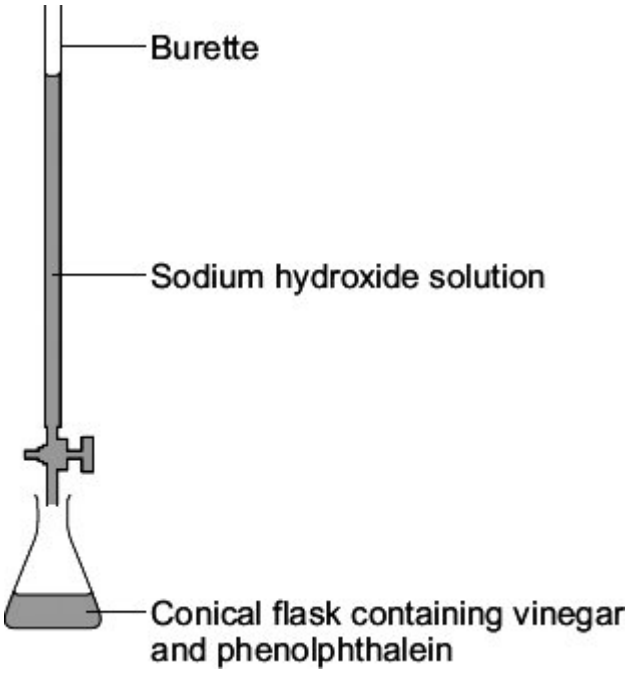
_____

_____

_____

(2)

(c) The diagram shows the apparatus used to find the concentration of ethanoic acid in vinegar.



STEMUP.CO.UK

(i) Why should phenolphthalein indicator be used for this titration instead of methyl orange?

_____

_____

(1)

(ii) 25.00 cm^3 of vinegar was neutralised by 30.50 cm^3 of a solution of sodium hydroxide with a concentration of 0.50 moles per cubic decimetre.

The equation for this reaction is:

$$CH_3COOH(aq) + NaOH(aq) \rightarrow CH_3COONa(aq) + H_2O(l)$$

Calculate the concentration of ethanoic acid in this vinegar.

_____

_____

_____

_____

Concentration of ethanoic acid in this vinegar = _____ moles per cubic decimetre

(2)

(d) The concentration of ethanoic acid in a different bottle of vinegar was 0.80 moles per cubic decimetre.

Calculate the mass in grams of ethanoic acid (CH_3COOH) in 250 cm^3 of this vinegar. The relative formula mass (M_r) of ethanoic acid = 60.

_____

_____

_____

_____

Mass of ethanoic acid = _____ g

(2)

(Total 8 marks)

Q24.

(a) A magnesium atom contains 12 protons (●),12 neutrons (o) and 12 electrons (x).

Which diagram, **A**, **B** or **C**, represents this magnesium atom?

