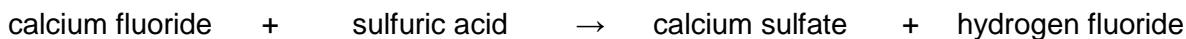


## Chemical Changes Part 3

### Q1.

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.



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 

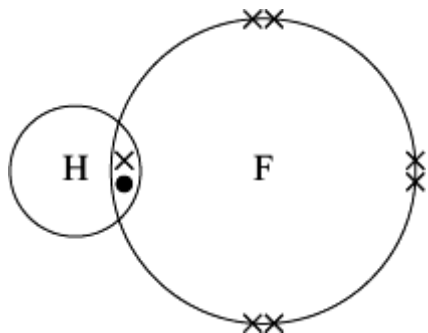
less
more

 collisions

between the particles each second.

(3)

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



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

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

<b>electrons</b>	<b>neutrons</b>	<b>protons</b>
------------------	-----------------	----------------

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.



(1)

(Total 6 marks)

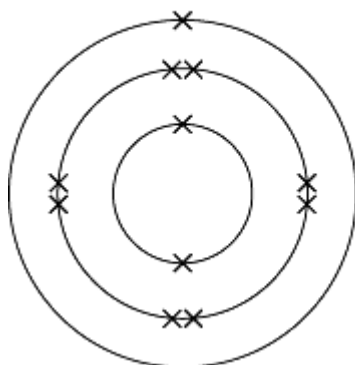
**Q2.**

Sodium chloride is a raw material.

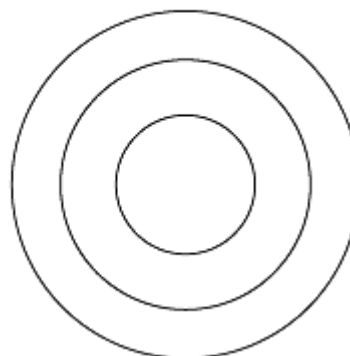
- (a) The electronic structure of a sodium atom is shown below.

Complete the diagram for the electronic structure of a chlorine atom. A chlorine atom has 17 electrons.

**Sodium atom**



**Chlorine atom**



(1)

- (b) When sodium and chlorine react to form sodium chloride they form sodium ions ( $Na^+$ ) and chloride ions ( $Cl^-$ ).

How does a sodium atom change into a sodium ion?

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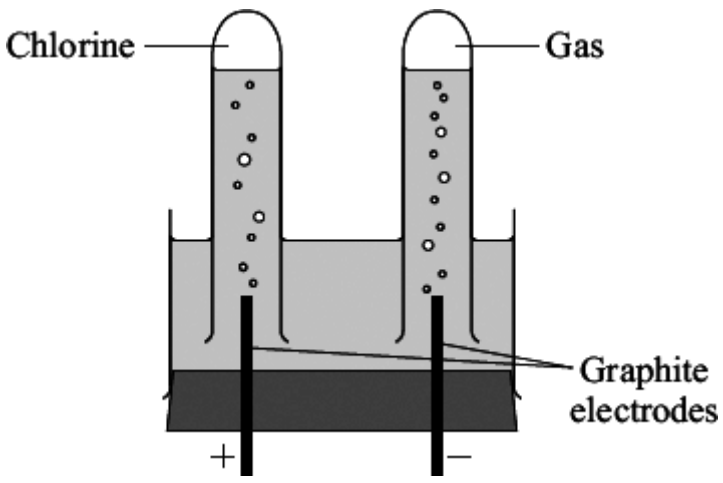
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(2)

(c) The diagram shows apparatus used in a school laboratory for the electrolysis of sodium chloride solution.



The solution contains sodium ions ( $\text{Na}^+$ ), chloride ions ( $\text{Cl}^-$ ), hydrogen ions ( $\text{H}^+$ ) and hydroxide ions ( $\text{OH}^-$ ).

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

---

(1)

(ii) Name the gas formed at the negative electrode.

---

(1)

(d) Chlorine and chlorine compounds are used to bleach wood pulp that is used to make paper.

The article below is from a newspaper.

Local people have been protesting outside a paper factory. They say:  
'We want the company to stop using chlorine compounds. Chlorine compounds release poisons into the environment. The company should use safer compounds.'

The company replied:  
'Chlorine has been used safely for many years to treat drinking water. Only tiny amounts of chlorine are released, which cause no harm. Using other compounds will be more expensive and may put us out of business.'

(i) Why are some local people worried about the use of chlorine compounds?

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(1)

- (ii) Why might other local people want the company to continue to use chlorine compounds?

---

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(1)

- (iii) It is decided to have an inquiry.  
Why should this be done by independent scientists?

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(1)

(Total 8 marks)

### Q3.

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.

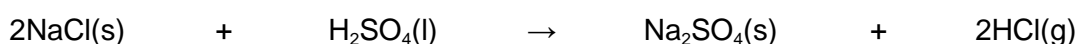
**Step 3.** The sodium carbonate was dissolved in water and separated from the insoluble calcium sulfide and unreacted coal.

**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 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.



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. \_\_\_\_\_

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2. \_\_\_\_\_

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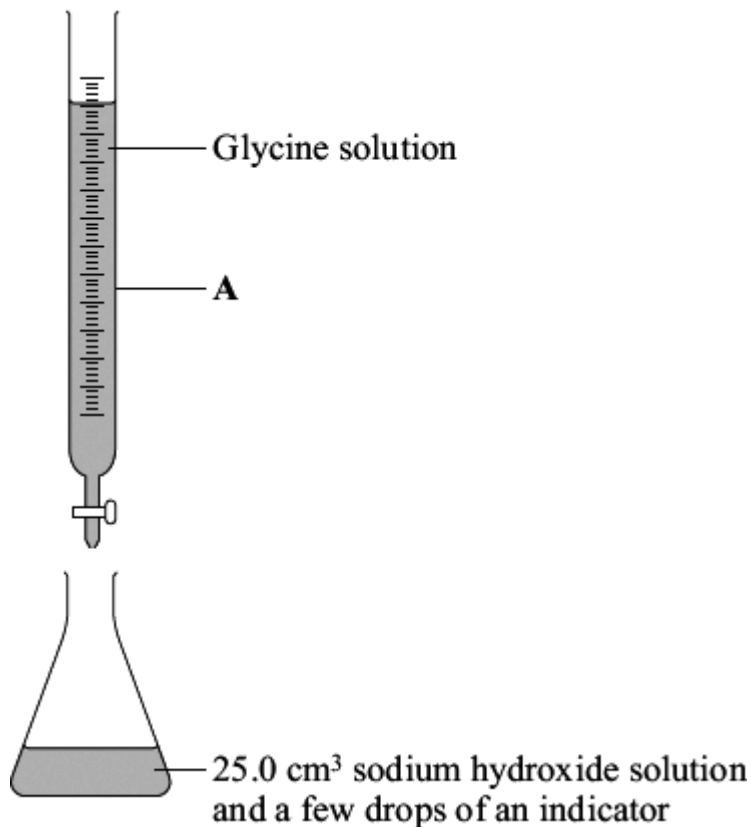
(4)  
(Total 7 marks)

#### Q4.

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<sup>3</sup> 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 <sup>3</sup>
1	18.5
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)**

**Q5.**

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)

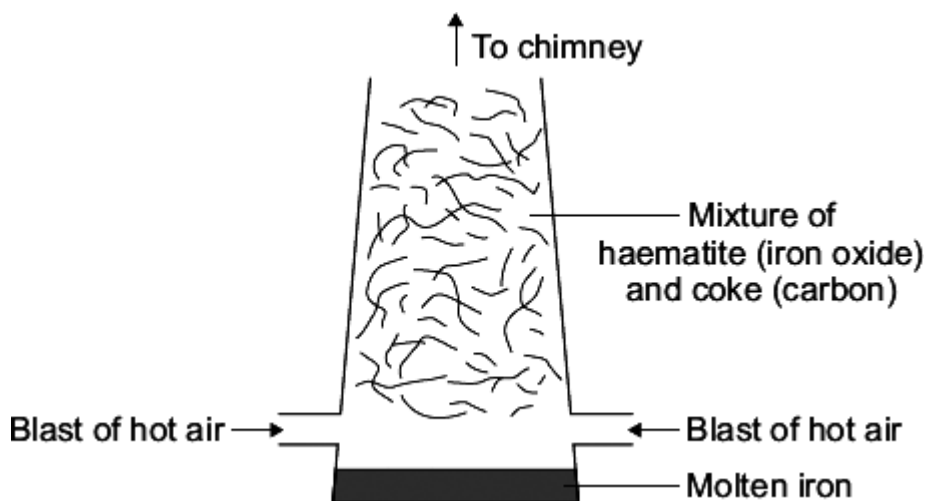
(c) You are given solutions of sodium hydroxide and ammonia of the same concentration.

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

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

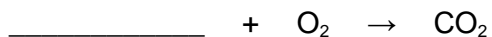
**Q6.**

Iron is produced by reacting a mixture of haematite and coke in a blast furnace. Haematite is an ore of iron containing iron oxide ( $\text{Fe}_2\text{O}_3$ ). Coke is made from coal and is almost pure carbon.



- (a) (i) The coke burns in air. This reaction heats the furnace to above  $1300\text{ }^\circ\text{C}$ .

Complete the chemical equation for carbon reacting with oxygen to form carbon dioxide.



(1)

- (ii) Carbon monoxide is also formed in the furnace. Carbon monoxide reacts with iron oxide to produce iron and carbon dioxide.

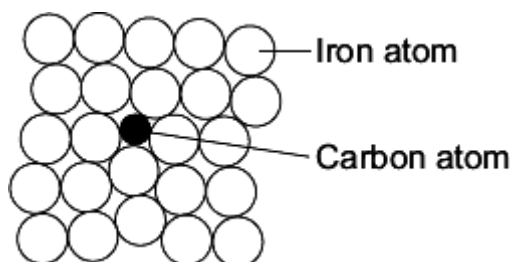


Complete and balance the chemical equation for the production of iron.



(2)

- (iii) Iron from a blast furnace is called cast iron and contains about 4% carbon.



Why is pure iron softer than cast iron?

\_\_\_\_\_



(1)

- (b) Steel is made by reducing the percentage of carbon in cast iron and then adding different metals to form the type of steel required.

In the UK we use about 1.8 billion steel cans every year but only 30% of these are recycled. Recycling reduces waste. Producing steel from recycled cans requires only 25% of the energy needed to make steel from iron ore.

Give **three** environmental benefits of recycling a higher percentage of used steel cans.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

3. \_\_\_\_\_

\_\_\_\_\_

(3)

(Total 7 marks)

### Q7.

- (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.

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

---

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(1)

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

---

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(1)

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

---

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(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.

	<b>Experiment 1</b> Strontium chloride dissolved in water	<b>Experiment 2</b> 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 \_\_\_\_\_

\_\_\_\_\_ (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)

### 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 <sup>+</sup>	Cl <sup>-</sup>	1	Goes red
Sodium hydroxide	Strong alkali	Na <sup>+</sup>	OH <sup>-</sup>	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 <sup>-</sup>
H <sup>+</sup>
OH <sup>-</sup>

 ions

(1)

- (ii) Sodium hydroxide solution is alkaline.

H <sup>+</sup>
----------------

This is because it contains 

Na <sup>+</sup>
OH <sup>-</sup>

 ions

(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.

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(2)

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

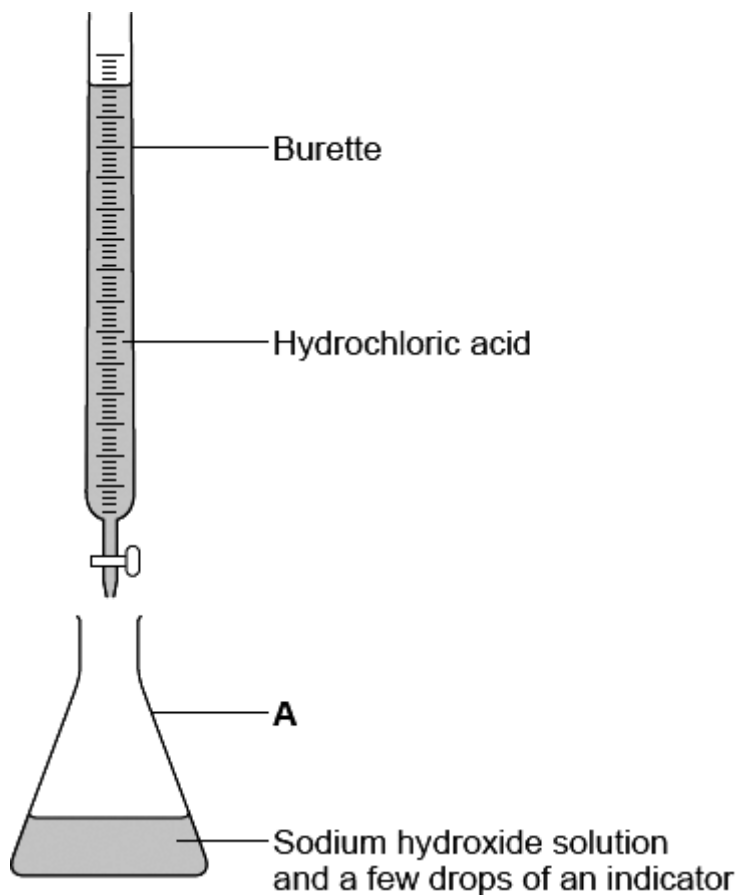
Strong acids and strong alkalis are 

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<sup>3</sup> 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.

<b>distillation</b>	<b>filtration</b>	<b>titration</b>
---------------------	-------------------	------------------

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.

\_\_\_\_\_

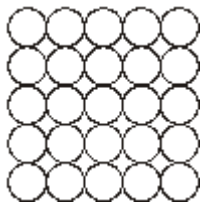
(1)

(Total 9 marks)

### Q9.

Iron is the main structural metal used in the world.

- (a) The diagram represents the particles in iron, Fe.



Draw a ring around the correct word in the box to complete the sentence.

Iron is described as an element because all the

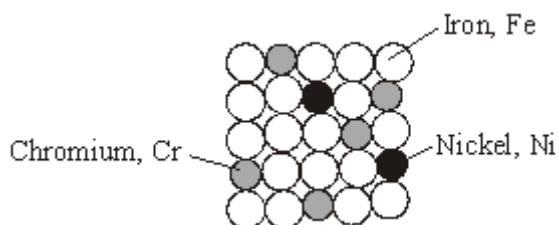
atoms
compounds
metals

are the same.

(1)

(b) Stainless steel is mostly iron.

The diagram represents the particles in stainless steel.



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

metal	mixture	molecule	polymer	smart	structure
-------	---------	----------	---------	-------	-----------

Stainless steel is an alloy because it is a \_\_\_\_\_ of iron, chromium and nickel.

An alloy is made up of more than one type of \_\_\_\_\_.

Stainless steel alloys are harder than iron because the different sized atoms added change the \_\_\_\_\_.

An alloy that can return to its original shape after being deformed is called a \_\_\_\_\_ alloy.

(4)

(c) In the UK, we use about 1.8 billion steel cans every year but only 25% are recycled. Used steel cans are worth about £100 per tonne.