STEMUP.CO.UK

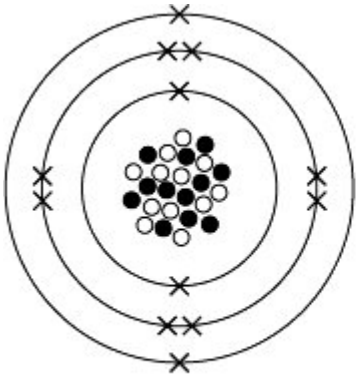


Diagram A

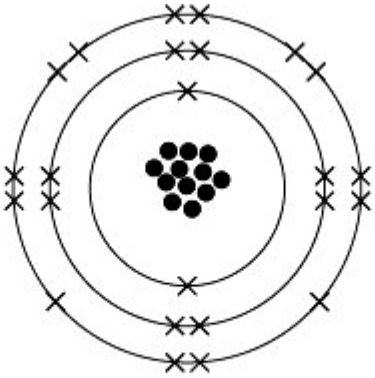


Diagram B

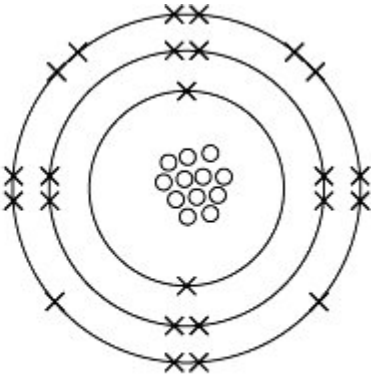
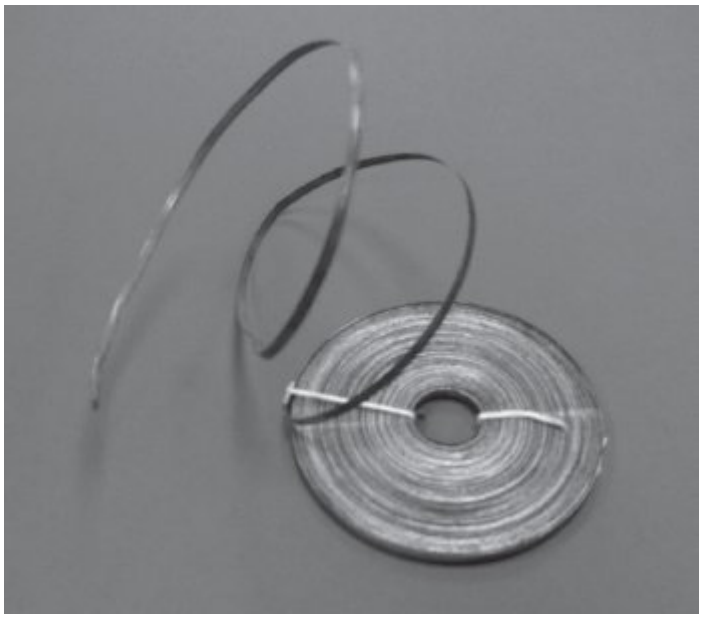


Diagram C

This magnesium atom is **Diagram** ☐

(1)

(b) Magnesium metal is shaped to make magnesium ribbon.



Tick (✓) **two** reasons which explain why metals can be shaped.

Reason why	Tick (✓)
The atoms are all joined by covalent bonds.	
The atoms can slide over each other.	
The atoms are large.	
The atoms are in layers.	

(2)

STEMUP.CO.UK

(c) 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)	→	$MgSO_4$(aq)	+	H_2(g)
magnesium		acid		magnesium sulfate solution		hydrogen

(i) Draw a ring around the name of the acid used in this reaction.

hydrochloric **nitric** **sulfuric**

(1)

(ii) Use the equation to help you to answer this question.

Tick (✓) **two** things that happen when this reaction takes place.

	Tick (✓)
Bubbles are produced.	
The magnesium disappears.	
A solid is formed.	
Water is formed.	

(2)

(iii) Draw a ring around a method to get solid magnesium sulfate from magnesium sulfate solution.

crystallisation **electrolysis** **oxidation**

(1)
(Total 7 marks)

Q25.

A student investigated the electrolysis of sodium chloride solution.

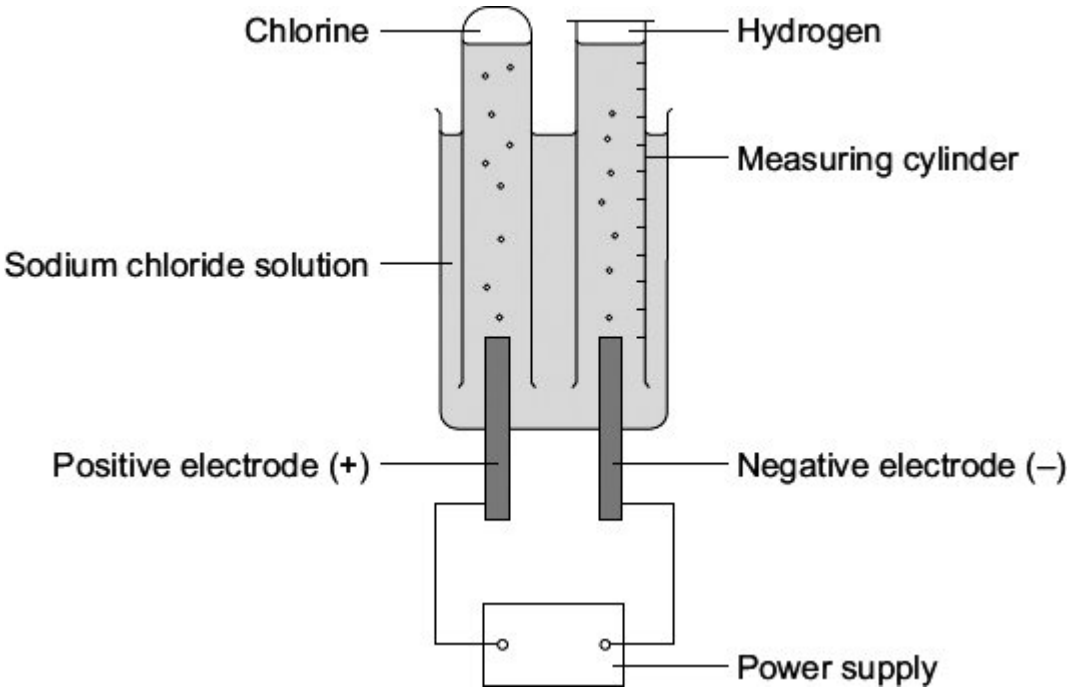
Five sodium chloride solutions were made. Each solution had a different concentration.