Recycling saves raw materials and reduces waste that would end up in landfill. Producing steel by recycling used cans saves 75% of the energy that would be needed to produce steel from iron ore. This also reduces carbon dioxide emissions.

(i) Give **two** reasons, from the information above, to explain why recycling used steel cans is a good idea.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)

- (ii) Suggest how the local council could increase the percentage of used steel cans that are recycled.

\_\_\_\_\_

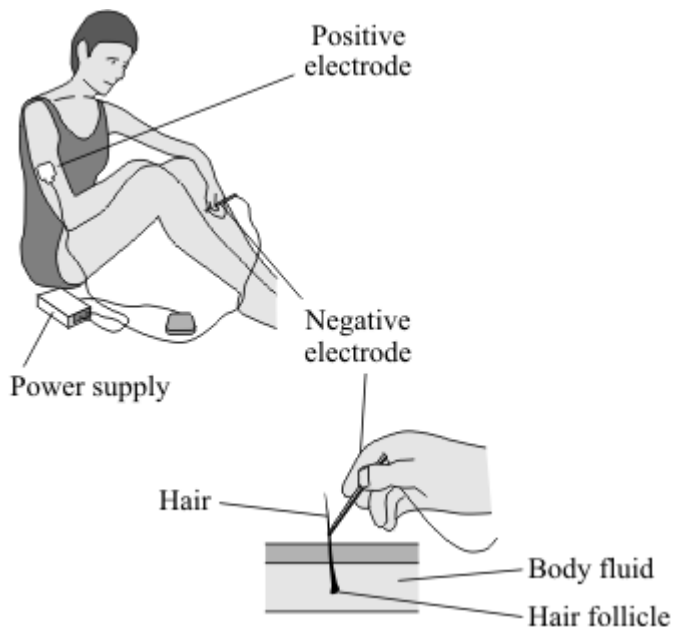
\_\_\_\_\_

(1)

(Total 8 marks)

### Q10.

Electrolysis can be used to remove unwanted hair from the skin.



The positive electrode is connected by a patch to the skin.

The negative electrode is connected to the hair.

The body fluid is a solution that contains sodium chloride. The electricity causes the electrolysis of a small amount of this solution.

- (a) In this solution hydrogen ions move to the negative electrode.

Complete the sentence using **one** word from the box.

negative

neutral

positive

Hydrogen ions move to the negative electrode because they have a

\_\_\_\_\_ charge.

(1)

- (b) Draw a ring around the name of the gas produced at the positive electrode during the electrolysis of sodium chloride solution.

**chlorine**

**hydrogen**

**nitrogen**

(1)

- (c) The electrolysis of the sodium chloride solution forms a strong alkali around the hair follicle.

- (i) Complete the name of this strong alkali using **one** of the words from the box.

**chloride**

**hydroxide**

**nitrate**

The name of this strong alkali is sodium \_\_\_\_\_ .

(1)

- (ii) Suggest how this strong alkali helps to remove the hair.

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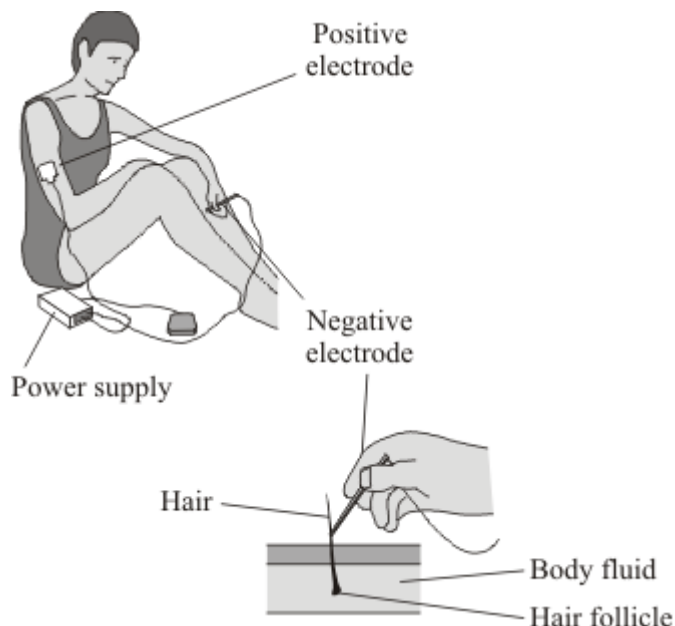
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(1)

**(Total 4 marks)**

### Q11.

Electrolysis can be used to remove unwanted hair from the skin.



The hair is first coated with a layer of gel containing ions in solution.

The positive electrode is connected by a patch to the skin.

The negative electrode is connected to the hair. Electricity flows through the gel and causes electrolysis of the body fluid around the hair follicle.

- (a) Metal wires conduct electricity to the electrodes.

Explain how metals conduct electricity.



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(2)

(b) Explain why the gel containing ions in solution can conduct electricity.

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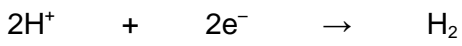
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(1)

(c) The body fluid is a solution that contains sodium chloride. The electricity causes the electrolysis of a small amount of this solution.

This solution contains hydrogen ions that move to the negative electrode.

(i) The half equation represents the reaction at the negative electrode.



Explain why this reaction is a reduction.

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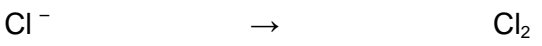
(1)

(ii) As a result of the electrolysis of sodium chloride solution, an alkali forms which kills the hair follicle.

What is the name of this alkali? \_\_\_\_\_

(1)

(iii) Complete the half equation for the reaction at the positive electrode.



(1)

(Total 6 marks)

**Q12.**

(a) Citric acid produces hydrogen ions in aqueous solution.

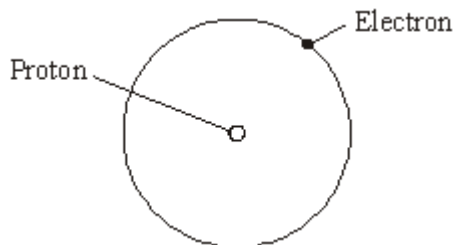
These ions can be represented as  $\text{H}^+(\text{aq})$ .

Complete this sentence.

The (aq) means that the acid has been dissolved in \_\_\_\_\_

(1)

(b) The diagram represents a hydrogen atom, H.



Use the diagram to explain why a hydrogen ion,  $H^+$ , is a proton.

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(1)

- (c) Citric acid is a *weak* acid.

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

The word *weak* means that the acid

has a low boiling point.

is dilute.

is partially ionised in water.

(1)

- (d) A student measured the pH of four acids, **A**, **B**, **C** and **D**.

The acids were the same concentration. The same quantity of magnesium ribbon was added to each of the acids. The volume of gas produced after 5 minutes was recorded.

The results are shown in the table.

Acid	pH	Volume of gas in $cm^3$
<b>A</b>	2	18
<b>B</b>	5	6
<b>C</b>	1	24
<b>D</b>	4	12

- (i) State **one** way in which the student made sure that the experiment was fair.

---

(1)

- (ii) Use the results to arrange the acids, **A**, **B**, **C** and **D** in order of **decreasing** acid strength.

Most acidic \_\_\_\_\_ Least acidic.

(1)

(e) When acids react with alkalis, the hydrogen ions from the acid react with the hydroxide ions from the alkali.

(i) Which **one** of the following represents the formula of a hydroxide ion?

Draw a ring around your answer.



(1)

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

A solution with more hydrogen ions than hydroxide ions is

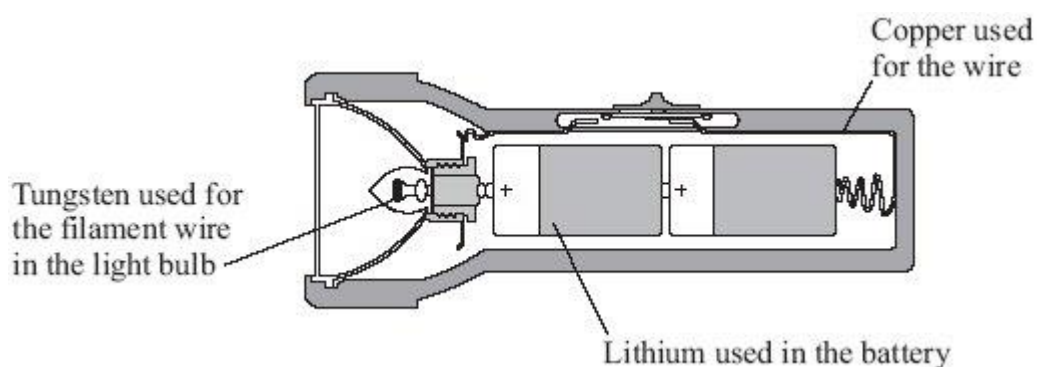
acidic.
alkaline.
neutral.

(1)

(Total 7 marks)

### Q13.

The diagram shows a circuit that is used in a torch. Electrons flow through this circuit.

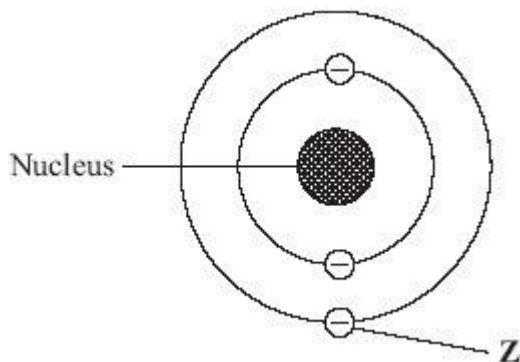


(a) Why is copper used for the wire?

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(1)

(b) The diagram shows the structure of an atom of lithium.



Name the particle labelled **Z**.

---

(1)

(c) The table shows some properties of the metals used in the electrical circuit.

Metal	Melting point in °C	Boiling point in °C	Reaction with oxygen
Copper	1083	2582	Reacts <b>slowly</b> to form a thin oxide layer on surface
Lithium	179	1317	Reacts <b>rapidly</b> to form oxide
Tungsten	3370	5930	Reacts <b>only</b> when very hot to form oxide

(i) Use information from the table to suggest the order of reactivity for copper, lithium and tungsten.

**most reactive** \_\_\_\_\_

\_\_\_\_\_

**least reactive** \_\_\_\_\_

(2)

(ii) The filament wire glows because it gets very hot.

Use information from the table to suggest **one** reason why tungsten is used for the filament wire in the light bulb.

\_\_\_\_\_  
\_\_\_\_\_

(1)

(d) The gas used in the light bulb is argon.

Draw a ring around the correct word in the box to complete the sentence.

Argon is used in the light bulb because it is

dense.

solid.

unreactive.

(1)

(Total 6 marks)

### Q14.

(a) PEX is a material that is used as an alternative to copper for hot water pipes. PEX is made from poly(ethene).

(i) Describe how ethene forms poly(ethene).

\_\_\_\_\_

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(2)

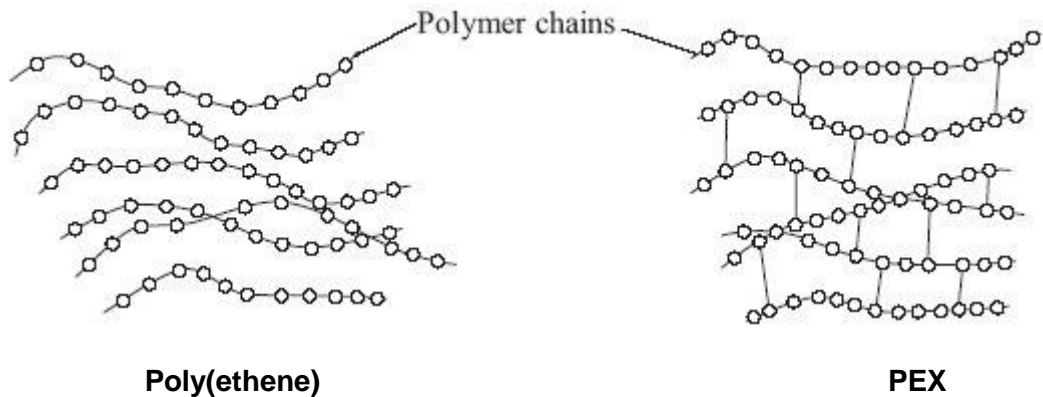
(ii) PEX is a shape memory polymer. What property does a shape memory polymer have?

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(1)

(iii) The simplified structures of poly(ethene) and PEX are shown.



Poly(ethene) is a thermoplastic that softens easily when heated.

Suggest and explain how the structure of PEX changes this property.

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(3)

(b) Copper was considered to be the most suitable material to use for hot water pipes. PEX is now used as an alternative material for hot water pipes.

Copper is extracted from its ore by a series of processes.

- 1 The low-grade ore is powdered and concentrated.
- 2 Smelting is carried out in an oxygen flash furnace. This furnace is heated to 1100 °C using a hydrocarbon fuel. The copper ore is blown into the furnace with air, producing impure, molten copper.
- 3 Oxygen is blown into the impure, molten copper to remove any sulfur. The copper is cast into rectangular slabs.
- 4 The final purification of copper is done by electrolysis.

PEX is made from crude oil by a series of processes.

- 1 Fractional distillation
- 2 Cracking

- 3 Polymerisation
- 4 Conversion of poly(ethene) into PEX

Suggest the possible environmental advantages of using PEX instead of copper for hot water pipes.

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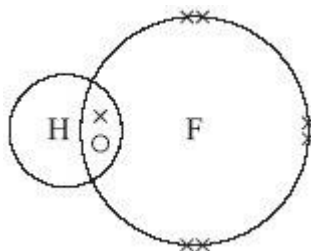
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(4)  
(Total 10 marks)

**Q15.**

This question is about fluorine and some of its compounds.

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



Draw a ring around the type of bonding that holds the hydrogen and fluorine atoms together in this molecule.

**covalent                      ionic                      metallic**

(1)

- (b) Fluorine is made in industry by the electrolysis of a mixture of potassium fluoride and hydrogen fluoride.
- (i) Use **one** word from the box to complete the sentence.

<b>gas</b>	<b>liquid</b>	<b>solid</b>
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To allow electrolysis to take place the mixture of potassium fluoride and hydrogen fluoride must be \_\_\_\_\_ .

(1)

- (ii) The mixture of potassium fluoride and hydrogen fluoride contains fluoride ions (F<sup>-</sup>), hydrogen ions (H<sup>+</sup>) and potassium ions (K<sup>+</sup>).

Use **one** word from the box to complete the sentence.

<b>fluorine</b>	<b>hydrogen</b>	<b>potassium</b>
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During electrolysis the element formed at the **positive** electrode is

\_\_\_\_\_.

(1)

- (c) Fluoride ions are sometimes added to drinking water. It is thought that these ions help to reduce tooth decay.

- (i) Tick (✓) **one** question that **cannot** be answered by scientific investigation alone.

Question	Tick (✓)
Do fluoride ions in drinking water reduce tooth decay?	
Are fluoride ions in drinking water harmful to health?	
Should fluoride ions be added to drinking water?	

(1)

- (ii) Explain why you have chosen this question.

\_\_\_\_\_  
\_\_\_\_\_

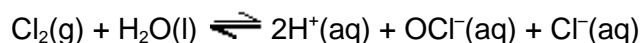
(1)

(Total 5 marks)

### Q16.

This question is about methods of treating water.

- (a) Chlorine is used to kill microorganisms in water. When chlorine is added to water a chemical reaction takes place. The equation for this reaction is shown below.

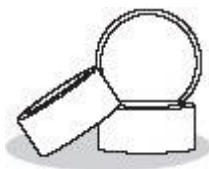


An acidic solution is produced when chlorine reacts with water.

Which ion, shown in the equation, makes the solution acidic? \_\_\_\_\_

(1)

- (b) Calcium hypochlorite tablets are added to water in some swimming pools to kill microorganisms.



The formula of calcium hypochlorite is  $\text{CaCl}_2\text{O}_2$

- (i) Calculate the relative formula mass ( $M_r$ ) of calcium hypochlorite.

Relative atomic masses: O = 16; Cl = 35.5; Ca = 40.

---

---

Relative formula mass ( $M_r$ ) of calcium hypochlorite = \_\_\_\_\_

(2)

- (ii) Calculate the percentage by mass of chlorine in calcium hypochlorite.

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Percentage by mass of chlorine in calcium hypochlorite = \_\_\_\_\_ %

(2)

- (iii) Calculate the mass of chlorine in a 20 g tablet of calcium hypochlorite.

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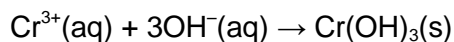
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Mass of chlorine = \_\_\_\_\_ g

(1)

- (c) Waste water from some industrial processes sometimes contains harmful metal ions, such as chromium ions. These ions must be removed from the water before it can be returned to a river.

A method of removing chromium ions ( $\text{Cr}^{3+}$ ) from water is represented by this equation.



- (i) What type of substance would be added to the water to provide the  $\text{OH}^{-}$  ions?

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(1)

- (ii) A *precipitate* is formed in this reaction.

What is a *precipitate*?

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(1)

(iii) What method could be used to separate the precipitate from the solution?

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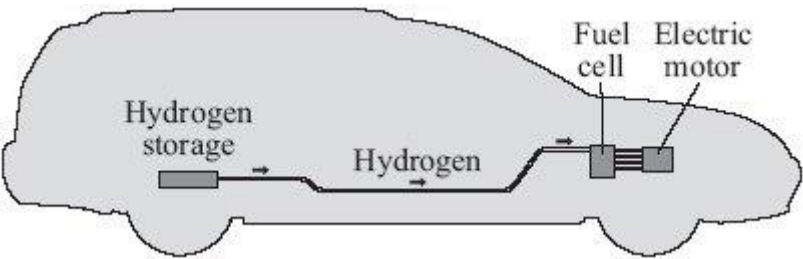
(1)

(Total 9 marks)

### Q17.

Read the article and then answer the questions that follow.

**Hydrogen fuel for cars?**



Hydrogen is an excellent fuel. It can be made by the electrolysis of potassium hydroxide solution.

Hydrogen gas can be stored under pressure in a cylinder but a leak of the gas could cause an explosion.

It has been found that lithium nitride can absorb and then release large volumes of hydrogen. A chemical reaction takes place between the hydrogen and the lithium nitride. The hydrogen is held in the resulting compounds by chemical bonds.

The problem is that the rate at which hydrogen is absorbed and then released from normal sized particles of lithium nitride is slow.

Recently scientists have made 'nanosized' particles of lithium nitride. These particles absorb hydrogen in the same way as normal sized lithium nitride particles. The 'nanosized' particles have the advantage that they absorb and release the hydrogen much faster when needed in the fuel cell.

It is hoped that 'nanosized' particles of lithium nitride may provide a safe method of storing hydrogen in the future.

(a) Hydrogen is produced at the negative electrode during the electrolysis of potassium hydroxide solution.

(i) Why are hydrogen ions attracted to the negative electrode?

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(1)

(ii) Potassium ions are also attracted to the negative electrode.

Explain why hydrogen gas is formed but not potassium.

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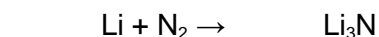
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(1)

(b) Lithium nitride is made by reacting lithium with nitrogen.

Balance the equation for this reaction.



(1)

(c) (i) The equation for the reaction of lithium nitride with hydrogen is:



What feature of this reaction allows the hydrogen to be released?

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(1)

(ii) Hydrogen stored in a fuel tank filled with lithium nitride would be safer in an accident than a cylinder full of hydrogen.

Suggest and explain why.

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(2)

(d) Lithium nitride is an ionic compound which contains lithium ions ( $\text{Li}^+$ ) and nitride ions ( $\text{N}^{3-}$ ).

(i) The formation of a lithium ion from a lithium atom is an oxidation reaction.

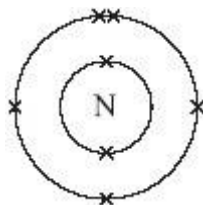
Explain why.

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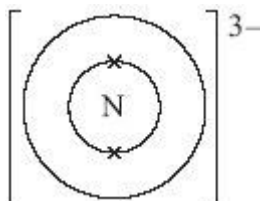
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(1)

(ii) The diagram shows the electronic structure of a nitrogen atom.

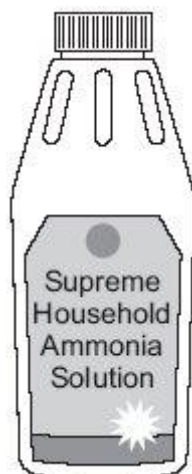


Complete the diagram below to show the electronic structure of a nitride ion ( $\text{N}^{3-}$ ).



(1)  
(Total 8 marks)

**Q18.**



*Supreme* is used to clean and degrease tiles, work surfaces and windows. The active ingredient is ammonia solution, which is an alkali.

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

(i) Ammonia solution is alkaline because of

hydroxide

magnesium

ions.

sulfate

(1)

(ii) Ammonia solution turns litmus paper

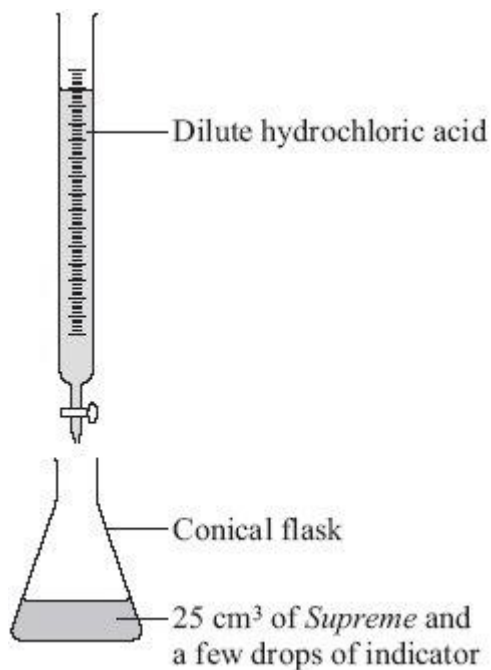
blue.

green.

red.

(1)

(b) The diagram shows the apparatus a student could use for a titration.



Draw a ring around the correct answer to complete each sentence about how the student could do this titration.

(i) Measure 25 cm<sup>3</sup> of *Supreme* into a conical flask using a

pipette.  
test tube.  
thermometer.

(1)

(ii) Add a few drops of an indicator to the *Supreme* in the conical flask.

Then put hydrochloric acid into a

beaker.  
burette.  
measuring cylinder.

(1)

(iii) Add the acid to the *Supreme* until the indicator

changes colour.  
dissolves.  
forms a gas.

(1)

(c) The student recorded the volume of hydrochloric acid used.

Suggest how the student could check the reliability of this result.

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**Q19.**

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*.

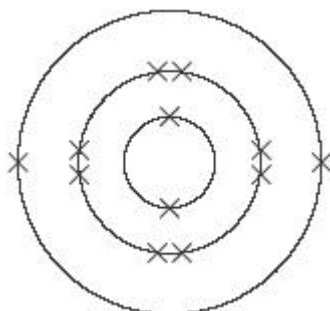
Complete the following sentence using the correct words from the box.

<b>gives out heat</b>	<b>stores heat</b>	<b>takes in heat</b>
-----------------------	--------------------	----------------------

An *exothermic* reaction is one which \_\_\_\_\_

(1)

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



**Magnesium atom**

The atomic (proton) number of oxygen is 8.

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

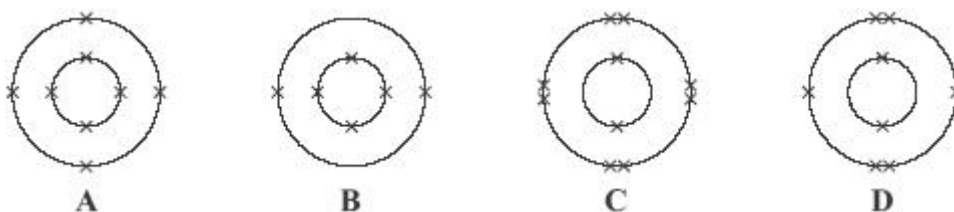
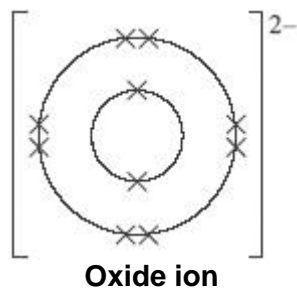


Diagram \_\_\_\_\_

(1)

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

The diagram shows the electronic structure of an oxide ion.



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

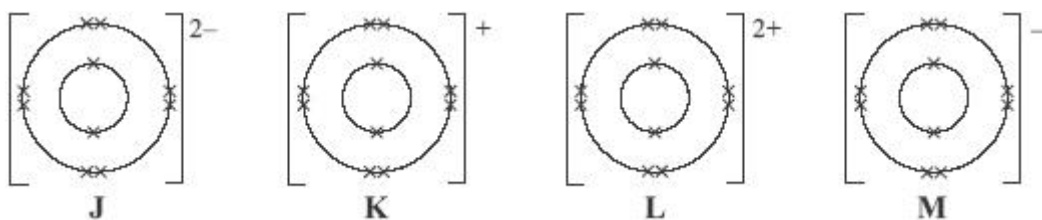


Diagram \_\_\_\_\_

(1)

- (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)

(Total 4 marks)

## Q20.

The electrolysis of sodium chloride solution produces useful substances.

- (a) (i) Choose a word from the box to complete the sentence.

<b>covalent</b>	<b>ionic</b>	<b>non-metallic</b>
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Electrolysis takes place when electricity passes through \_\_\_\_\_ compounds when they are molten or in solution.

(1)

- (ii) Choose a word from the box to complete the sentence.

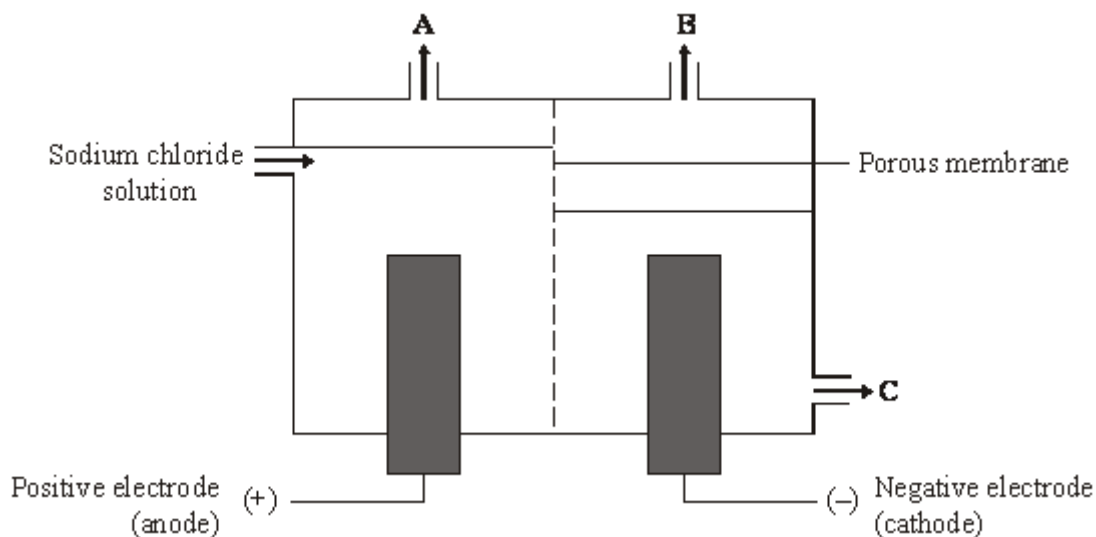
<b>alkenes</b>	<b>elements</b>	<b>salts</b>
----------------	-----------------	--------------

During electrolysis the compound is broken down to form \_\_\_\_\_

(1)

- (b) The table of ions on the Data Sheet may help you to answer this question.

The diagram shows an apparatus used for the electrolysis of sodium chloride solution.



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Identify the products **A**, **B** and **C** on the diagram using substances from the box.

chlorine gas gas	hydrogen gas	oxygen
sodium hydroxide solution		sodium metal

- (i) **A** is \_\_\_\_\_ (1)
- (ii) **B** is \_\_\_\_\_ (1)
- (iii) **C** is \_\_\_\_\_ (1)
- (Total 5 marks)**

### Q21.

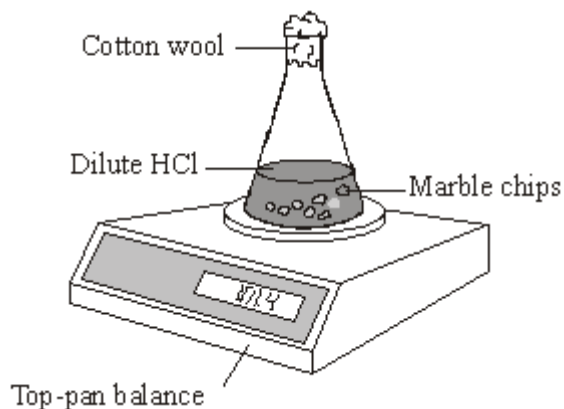
A student investigated the rate of reaction between marble and hydrochloric acid.

The student used an excess of marble.

The reaction can be represented by this equation.