To make each solution the student:

- weighed the amount of sodium chloride needed
- dissolved it in water
- added more water until the total volume was one cubic decimetre (1 dm^3).

The solutions were placed one at a time in the apparatus shown below.

STEMUP.CO.UK



The student measured the volume of hydrogen gas produced in ten minutes.

The results are shown on the graph below.

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

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

_____

_____

(1)

(b) Chlorine is produced at the positive electrode.

Why are chloride ions attracted to the positive electrode?

_____

(1)

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

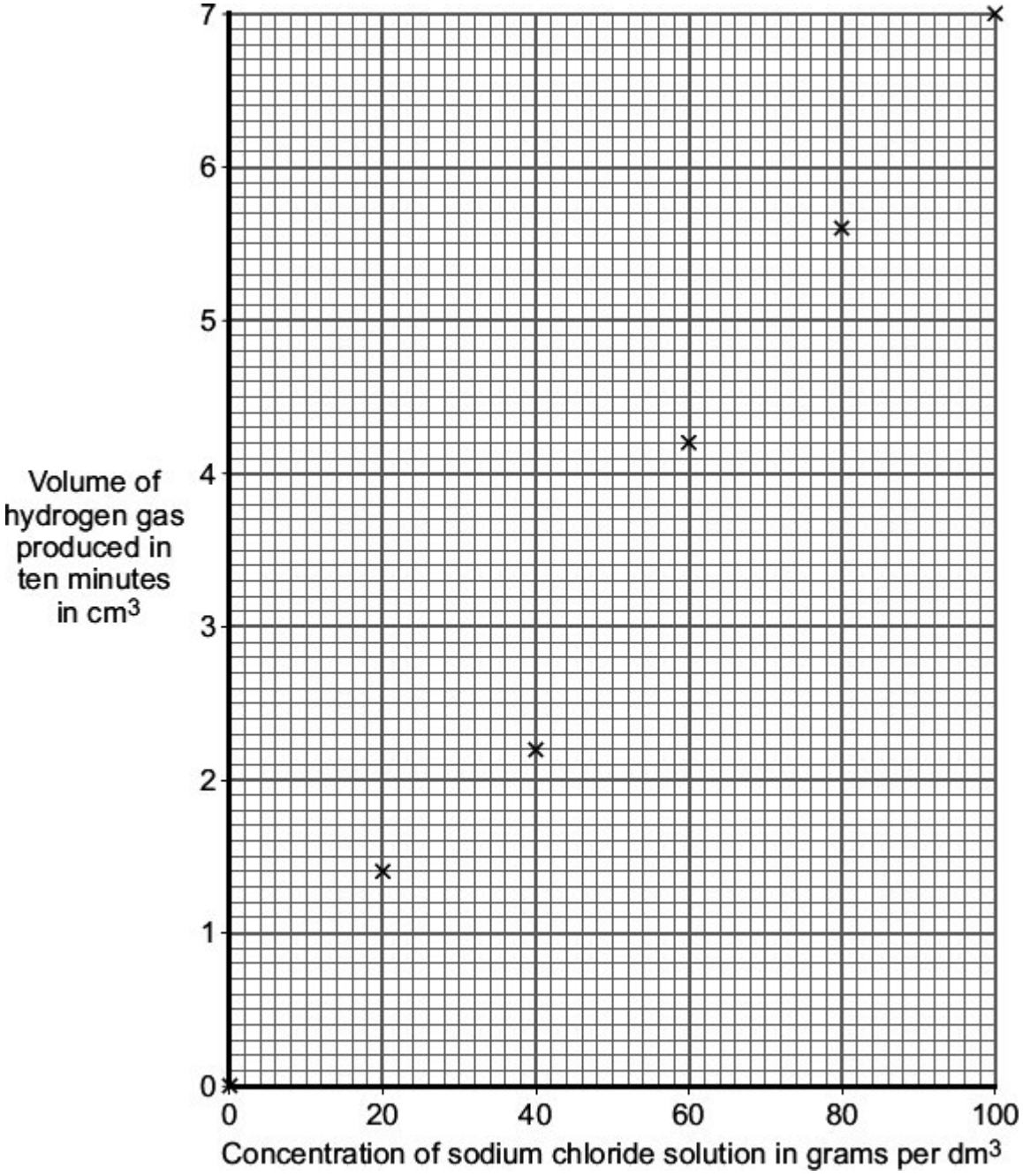
Draw a ring around **one** number which could be the pH of this solution.

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

(1)

(d) The results for the experiment above are shown on the graph.

STEMUP.CO.UK



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

(1)

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

The result at concentration _____ grams per dm^3

(1)

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

1. _____

_____

2. _____

STEMUP.CO.UK

_____

(2)

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

_____

_____

(1)

(iv) How did an increase in the concentration of the sodium chloride solution affect the volume of hydrogen gas produced in ten minutes?

_____

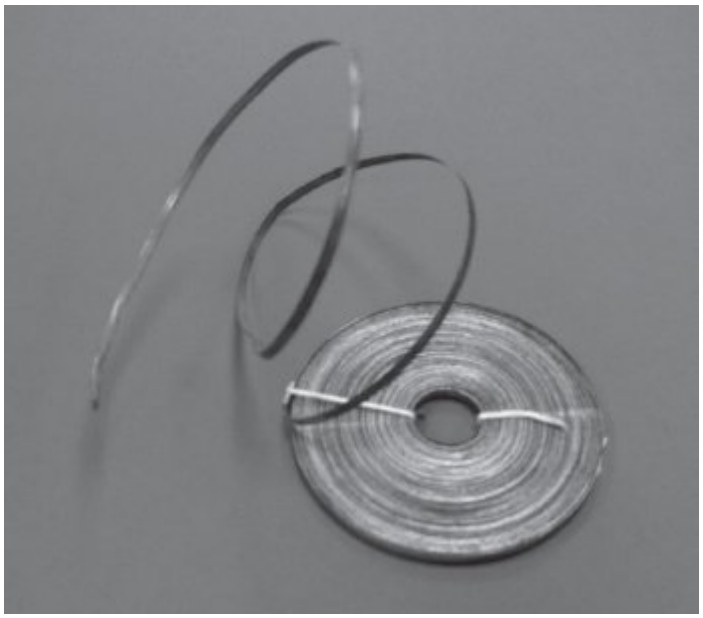
_____

(1)

(Total 9 marks)

Q26.

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



Explain why metals can be shaped.

_____

_____

_____

_____

_____

(2)

(b) Magnesium sulfate is a salt of magnesium.

STEMUP.CO.UK

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

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

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

_____ acid

(1)

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

_____

_____

_____

_____

_____

(2)

(iii) The magnesium sulfate is in solution.

How could you obtain solid magnesium sulfate from this solution?

_____

_____

(1)

(Total 6 marks)

Q27.

Humberstone was a town in the desert of Northern Chile in South America. It was built for the people who worked in the nearby sodium nitrate mines.

The sodium nitrate was used as a fertiliser.

The sodium nitrate was exported by ship to countries all around the world.

Today the mines have closed and nobody lives in Humberstone.

One of the reasons for the mines closing was the invention of the Haber process.