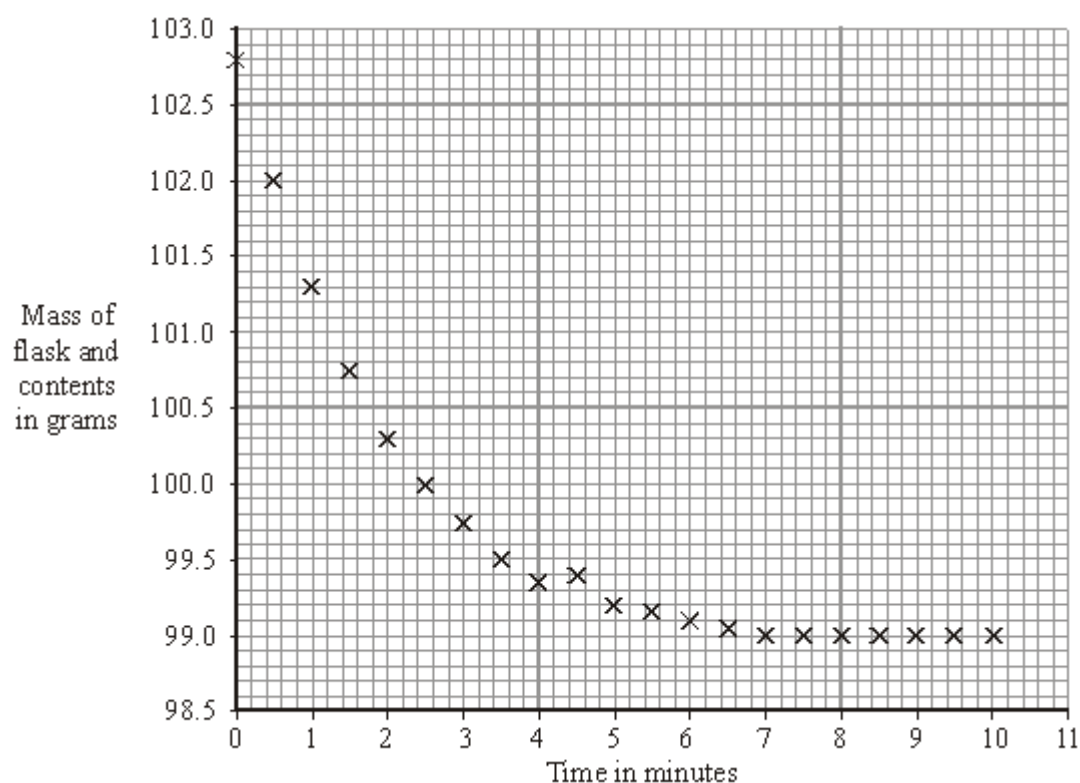


The student used the apparatus shown in the diagram.



The student measured the mass of the flask and contents every half minute for ten minutes.

The results are shown on the graph. Use the graph to answer the questions.



(a) Complete the graph opposite by drawing a line of best fit.

(1)

(b) Why did the mass of the flask and contents decrease with time?

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(1)

(c) After how many minutes had all the acid been used up?

\_\_\_\_\_ minutes

(1)

(d) The student repeated the experiment at a higher temperature. All other variables were kept the same as in the first experiment. The rate of reaction was much faster.



(i) Draw a line **on the graph** to show what the results for this second experiment might look like.

(2)

(ii) Why does an increase in temperature increase the rate of reaction?

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(3)

(Total 8 marks)

**Q22.**

The *electrolysis* of sodium chloride solution produces useful substances.

(a) Explain the meaning of *electrolysis*.

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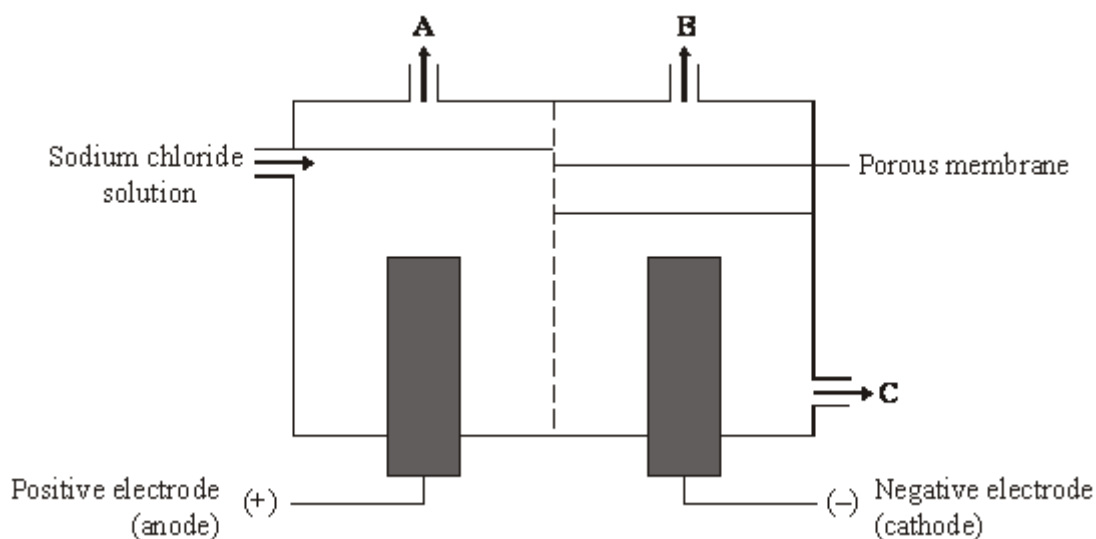
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(2)

(b) The diagram shows an apparatus used for the electrolysis of sodium chloride solution.



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The electrolysis produces two gases, chlorine and Gas **A**.

Name Gas A \_\_\_\_\_

(1)

- (c) The electrodes used in this process can be made of graphite. Explain why graphite conducts electricity.

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(2)

(Total 5 marks)

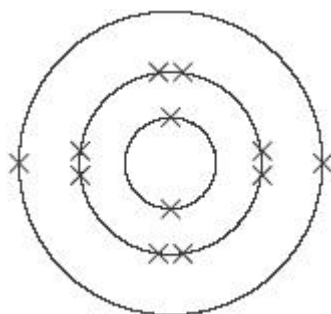
**Q23.**

- (a) Write a balanced symbol equation for the reaction between magnesium (Mg) and oxygen (O<sub>2</sub>) to form magnesium oxide (MgO).

---

(1)

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



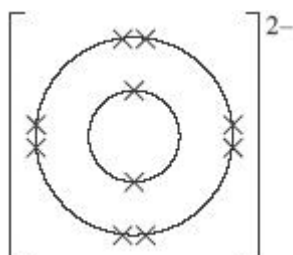
**Magnesium atom**

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

(1)

- (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**

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

(1)

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

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

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(2)

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

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

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

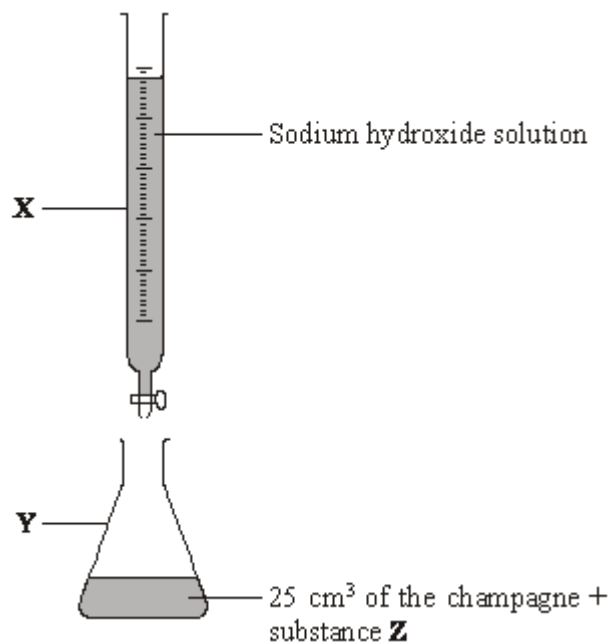
(1)

(Total 6 marks)

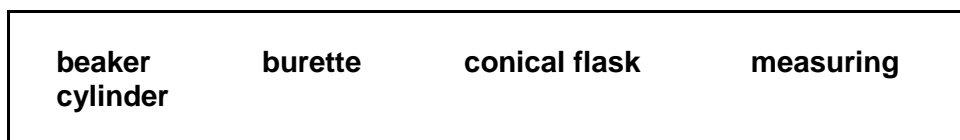
#### Q24.

In 1916 a ship was sunk by a German submarine. The ship was carrying bottles of champagne. The wreck was discovered in 1997 and the champagne was brought to the surface and analysed.

The diagram shows the apparatus used to find the amount of acid in 25 cm<sup>3</sup> of the champagne.



- (a) Choose the correct words from the box to name apparatus **X** and **Y**.



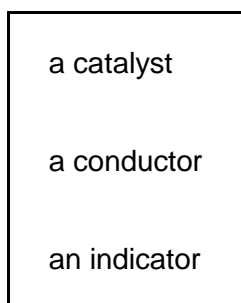
- (i) Apparatus **X** is a \_\_\_\_\_ (1)

\_\_\_\_\_ (1)

- (b) Sodium hydroxide solution was added to this champagne until substance **Z** showed that the reaction was complete. The volume of sodium hydroxide used was recorded. The result was used to calculate the amount of acid present.

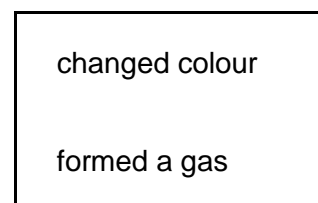
Complete these sentences by drawing a ring around the correct answer.

- (i) Substance **Z** is



(1)

- (ii) The reaction was complete when substance **Z**



gave a precipitate

(1)

(iii) The name of this method of analysis is

distillation

filtration

titration

(1)

(c) 250 cm<sup>3</sup> of this champagne were found to contain 1 g of acid.

Calculate the mass of acid in 750 cm<sup>3</sup> of this champagne.

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Mass = \_\_\_\_\_ g

(2)

(d) (i) Which **one** of the following ions makes champagne acidic?

Draw a ring around your answer.

**chloride**

**hydrogen**

**sodium**

(1)

(ii) The acid in champagne is a *weak* acid.

Complete this sentence by drawing a ring around the correct answer.

The word *weak* means that the acid

has a low boiling point

is dilute

is partially ionised

(1)

(Total 9 marks)

### Q25.

Metals and their alloys have many uses.

(a) Dentists use a smart alloy to make braces that gently push teeth into the right position.

What is meant by a *smart alloy*?

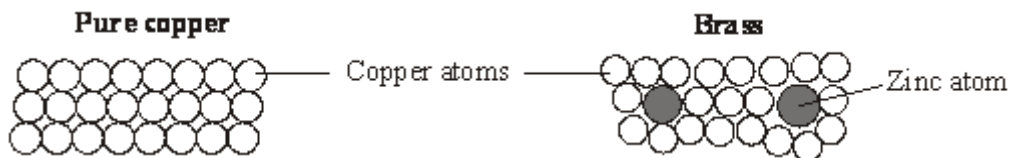
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(1)

- (b) Pure copper is made up of layers of copper atoms. Brass is an *alloy* of copper and zinc.



Why are the physical properties of brass different from the physical properties of pure copper?

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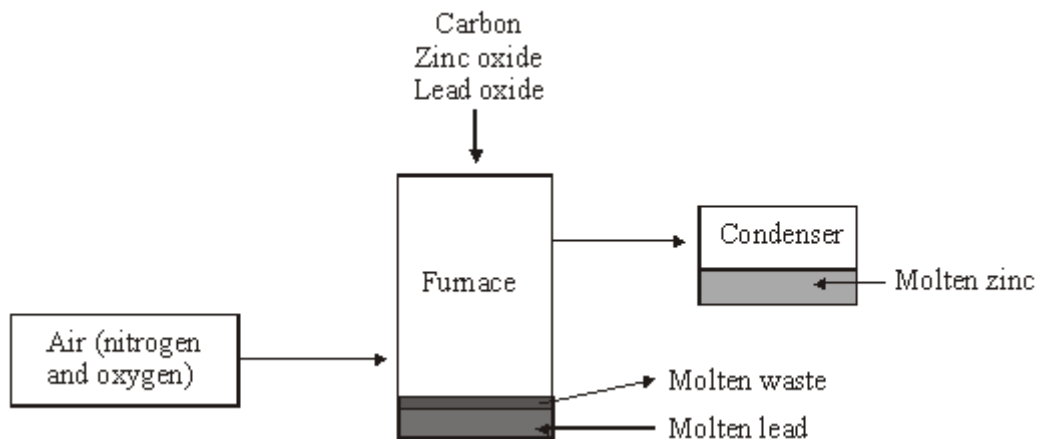
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(2)

- (c) Nearly all zinc is obtained from ores that also contain lead. The metals zinc and lead can be extracted by reducing their oxides using carbon.



- (i) Choose **one** element from the box below to complete the sentence about the reduction of zinc oxide.

lead	nitrogen	oxygen
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Zinc oxide is reduced by carbon, which takes away \_\_\_\_\_ to leave zinc metal.

(1)

- (ii) The melting points and boiling points of lead and zinc are given in the table.

Metal	Lead	Zinc
Melting point in °C	328	420
Boiling point in °C	1740	907

The furnace operates at a temperature of 1200 °C.

Suggest how the lead metal and zinc metal are separated in the furnace.

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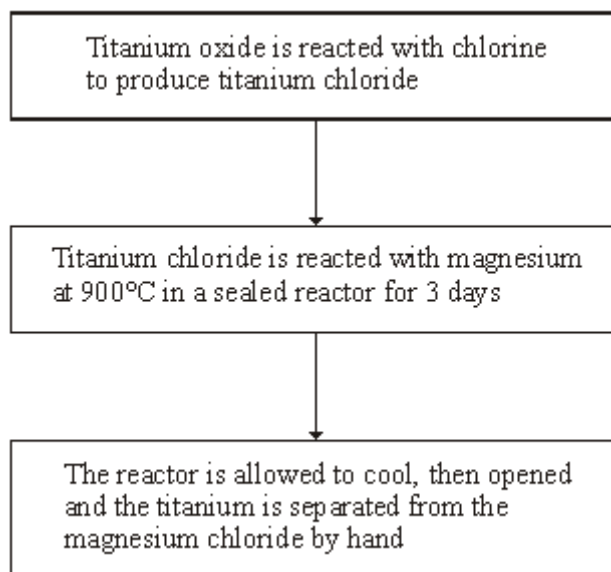
(2)

(Total 6 marks)

**Q26.**

Titanium is used in aircraft, ships and hip replacement joints. Titanium is as strong as steel but 45% lighter, and is more resistant to acids and alkalis.

Most titanium is produced from its ore, rutile (titanium oxide), by a batch process that takes up to 17 days.



Titanium reactors produce about 1 tonne of the metal per day.

Iron blast furnaces produce about 20 000 tonnes of the metal per hour.

- (a) Give **one** property of titanium that makes it more useful than steel for hip replacement joints.

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(1)

- (b) In the reactor magnesium is used to produce titanium. If carbon were used instead of magnesium, no titanium would be produced.

What does this tell you about the relative reactivities of carbon, magnesium and titanium?

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(2)

(c) The use of titanium is limited because it is expensive.

Explain why titanium costs more than steel.

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(3)

(Total 6 marks)

**Q27.**

This label was taken from a cola drink.



The pH of this drink is 2.5.

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

---

(1)



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

chloride      hydrogen      hydroxide      sodium

(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.

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

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(1)

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

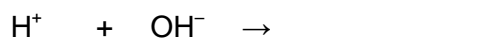
The table lists several statements. Put a tick (✓) next to the **one** statement which best describes a high atom economy.

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)

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

Complete the equation by writing the formula of the product.



(1)

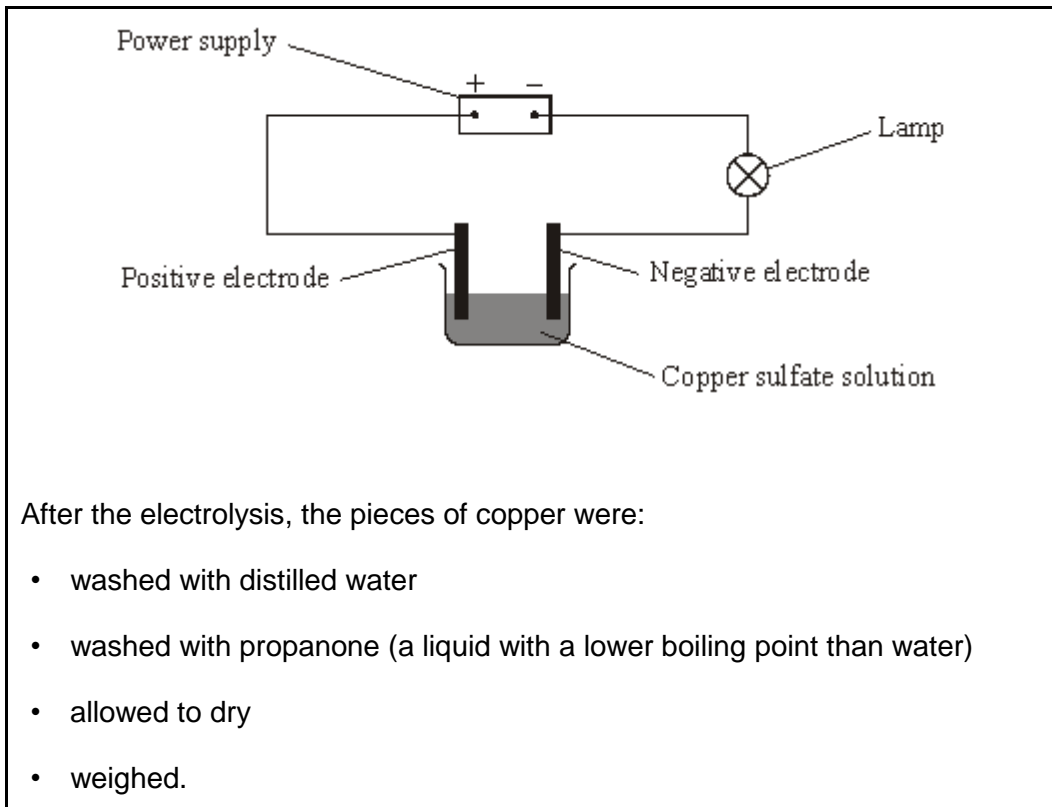
(Total 5 marks)

**Q28.**

A student investigated the electrolysis of copper sulfate solution. The student's method is shown below.

Two clean pieces of copper were weighed. One piece was used as the positive electrode and the other piece was used as the negative electrode.

The circuit was set up as shown in the diagram.



(a) Explain why the electrode would dry faster when washed with propanone instead of water.

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(1)

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

	Positive electrode	Negative electrode
mass of electrode before electrolysis, in grams	16.41	15.46
mass of electrode after electrolysis, in grams	16.10	15.75

The mass of the positive electrode decreased by 0.31 g.

(i) What is the change in mass of the negative electrode?

\_\_\_\_\_ g

(1)

(ii) The mass lost by the positive electrode should equal the mass gained by the negative electrode.

Suggest **two** reasons why the results were **not** as expected.

1. \_\_\_\_\_

---

2. \_\_\_\_\_  
\_\_\_\_\_

(2)

- (c) Describe and explain how electrolysis is used to make pure copper from a lump of impure copper.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(4)

(Total 8 marks)

**Q29.**

Copper sulfate ( $\text{CuSO}_4$ ) is a salt that has many uses.

An aqueous solution of copper sulfate can be made by reacting copper oxide ( $\text{CuO}$ ) with an acid.

- (a) (i) Name this acid. \_\_\_\_\_

(1)

- (ii) Write a balanced symbol equation, including state symbols, for this reaction.

\_\_\_\_\_

(2)

- (b) Copper oxide reacts much faster with acid at  $40\text{ }^\circ\text{C}$  than at  $20\text{ }^\circ\text{C}$ .

Explain why in terms of particles.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

(Total 5 marks)

**Q30.**

Many everyday items are made from iron.

(a) Haematite is an *ore* of iron. Haematite contains iron oxide, Fe<sub>2</sub>O<sub>3</sub>.

(i) What is the meaning of the term *ore*?

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(1)

(ii) Iron can be produced by reacting iron oxide with carbon in a blast furnace.  
What type of reaction produces the iron?

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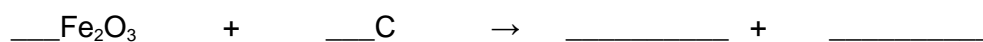
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(1)

(iii) The word equation for this reaction is:

iron oxide + carbon → iron + carbon dioxide

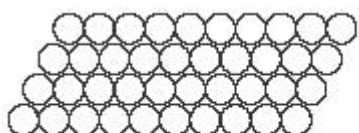
Complete and balance the symbol equation for this reaction.



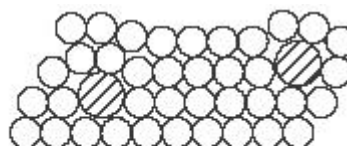
(2)

(b) Pure iron is relatively soft and not very strong.

The iron from the blast furnace is very hard and brittle. It contains about 4% carbon and is used as cast iron.



Pure iron



Cast iron

Explain the differences in the properties of pure iron and cast iron by referring to the diagrams.

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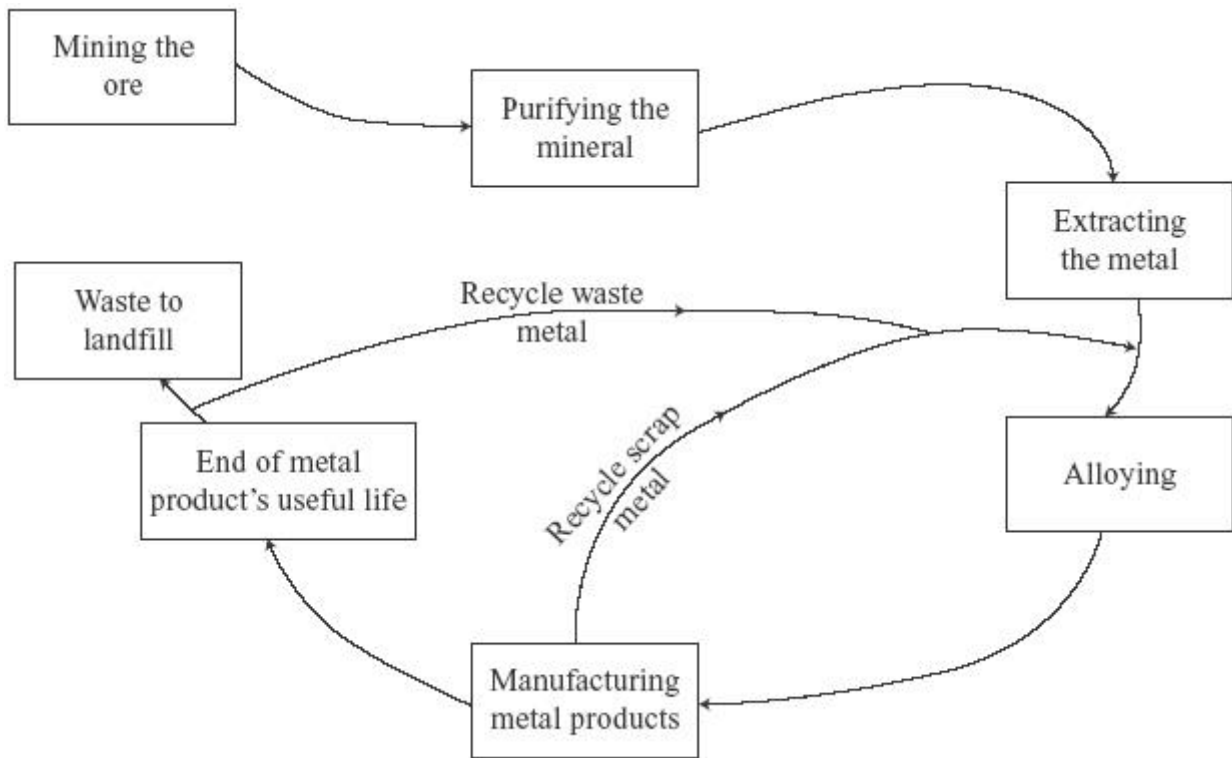
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(3)

(c) The diagram shows the way in which iron is extracted, used and recycled.



Explain why the recycling of iron is necessary for sustainable development.

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(3)  
(Total 10 marks)

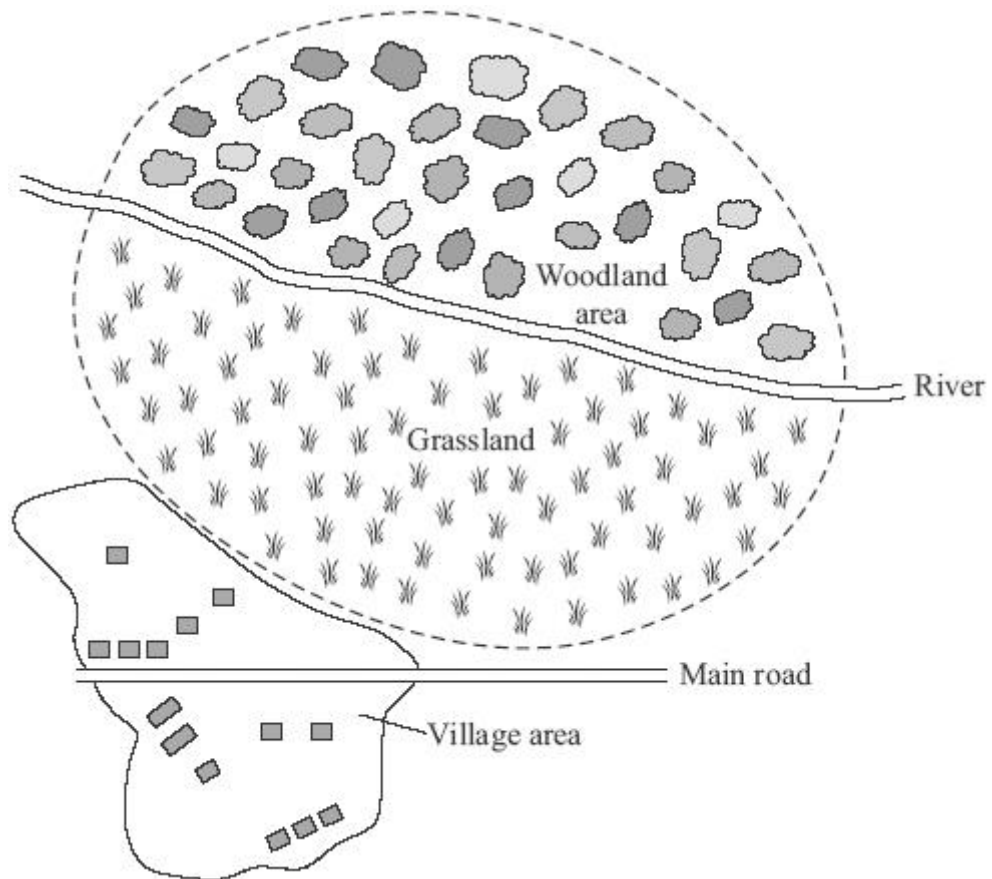
**Q31.**

Iron ore is the main source of iron.

(a) This was the headline in a newspaper.

**‘Village protests against quarry’**

The dotted line ( ---- ) on the map is drawn around the area from which a company wants to quarry iron ore.



- (i) Give **one** reason that the company could give for the need to quarry the iron ore.

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(1)

- (ii) The people who live in the village do not want the quarry because it would decrease the value of their homes.

Suggest **two** other reasons why the villagers do not want the quarry.

1. \_\_\_\_\_

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2. \_\_\_\_\_

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(2)

- (b) Iron ore contains the compound iron oxide,  $\text{Fe}_2\text{O}_3$ .

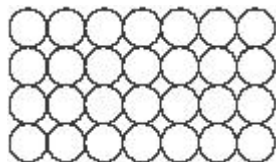
- (i) Iron is extracted from its oxide in the blast furnace.

Complete the word equation for the extraction of iron.

iron oxide + \_\_\_\_\_  $\rightarrow$  iron + carbon dioxide

(1)

- (ii) This diagram represents pure iron.



Use the diagram to explain why pure iron is described as an element.

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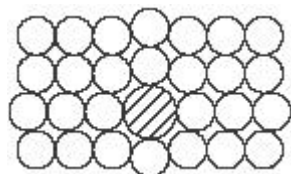
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(2)

- (iii) Pure iron is relatively soft. The iron from the blast furnace is hard and brittle. The diagram below represents iron from the blast furnace.



Use the diagram to explain why iron from the blast furnace is hard and brittle.

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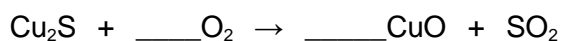
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(2)

(Total 8 marks)

### Q32.

Copper is a widely used metal. The main ore of copper contains copper sulfide. Copper can be extracted from copper sulfide in a three stage process.



(1)

- (ii) Explain why there would be an environmental problem if the gas from this reaction were allowed to escape into the atmosphere.

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(2)

- (b) In the second stage copper oxide, CuO, is reduced using carbon.

Describe and explain what happens during this reaction.

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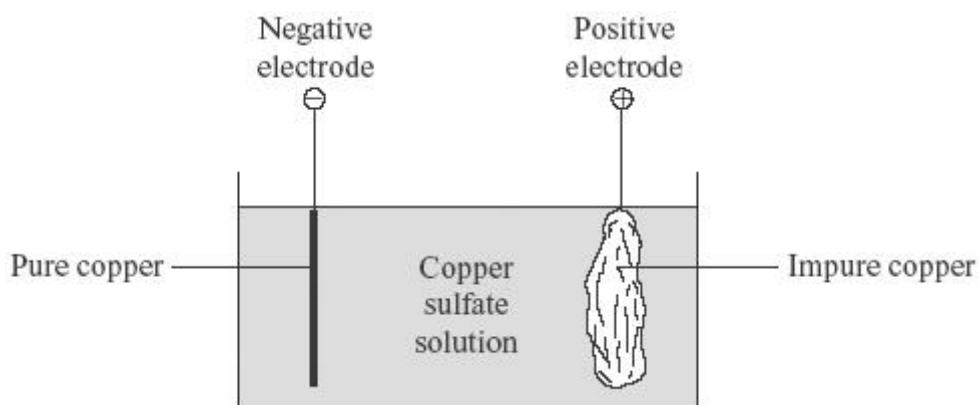
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(2)

(c) During the third stage the copper can be purified as shown in the diagram.



(i) What is the name of the type of process used for this purification?

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(1)

(ii) Give **one** use of purified copper.

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(1)

(d) Copper-rich ores are running out.

New ways of extracting copper from low grade ores are being researched.

Recycling of copper may be better than extracting copper from its ores.

Explain why.

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(3)

(Total 10 marks)



**Q33.**

Nitric acid can be neutralised by alkalis to make salts.

- (i) The salt called potassium nitrate can be made from nitric acid.

Complete the word equation for this neutralisation reaction.  
Choose the correct substances from the box.

hydrogen	oxygen	potassium chloride
potassium hydroxide		water

nitric acid + \_\_\_\_\_ → potassium nitrate + \_\_\_\_\_

(2)

- (ii) Ammonium nitrate is another salt made from nitric acid.