STEMUP.CO.UK



By Sznegra (Own work) [CC-BY-SA-3.0], via Wikimedia Commons

(a) The Haber process is used to make ammonia (NH_3).

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

The forward reaction is exothermic.

(i) Name the raw materials that are used to supply the nitrogen and hydrogen.

Nitrogen _____

Hydrogen _____

(2)

(ii) The Haber process uses a temperature of 450 °C.

Explain, as fully as you can, why a temperature of 450 °C is used rather than a much higher temperature or a much lower temperature.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(iii) Ammonia can be converted to ammonium nitrate by adding an acid.

Name this acid.

STEMUP.CO.UK

_____

(1)

(b) Suggest and explain why the invention of the Haber process caused the closure of the Humberstone mines in Chile.

_____

_____

_____

_____

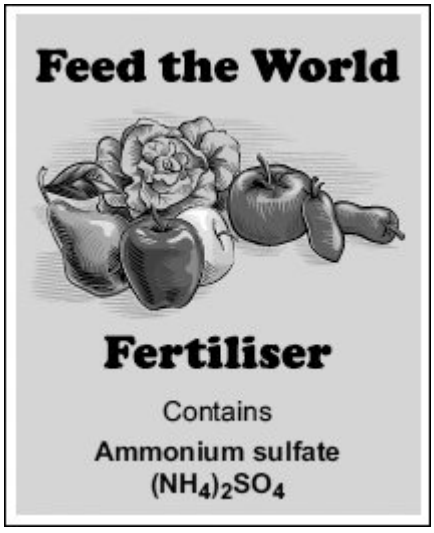
_____

(2)

(Total 8 marks)

Q28.

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.

| blue. |

STEMUP.CO.UK

Ammonia turns damp litmus paper [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.]

STEMUP.CO.UK

SO_4^{2-} ions.

(1)

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

The pH of stronger acids is

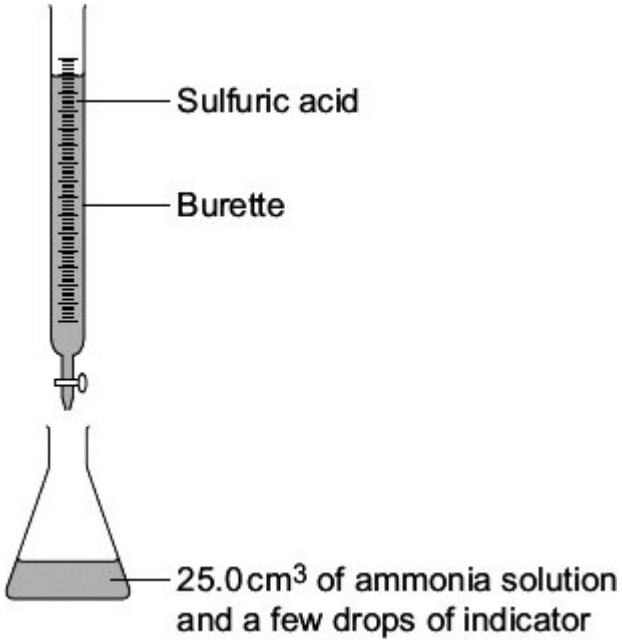
higher than
lower than
the same as

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? _____

STEMUP.CO.UK

(1)

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

_____

_____

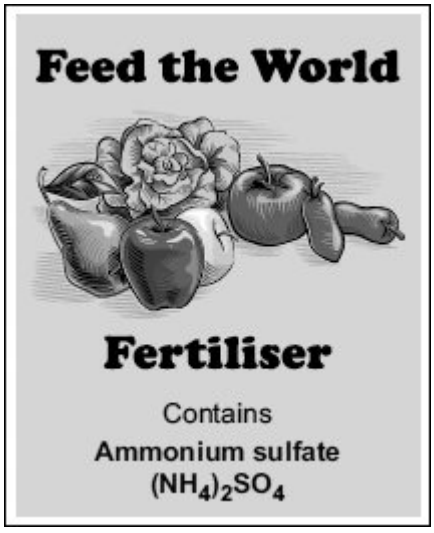
Mean volume = _____ cm^3

(1)

(Total 10 marks)

Q29.