Which **one** of the following is the main use of ammonium nitrate? Draw a ring around your answer.

dye                      fertiliser                      plastic                      fuel

(1)

- (iii) Complete this sentence by choosing the correct ion from the box.

$H^+$	$NH_4^+$	$NO_3^-$	$O^{2-}$	$OH^-$
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The ion that makes solutions acidic is \_\_\_\_\_.

(1)

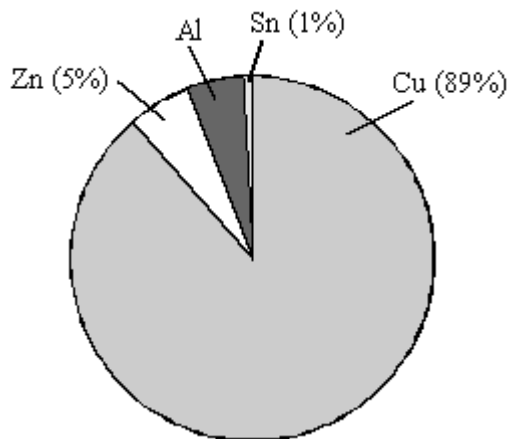
(Total 4 marks)

**Q34.**

The 50 Eurocent coin is made from an alloy called 'Nordic Gold'.



The pie chart shows the percentage by mass of each metal in 'Nordic Gold'.



- (a) (i) Calculate the percentage of aluminium, Al, in the coin.

\_\_\_\_\_

(1)

- (ii) The 50 Eurocent coin has a mass of 7 grams.  
Calculate the mass of zinc, Zn, in this coin.

\_\_\_\_\_

\_\_\_\_\_

Mass of zinc = \_\_\_\_\_ g

(2)

- (b) Zinc is extracted by removing oxygen from zinc oxide.

- (i) What name is given to a reaction in which oxygen is removed from a substance?

\_\_\_\_\_

(1)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)

(Total 6 marks)

**Q35.**

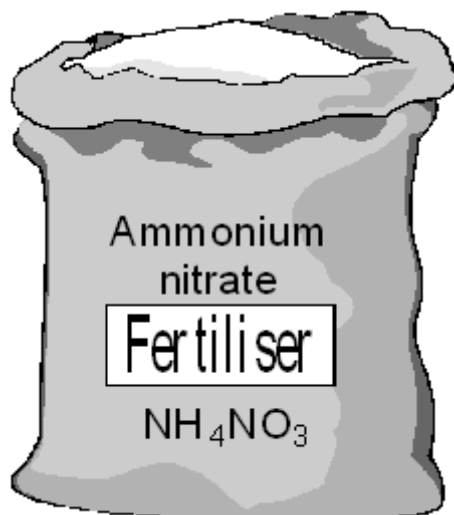
Neutralisation reactions can be used to make salts.

- (a) Write an ionic equation for a neutralisation reaction, including state symbols.

\_\_\_\_\_

(2)

- (b) Ammonium nitrate is a salt used as a fertiliser.



- (i) Ammonium nitrate is made by mixing two solutions. Name these solutions.

\_\_\_\_\_ and \_\_\_\_\_

(1)

- (ii) Hazard information about ammonium nitrate states:

- it is not itself a fire hazard (does not burn);
- it must not be allowed to come into contact with combustible materials such as fuels because it can cause these to catch fire.

Suggest why ammonium nitrate helps other substances to burn.

\_\_\_\_\_  
\_\_\_\_\_

(1)

(Total 4 marks)

### Q36.

Ammonium nitrate and potassium chloride are both salts. They can be made by neutralisation reactions.

Choose substances from the box to complete the word equations for the formation of these two salts.

ammonia	hydrochloric acid	nitric acid
potassium nitrate	water	potassium hydroxide

ammonia + \_\_\_\_\_ → ammonium nitrate + water

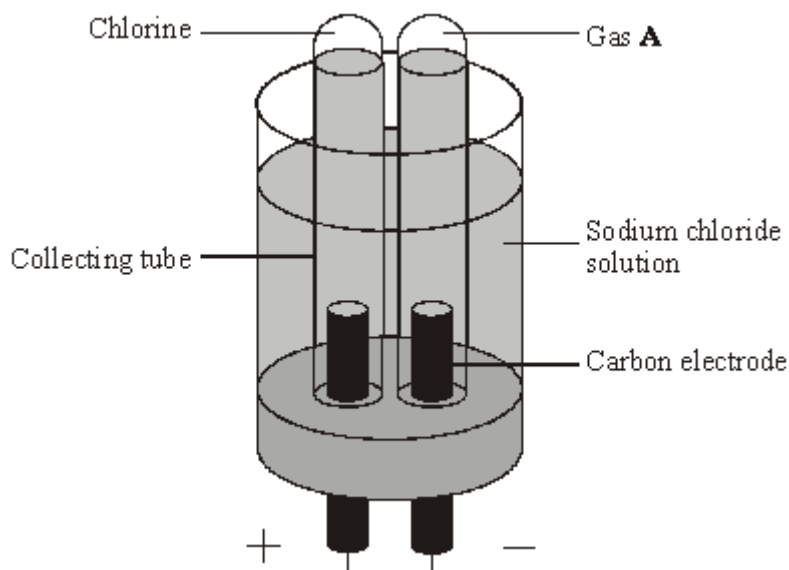
\_\_\_\_\_ + hydrochloric acid → potassium chloride + \_\_\_\_\_

(Total 3 marks)

### Q37.

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

apparatus shown below can be used to show this electrolysis in the laboratory.



(a) Name gas **A**.

\_\_\_\_\_

(1)

(b) Chlorine is produced at the positive electrode. Describe and give the result of a chemical test to prove that the gas is chlorine.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

(c) Chloride ions move to the positive electrode. Explain why.

\_\_\_\_\_  
\_\_\_\_\_

(1)

(d) A small quantity of chlorine is added to drinking water. Explain why.

\_\_\_\_\_  
\_\_\_\_\_

(1)

(e) The solution around the negative electrode becomes alkaline. Name the ion which makes the solution alkaline.

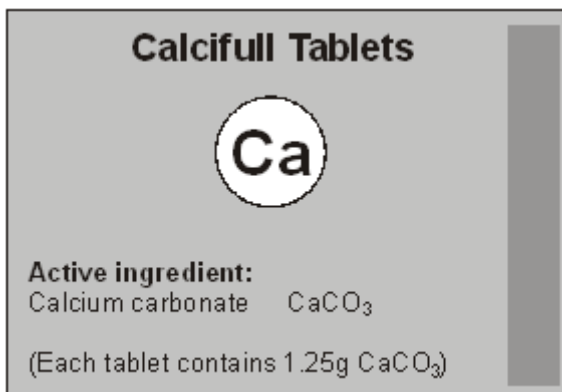
\_\_\_\_\_  
\_\_\_\_\_

(1)

(Total 6 marks)

**Q38.**

Calcium carbonate tablets are used to treat people with calcium deficiency.



- (a) Calculate the relative formula mass ( $M_r$ ) of calcium carbonate.

Relative atomic masses: C = 12; O = 16; Ca = 40.

\_\_\_\_\_

\_\_\_\_\_

Relative formula mass = \_\_\_\_\_

(2)

- (b) Calculate the percentage of calcium in calcium carbonate,  $\text{CaCO}_3$ .

\_\_\_\_\_

\_\_\_\_\_

Percentage of calcium = \_\_\_\_\_ %

(2)

- (c) Calculate the mass of calcium in each tablet.

\_\_\_\_\_

\_\_\_\_\_

Mass of calcium = \_\_\_\_\_ g

(2)

- (d) An unwanted side effect of this medicine is that it can cause the patient to have 'wind' (too much gas in the intestine).

The equation below represents the reaction between calcium carbonate and hydrochloric acid (the acid present in the stomach).



Suggest why the patient may suffer from 'wind'.

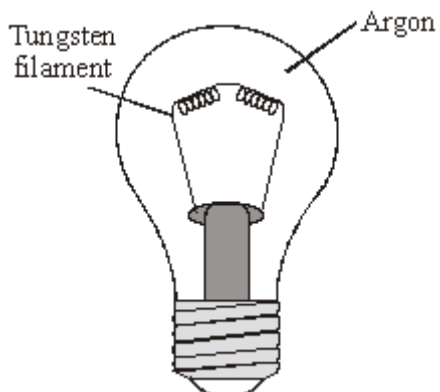
\_\_\_\_\_

\_\_\_\_\_

(1)

**Q39.**

The diagram shows an electric light bulb.



When electricity is passed through the tungsten filament it gets very hot and gives out light.

- (a) What reaction would take place if the hot tungsten was surrounded by air?

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(1)

- (b) State why argon is used in the light bulb. Explain your answer in terms of the electronic structure of an argon atom.

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(3)

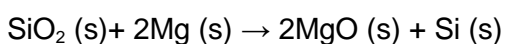
(Total 4 marks)

**Q40.**

Silicon is an important element used in the electronics industry.

- (a) Silicon can be made by heating a mixture of sand (silicon dioxide) with magnesium powder.

The equation for this reaction is shown below.



Calculate the mass of silicon dioxide needed to make 1 g of silicon.

Relative atomic masses: O = 16; Si = 28

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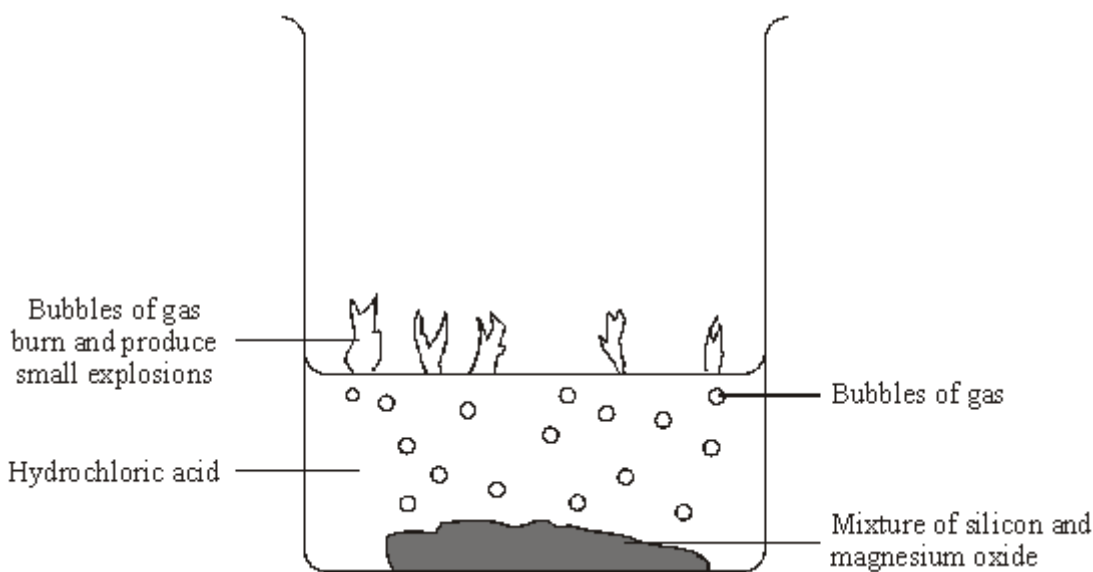
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Mass = \_\_\_\_\_ g

(3)

- (b) The resulting mixture of magnesium oxide and silicon is added to a beaker containing hydrochloric acid. The silicon is then filtered from the solution.



- (i) The magnesium oxide reacts with the hydrochloric acid and forms magnesium chloride ( $\text{MgCl}_2$ ) solution and water.

magnesium oxide + hydrochloric acid  $\rightarrow$  magnesium chloride solution + water

Write a balanced symbol equation for this reaction, including state symbols.

---

(2)

- (ii) The gases produced are a mixture of several silicon hydrides.

One of the gases produced in the reaction is the silicon hydride with the formula  $\text{SiH}_4$ . The structure of this molecule is similar to methane,  $\text{CH}_4$ .

Draw a diagram to show the bonding in a molecule of  $\text{SiH}_4$ . Represent the electrons as dots and crosses and only show the outer shell (energy level) electrons.

(1)

- (iii) A sample of a different silicon hydride was found to contain 1.4 g of silicon and 0.15 g of hydrogen.

Calculate the formula of this silicon hydride. You must show all your working to gain full marks.

Relative atomic masses: H = 1; Si = 28

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(4)

- (iv) The silicon hydrides react immediately they come into contact with oxygen in the air. They burst into flames with a small explosion and give out energy.

Which letter, **A** to **H**, best describes this reaction?

Energy involved in breaking and forming bonds	Activation energy	Rate of reaction	Letter
The energy released from forming new bonds is greater than the energy needed to break existing bonds	high	fast	<b>A</b>
		slow	<b>B</b>
	low	fast	<b>C</b>
		slow	<b>D</b>
The energy needed to break existing bonds is greater than the energy released from forming new bonds	high	fast	<b>E</b>
		slow	<b>F</b>
	low	fast	<b>G</b>
		slow	<b>H</b>

Letter \_\_\_\_\_



- (c) The structure of silicon is similar to the structure of diamond.

Describe the structure of silicon and explain why it has a high melting point. You may draw a diagram if this helps.

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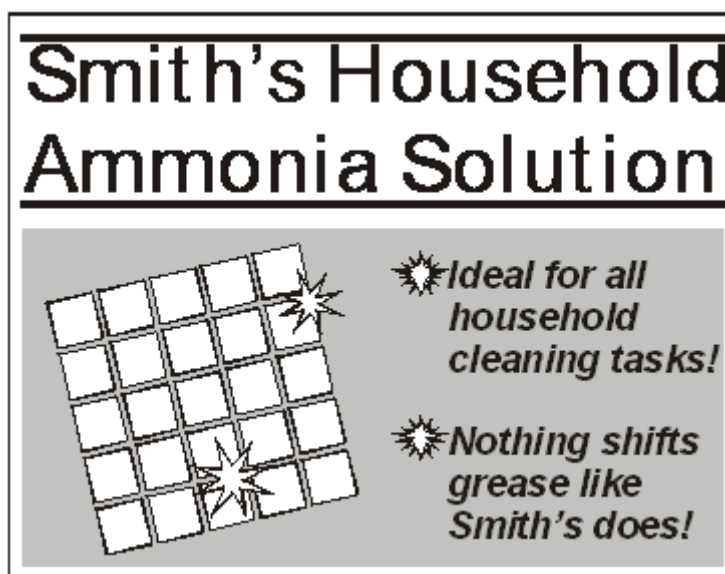
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(4)

(Total 15 marks)

**Q41.**

This label has been taken from a bottle of household ammonia solution.



Household ammonia is a dilute solution of ammonia in water. It is commonly used to remove grease from ovens and windows.

- (a) The amount of ammonia in household ammonia can be found by titration.

25.0 cm<sup>3</sup> of household ammonia is placed in a conical flask. Describe how the volume of dilute nitric acid required to neutralise this amount of household ammonia can be found accurately by titration. Name any other apparatus and materials used.

*To gain full marks you should write down your ideas in good English. Put them into a sensible order and use correct scientific words.*



- (a) (i) The reactions of acids with alkalis can be represented by the equation below. Choose a substance from the box to complete the equation.