Ammonium sulfate is an artificial fertiliser.



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

Test _____

_____

Result _____

_____

(2)

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

Test _____

_____

Result _____

_____

(2)

STEMUP.CO.UK

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

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

_____

(1)

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

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

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

_____

(1)

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

The equation that represents this reaction is:

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

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

_____

_____

_____

_____

_____

Concentration = _____ moles per cubic decimetre

(3)

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

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

Relative formula mass of ammonia (NH_3) = 17.

_____

_____

_____

STEMUP.CO.UK

Concentration = _____ grams per cubic decimetre

(2)

(Total 11 marks)

Q30.

Hydrogen fluoride is used to make hydrofluoric acid.

(a) A company makes hydrogen fluoride by reacting solid calcium fluoride with sulfuric acid. The reaction takes place in a rotating kiln.

calcium fluoride + sulfuric acid → calcium sulfate + hydrogen fluoride

The company want this reaction to take place quickly.

(i) Rotating the kiln makes the reaction take place faster.

Suggest why.

_____

_____

(1)

(ii) Draw a ring around the correct word in each box.

To make the reaction take place **faster**:

the temperature should be [higher / lower] so that the particles have [less / more] energy

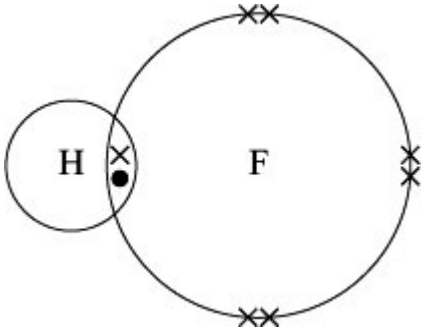
the solid calcium fluoride should be [powder / lumps] to give a [small / big] surface area

the sulfuric acid solution should be [dilute / concentrated] to give [less / more] collisions between the particles each second.

(3)

(b) The diagram represents a molecule of hydrogen fluoride.

STEMUP.CO.UK



The hydrogen and fluorine atoms are joined by a covalent bond.

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

electrons	neutrons	protons

In a covalent bond the atoms share _____ .

(1)

(c) Hydrogen fluoride is dissolved in water to make an acidic solution of hydrofluoric acid.

Draw a ring around the symbol of the ion that makes the solution acidic.

H^+ **OH^-** **F^-**

(1)

(Total 6 marks)

Q31.

Read the article.

In the late eighteenth century the French scientist Nicolas Leblanc invented a process to change sodium chloride into sodium carbonate.

The main steps in the original process were:

Step 1. Sodium chloride was reacted with sulfuric acid to make sodium sulfate. Hydrogen chloride was formed and escaped into the atmosphere. The hydrogen chloride damaged plants over a wide area around the factory.

Step 2. The sodium sulfate was heated with limestone and coal. A solid mixture was formed which contained sodium carbonate, calcium sulfide and unreacted coal. The calcium sulfide gave off a very unpleasant smell.

Step 3. The sodium carbonate was dissolved in water and separated from the insoluble calcium sulfide and unreacted coal.

Step 4. Crystals of sodium carbonate were obtained from the solution of sodium carbonate.

The process was later improved.

- The hydrogen chloride produced in **Step 1** was changed into chlorine which was

STEMUP.CO.UK

used to make bleach.

- The calcium sulfide produced in **Step 2** was converted into sulfur. This sulfur was used to make sulfuric acid.

(a) The symbol equation for the reaction in **Step 1** is shown below.

$$2NaCl(s) + H_2SO_4(l) \rightarrow Na_2SO_4(s) + 2HCl(g)$$

What property of hydrogen chloride allowed it to escape into the atmosphere?

_____

(1)

(b) The insoluble solids, calcium sulfide and unreacted coal were separated from the sodium carbonate solution in **Step 3**.

Suggest how this was done.

_____

_____

(1)

(c) Sodium carbonate crystals were obtained from sodium carbonate solution in **Step 4**.

Suggest how this was done.

_____

_____

(1)

(d) It has been stated that: 'the Chemical Industry can turn problems into profit'.

State **two** problems with the original process and explain how they were turned into profit.