<b>carbon dioxide</b>	<b>hydrogen</b>	<b>oxygen</b>	<b>water</b>
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acid + alkali → salt + \_\_\_\_\_

(1)

- (ii) Draw a ring around the word which best describes the reaction.

**displacement      neutralisation      oxidation      reduction**

(1)

- (b) Sodium sulphate is an important salt.

The table gives a list of some substances.

Put a tick (✓) next to the names of the acid **and** the alkali that would react to make sodium sulphate.

Substances	(✓)
Hydrochloric acid	
Nitric acid	
Potassium sulphate	
Sodium hydroxide	
Sodium nitrate	
Sulphuric acid	

(2)

(Total 4 marks)

### Q43.

The table gives information about some metals.

Name of the metal	Cost of one tonne of the metal in December 2003 (£)	Percentage of the metal in the crust of the earth (%)
Aluminium	883	8.2
Platinum	16720000	0.0000001
Iron	216	4.1
Gold	8236800	0.0000001

- (a) Use information in the table to suggest why gold and platinum are very expensive metals.

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(1)

(b) Aluminium and iron are made by *reduction* of their ores.

(i) Name the element that is removed from the ores when they are *reduced*.

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(1)

(ii) Use the reactivity series on the Data Sheet to suggest a metal that would reduce aluminium ore.

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(1)

(c) Aluminium is made by the reduction of molten aluminium ore, using a very large amount of electricity.

(i) How is iron ore reduced in a blast furnace to make iron?

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(2)

(ii) Suggest why aluminium is more expensive than iron.

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(1)

**(Total 6 marks)**

**Q44.**

Explain, in terms of ions and molecules, what happens when any acid reacts with any alkali.

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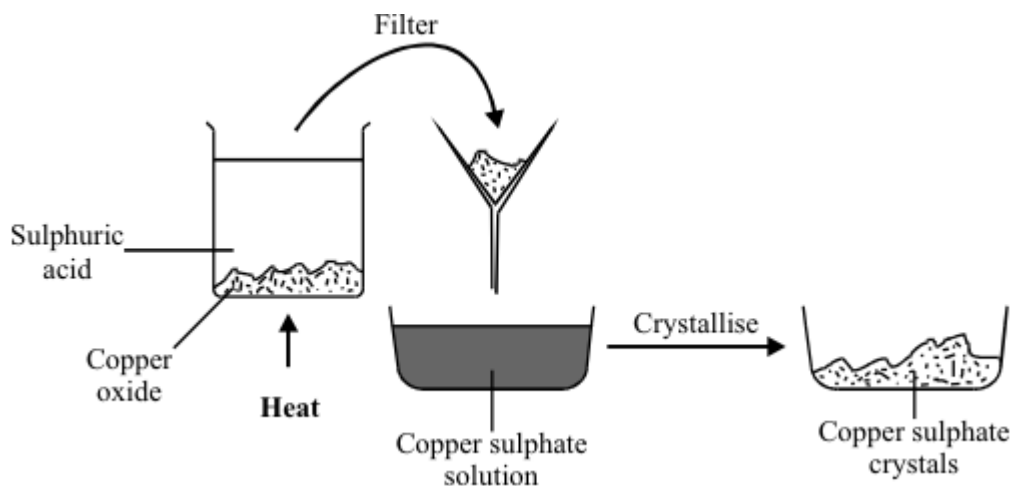
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**(Total 3 marks)**

**Q45.**

(a) The diagram shows one way of making crystals of copper sulphate.



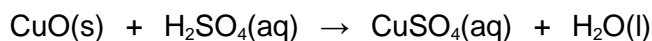
(i) Why was the solution filtered?

\_\_\_\_\_ (1)

(ii) How could you make the crystals form faster from the copper sulphate solution?

\_\_\_\_\_ (1)

(iii) The chemical equation is shown for this reaction.



In the chemical equation what does (aq) mean?

\_\_\_\_\_ (1)

(b) Blue copper sulphate crystals go white when warmed. How could you use the white copper sulphate as a test for water?



\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)  
(Total 5 marks)

**Q46.**

(a) Indigestion tablets called antacids can be taken to react with excess hydrochloric

acid in the stomach. A student investigated two different antacid tablets labelled **X** and **Y**.

- (i) Both tablets, **X** and **Y**, contained calcium carbonate. Give the chemical symbol for each of the three elements in calcium carbonate.

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(3)

- (ii) Name the gas formed when calcium carbonate reacts with hydrochloric acid.

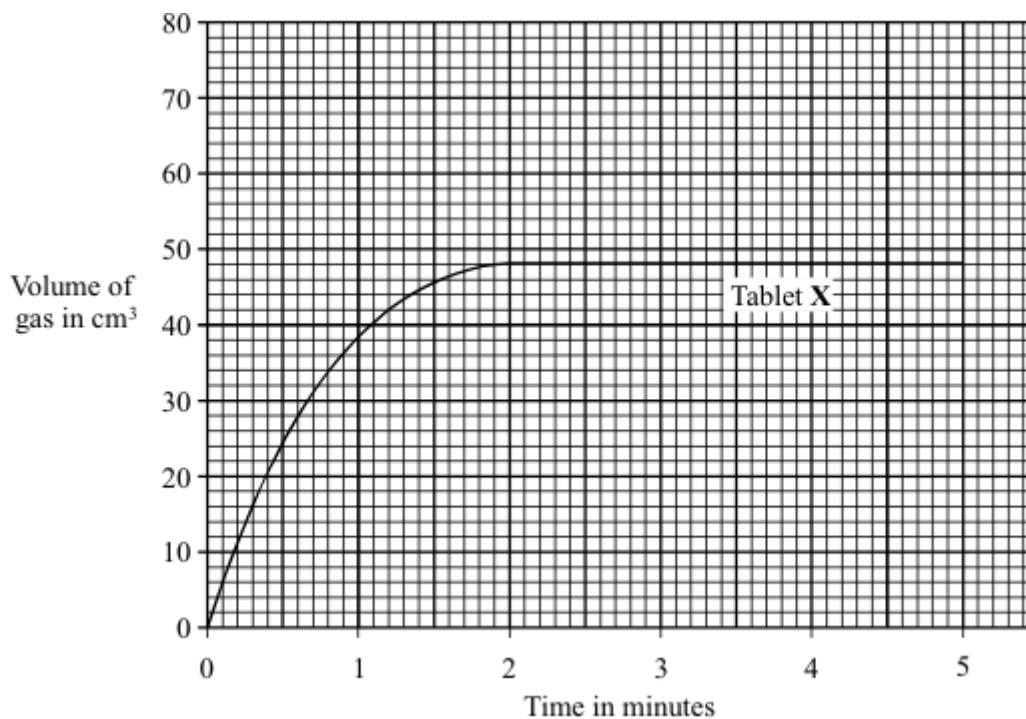
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(1)

- (b) The student first reacted tablet **X** and then tablet **Y**, with 100 cm<sup>3</sup> of a hydrochloric acid solution. The student measured the volume of gas produced during the first five minutes. The results are shown in the table.

Time in minutes	0	1	2	3	4	5
Volume of gas in cm <sup>3</sup> Tablet X	0	38	48	48	48	48
Volume of gas in cm <sup>3</sup> Tablet Y	0	31	54	67	72	72

- (i) Draw a graph of the results for tablet **Y**. (A graph of the results for tablet **X** has been drawn for you.)



(3)

- (ii) Tablet **X** contains less calcium carbonate than tablet **Y**. How do the results show this?

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(1)

(iii) Explain why the rate of reaction slows down for both tablets.

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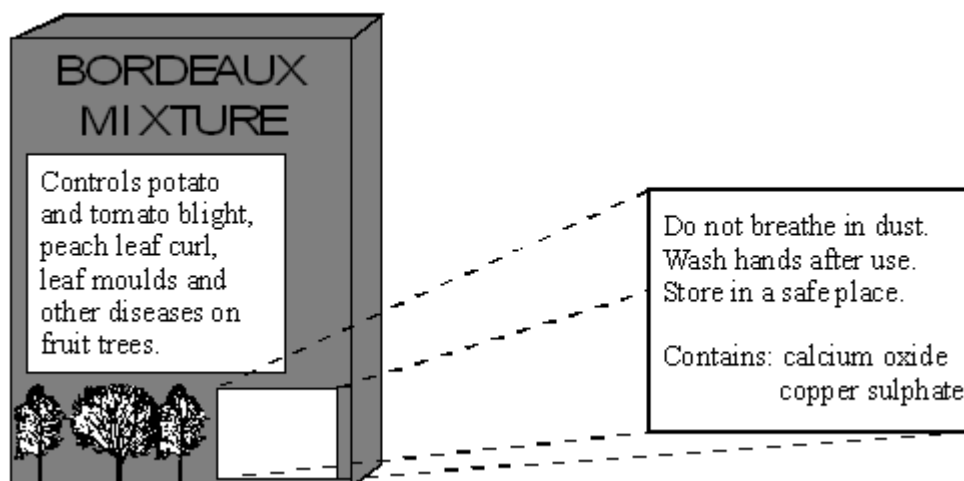
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(2)  
(Total 10 marks)

### Q47.

Bordeaux Mixture controls some fungal infections on plants.

A student wanted to make some Bordeaux Mixture.



(a) The student knew that calcium oxide could be made by heating limestone. Limestone contains calcium carbonate,  $\text{CaCO}_3$ .

(i) Write the word equation for this reaction.

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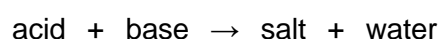
(1)

(ii) What type of reaction is this?

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(1)

(b) The student knew that copper sulphate,  $\text{CuSO}_4$ , could be made by the following general reaction.



(i) What type of reaction is this?

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(1)

(ii) The base used is copper oxide. Name and give the chemical formula of the

acid used.

Name \_\_\_\_\_

Chemical formula \_\_\_\_\_

(2)

(c) The student wrote about how the copper sulphate was made.

“Some of the acid was warmed. Copper oxide was added. The mixture was stirred. More copper oxide was added until no more would react. The mixture was then filtered.”

(i) Why was the acid warmed?

\_\_\_\_\_  
\_\_\_\_\_

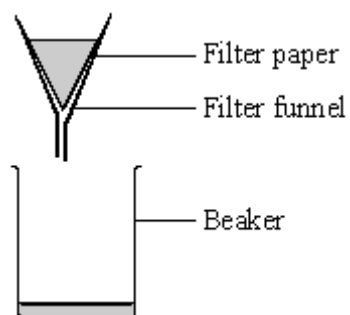
(1)

(ii) Copper oxide was added until no more would react. Explain why.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

(iii) The filtration apparatus is shown.



Describe and explain what happens as the mixture is filtered.

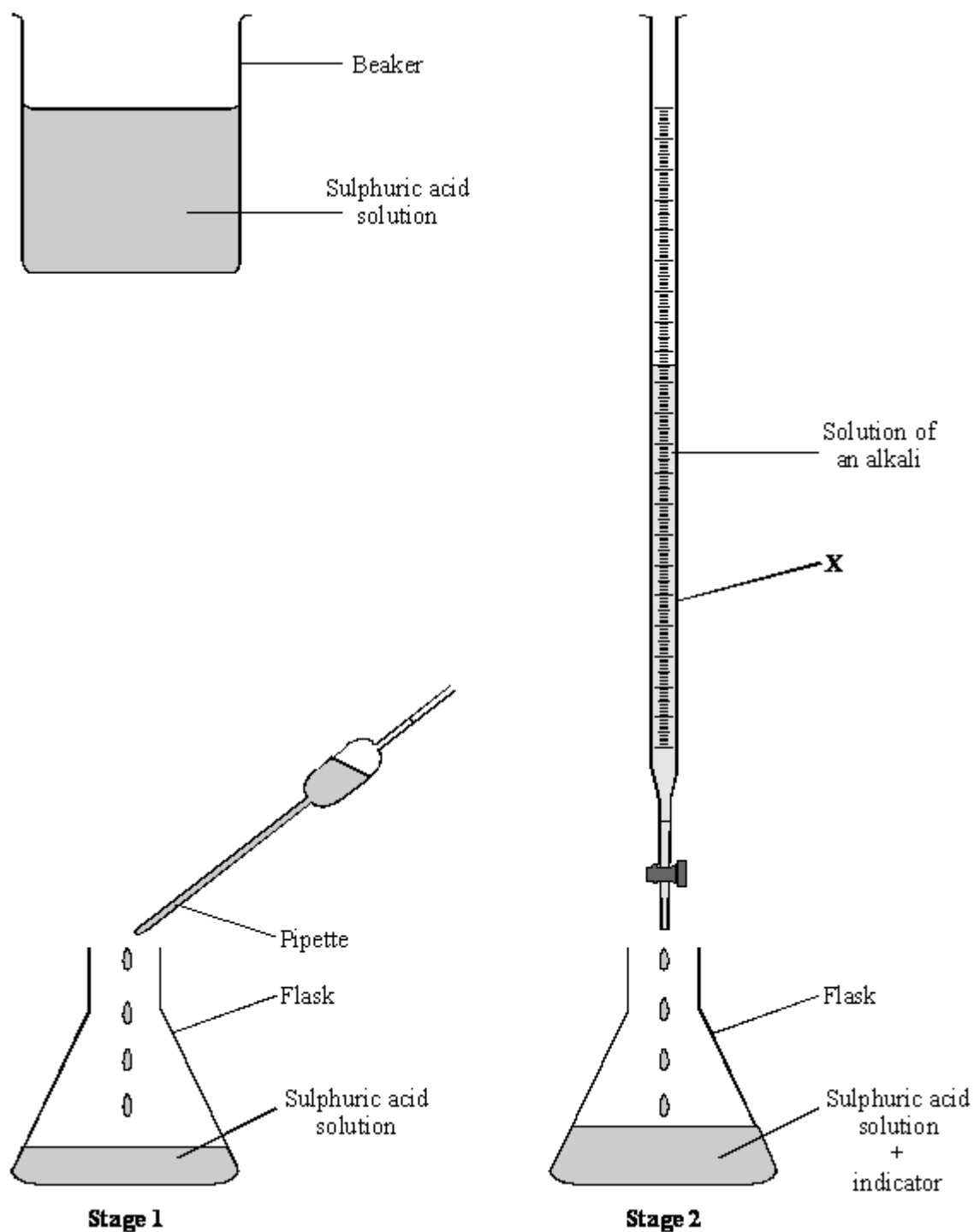
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

(Total 10 marks)



A titration was used to find the concentration of the sulphuric acid solution in the beaker.



**Stage 1** 25.0 cm<sup>3</sup> of the sulphuric acid solution was added to a flask using a pipette.

**Stage 2** A solution of an alkali was added to the acid until the solution was neutral. The volume of the alkali was noted.

(a) What would be the pH of the sulphuric acid solution?

---

(1)

(b) Why was a pipette used instead of a measuring cylinder in **Stage 1**?

---

(1)

(c) Name the apparatus labelled **X** which is used to add the alkali in **Stage 2**.

\_\_\_\_\_

(1)

(d) Name an alkali that could be used in **Stage 2**.

\_\_\_\_\_

(1)

(e) (i) Name an indicator that you could use to find out when the solution was neutral.

\_\_\_\_\_

(1)

(ii) How would you know that the solution was neutral?