1. _____

_____

_____

_____

2. _____

_____

_____

_____

(4)

(Total 7 marks)

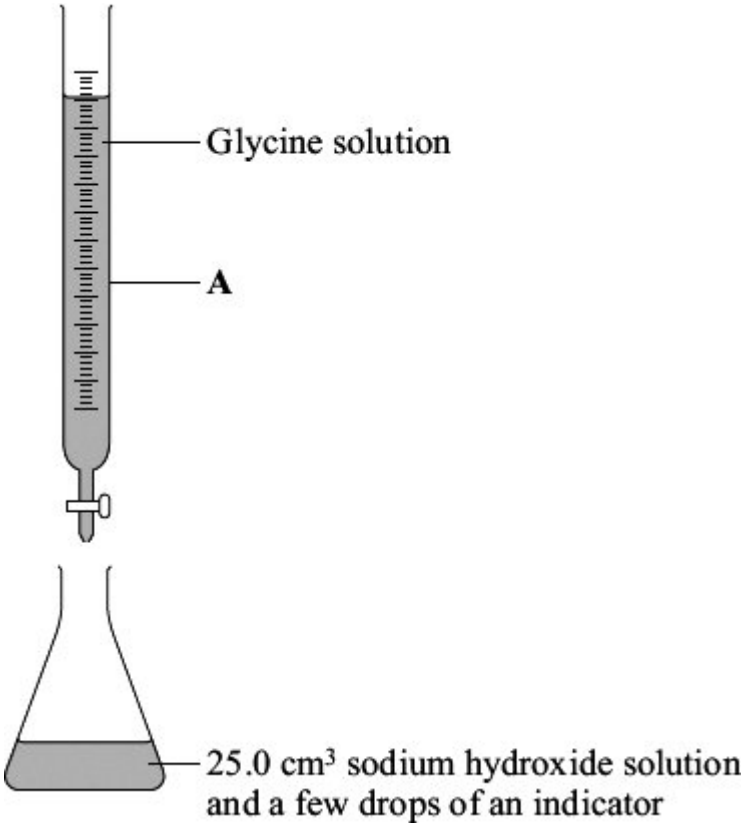
STEMUP.CO.UK

Q32.

Glycine is an amino acid. It is found in fish, meat, beans and dairy produce.

A student carried out a titration to find the amount of glycine solution that reacts with 25.0 cm^3 of sodium hydroxide solution.

The diagram shows the apparatus that the student used.



(a) Which **one** of the following words is the correct name for apparatus **A**?

Draw a ring around your answer.

burette **cylinder** **pipette**

(1)

(b) How would the student know when enough glycine solution had been added to react with all of the sodium hydroxide solution?

_____

_____

(1)

(c) The student's results are given in the table.

Titration	Volume of glycine solution added in cm^3
1	18.5

STEMUP.CO.UK

2	18.3
3	18.4

(i) What is the range?

_____

(1)

(ii) Calculate the mean.

_____

(1)

(iii) Suggest why the student repeated the titration.

_____

_____

(1)

(Total 5 marks)

Q33.

Go Grease is a drain and oven cleaner.



The active ingredient in Go Grease is the alkali sodium hydroxide (NaOH).

(a) Name or give the formula of the ion that makes solutions alkaline.

_____

(1)

(b) Sodium hydroxide is a *strong* alkali.

In terms of ionisation, what is meant by the word *strong*?

_____

_____

(1)

STEMUP.CO.UK

(c) You are given solutions of sodium hydroxide and ammonia of the same concentration.

Describe and give the results of a test to show that sodium hydroxide is a stronger alkali than ammonia solution.

_____

_____

_____

_____

_____

(2)

(Total 4 marks)

Q34.

(a) Read the article about the mineral strontianite.

Strontianite is a mineral that was discovered near the village of Strontian in Scotland. At first some scientists thought that strontianite was barium carbonate.

Strontianite



In 1790, Professor Adair Crawford and William Cruikshank were both lecturers in chemistry and doctors of medicine. They investigated the properties of strontianite. They found that strontianite had different properties from barium carbonate. They concluded that strontianite contained a new element.

After this, other scientists also showed that strontianite and barium carbonate had different properties. Strontianite is now known to be strontium carbonate.

Rob Lavinsky, iRocks.com – CC-BY-SA-3.0 [CC-BY-SA-3.0], via Wikimedia Commons

(i) What evidence did Crawford and Cruikshank use to prove that strontianite was **not** barium carbonate?

_____

STEMUP.CO.UK

_____

(1)

(ii) Crawford and Cruikshank's conclusion was immediately accepted by other scientists. Suggest why.

_____

_____

(1)

(iii) How was the reliability of the work of Crawford and Cruikshank confirmed?

_____

_____

(1)

(b) One of Crawford and Cruikshank's experiments was repeated in a school laboratory.

Samples of strontianite and barium carbonate were reacted with hydrochloric acid to produce strontium chloride and barium chloride.

Solid strontium chloride and solid barium chloride were separately added to water. The change in temperature of the water was measured.

The results of the experiments are shown below.

	Experiment 1 Strontium chloride dissolved in water	**Experiment 2** Barium chloride dissolved in water
Temperature of water before adding the chloride in °C	19.5	19.6
Temperature of water after adding the chloride in °C	21.2	17.5

(i) State **one** variable that should be controlled to make it a fair test.

_____

_____

(1)

(ii) Which experiment, **1** or **2**, is endothermic?

Explain how you know.

Experiment ☐ because _____

_____

STEMUP.CO.UK

(1)

(iii) The results prove that strontium chloride and barium chloride must be different even if all of the variables had not been controlled when they were dissolved. Explain why.

_____

_____

(1)

(c) In 1808, Humphry Davy was the first person to extract strontium. He did this by the electrolysis of molten strontium chloride. Strontium formed at the negative electrode.

Suggest why strontium ions are attracted to the negative electrode.

_____

_____

(1)

(Total 7 marks)

Q35.

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 each sentence.

(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

STEMUP.CO.UK

(1)

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

(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)

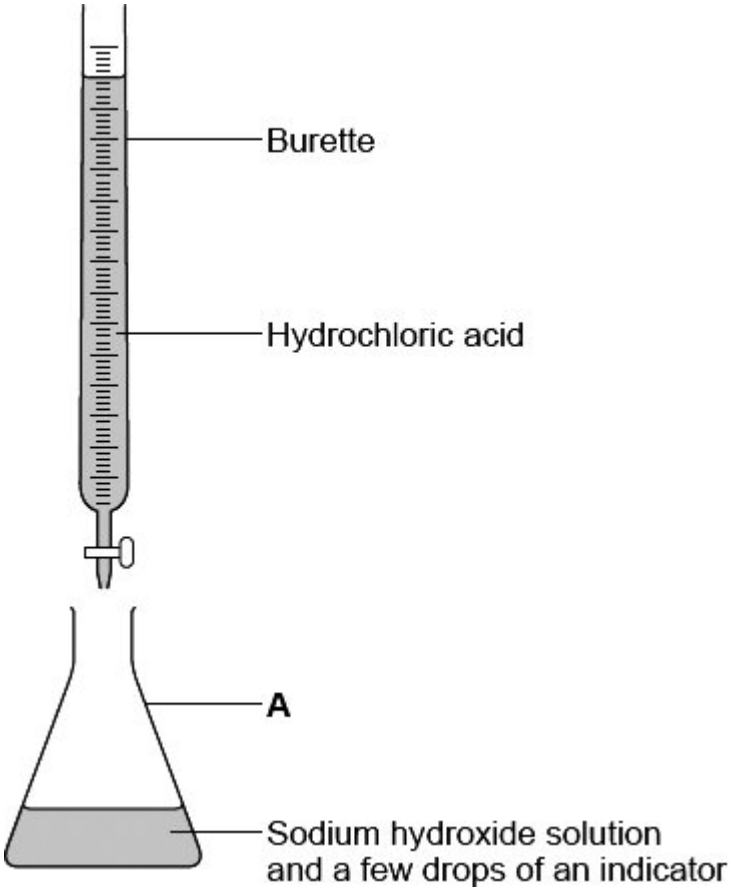
(c) Draw a ring around the correct answer to complete this sentence.

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.

STEMUP.CO.UK



(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**

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

(1)

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

_____

(1)

(Total 9 marks)

STEMUP.CO.UK