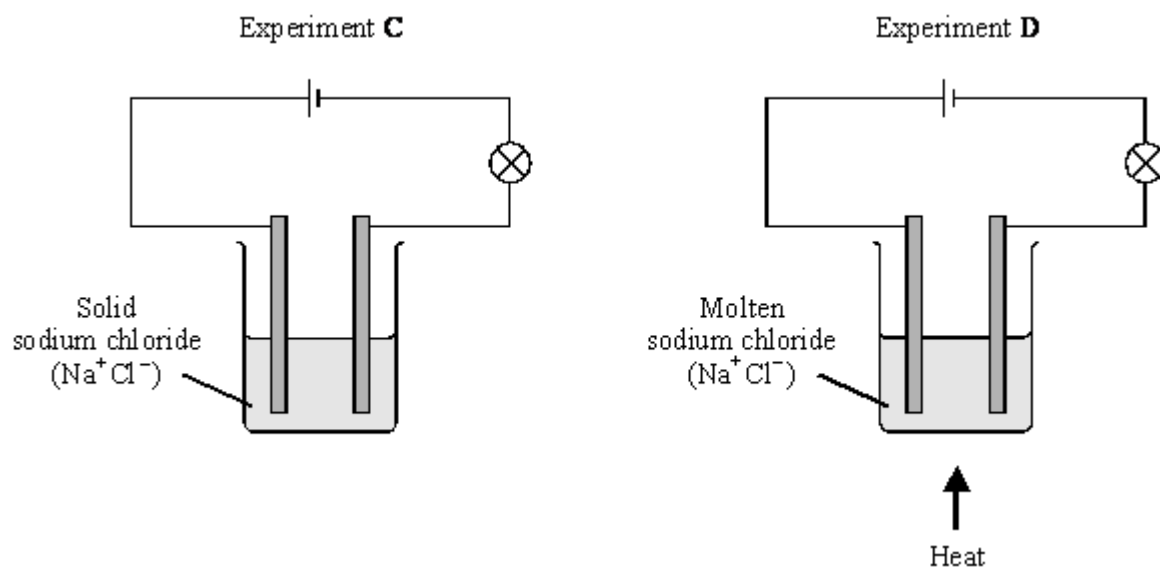
\_\_\_\_\_

(1)

(Total 6 marks)

### Q49.

(a) Two experiments were set up as shown.



(i) Give **two** observations which would be seen only in Experiment **D**.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2)

(ii) Explain why in Experiment **C** no changes would be seen.

\_\_\_\_\_

\_\_\_\_\_

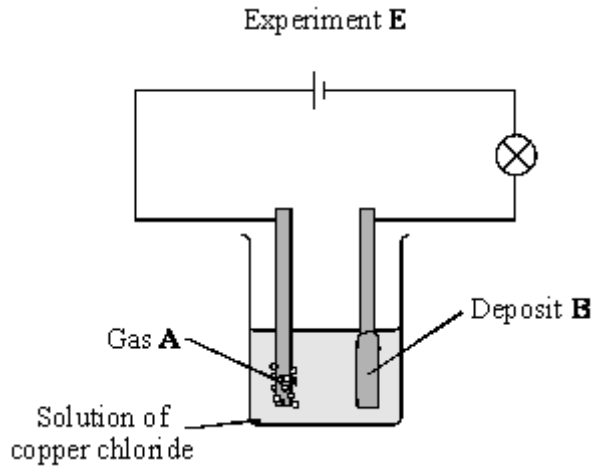
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(2)

(b) Another *electrolysis* experiment used an aqueous solution of copper chloride.



(i) What does *electrolysis* mean?

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(2)

(ii) Name the gas **A** and the deposit **B**.

Gas **A** \_\_\_\_\_

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(2)

(c) Give **one** industrial use of electrolysis.

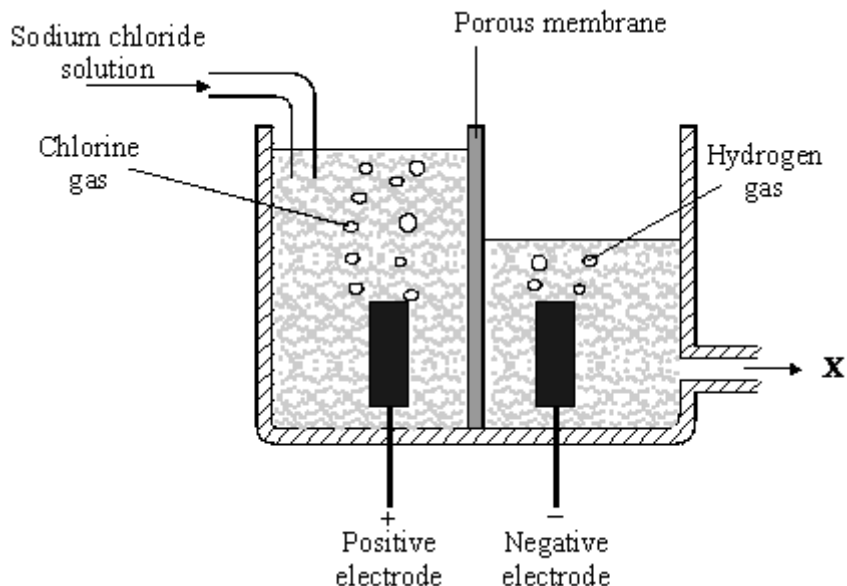
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(1)

(Total 9 marks)

**Q50.**

Sodium chloride solution is a useful raw material for the manufacture of other substances.



(i) What is the name of the process shown?

\_\_\_\_\_ (1)

(ii) Chloride ions lose electrons at the positive electrode. What is the name of this type of reaction?

\_\_\_\_\_ (1)

(iii) The solution formed at X is alkaline. What causes this solution to be alkaline?

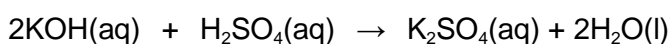
\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

(iv) Give a balanced ionic equation for the formation of hydrogen gas at the negative electrode.

\_\_\_\_\_ (3)  
**(Total 7 marks)**

**Q51.**

A student carried out a titration to find the concentration of a solution of sulphuric acid. 25.0 cm<sup>3</sup> of the sulphuric acid solution was neutralised exactly by 34.0 cm<sup>3</sup> of a potassium hydroxide solution of concentration 2.0 mol/dm<sup>3</sup>. The equation for the reaction is:



(a) Describe the experimental procedure for the titration carried out by the student.

\_\_\_\_\_  
 \_\_\_\_\_

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(4)

- (b) Calculate the number of moles of potassium hydroxide used.

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Number of moles = \_\_\_\_\_

(2)

- (c) Calculate the concentration of the sulphuric acid in mol/dm<sup>3</sup>.

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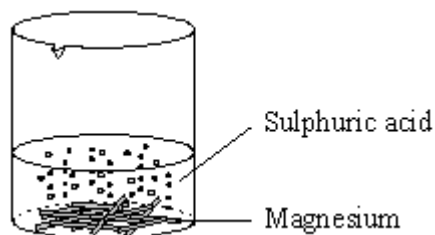
Concentration = \_\_\_\_\_ mol/dm<sup>3</sup>

(3)

(Total 9 marks)

**Q52.**

A student tried to make some magnesium sulphate. Excess magnesium was added to dilute sulphuric acid. During this reaction fizzing was observed due to the production of a gas.



- (i) Complete and balance the chemical equation for this reaction.



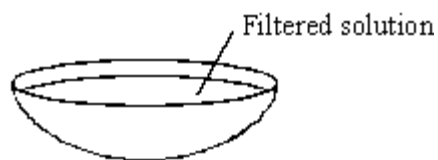
(3)

- (ii) At the end of the reaction the solution remaining was filtered. Why was the solution filtered?

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(1)

(iii) The filtered solution was left in a warm place.



Explain why the filtered solution was left in a warm place.

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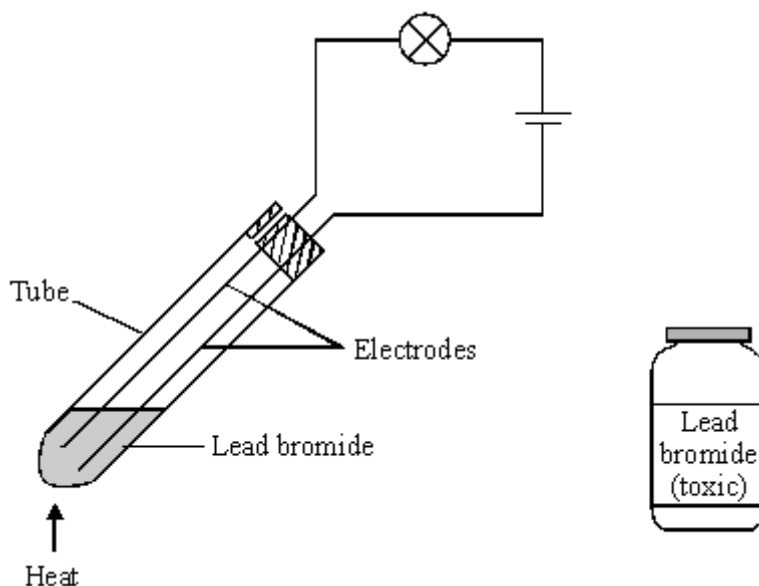
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(2)  
(Total 6 marks)

**Q53.**

A student investigated the *electrolysis* of lead bromide.



Lead bromide was placed in the tube and the circuit was switched on. The light bulb did not light up.

The tube was heated and soon the bulb lit up. The observations are shown in the table.

Positive electrode	Negative electrode
red-brown gas	silver liquid

(a) What is meant by *electrolysis*?

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(2)

(b) Why did the lead bromide conduct electricity when the tube was heated?

---

(1)

(c) Name the substances formed at the:

positive electrode; \_\_\_\_\_

negative electrode. \_\_\_\_\_

(2)

(d) Suggest **one** safety precaution that should be taken during this investigation.

\_\_\_\_\_

(1)

(Total 6 marks)

### Q54.

Acids and bases are commonly found around the home.

(a) Baking powder contains sodium hydrogencarbonate mixed with an acid.

(i) When water is added, the baking powder releases carbon dioxide. How could you test the gas to show that it is carbon dioxide?

Test \_\_\_\_\_

Result of test \_\_\_\_\_

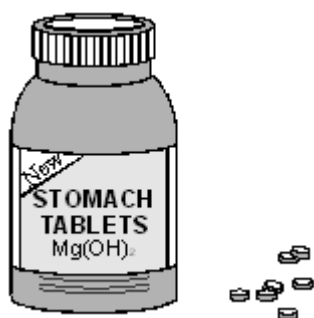
(2)

(ii) Complete and balance the chemical equation for the reaction of sodium hydrogencarbonate with sulphuric acid.

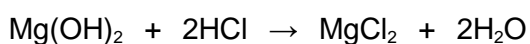


(2)

(b) Indigestion tablets contain bases which cure indigestion by neutralising excess stomach acid.



(i) One type of indigestion tablet contains magnesium hydroxide. This base neutralises stomach acid as shown by the balanced chemical equation.



Write a balanced **ionic** equation for the neutralisation reaction.

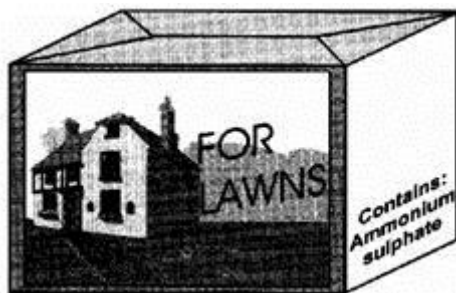
\_\_\_\_\_

(2)

(ii) How does the pH in the stomach change after taking the tablets?

(1)

(c) Ammonium sulphate is used as a lawn fertiliser.



Using ammonia solution, describe how you would make the fertiliser ammonium sulphate.

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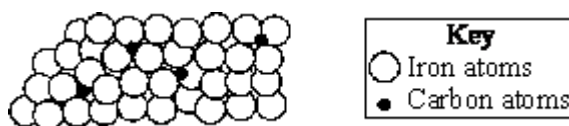
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(3)

(Total 10 marks)

**Q55.**

The diagram shows the arrangement of atoms in an *alloy*.



(a) What is meant by an *alloy*?

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(2)

(b) Name the alloy represented in the diagram.

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(1)

(c) Give **one** advantage of using this alloy instead of pure iron.

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(1)

(d) Which elements are used to make brass?

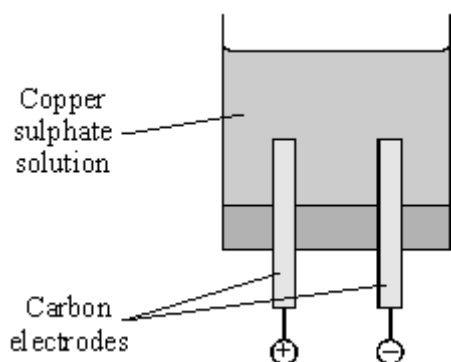
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(1)

(Total 5 marks)

**Q56.**

An investigation into the *electrolyte* copper sulphate solution was carried out as shown.



(a) What does *electrolyte* mean?

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(2)

(b) These were the observations.

Negative electrode	solid formed
Positive electrode	gas given off

(i) Name the solid formed.

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(1)

(ii) Name the gas given off.

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(1)

(c) How could a sample of gas be collected at the positive electrode?

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(2)

(d) Suggest why the blue colour of copper sulphate becomes paler during the

investigation.

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(2)  
(Total 8 marks)

**Q57.**

Many everyday substances can be classified as acids, bases or salts. For example, car batteries contain sulphuric acid, oven cleaners contain sodium hydroxide and table salt contains sodium chloride.

(a) A solution of each of these substances was tested with universal indicator.

Solution	Colour of universal indicator
Sulphuric acid (H <sub>2</sub> SO <sub>4</sub> )	red
Sodium hydroxide (NaOH)	purple
Sodium chloride (NaCl)	green

(i) Explain how these universal indicator colours and the corresponding pH values could be used to identify each of these solutions.

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(3)

(ii) Name and give the formula of the ion which causes the solution to be acidic.

Name of ion \_\_\_\_\_

Formula of ion \_\_\_\_\_

(2)

(b) Sodium chloride can be made by reacting sodium hydroxide with hydrochloric acid in the presence of an indicator.

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

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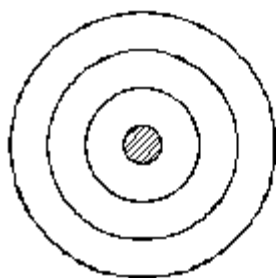
(1)

(ii) Write a balanced chemical equation for this reaction.

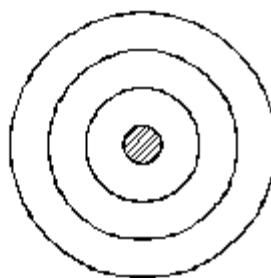
\_\_\_\_\_(aq) + \_\_\_\_\_(aq) → \_\_\_\_\_(aq) + \_\_\_\_\_(l)

(2)

(c) The atomic number for sodium is 11 and for chlorine is 17.



Sodium atom



Chlorine atom

(i) Complete the diagrams to show the electron arrangements for a sodium atom and a chlorine atom. (2)

(ii) These atoms form different particles by one electron transferring from the sodium atom to the chlorine atom. What is the name given to the particles formed?

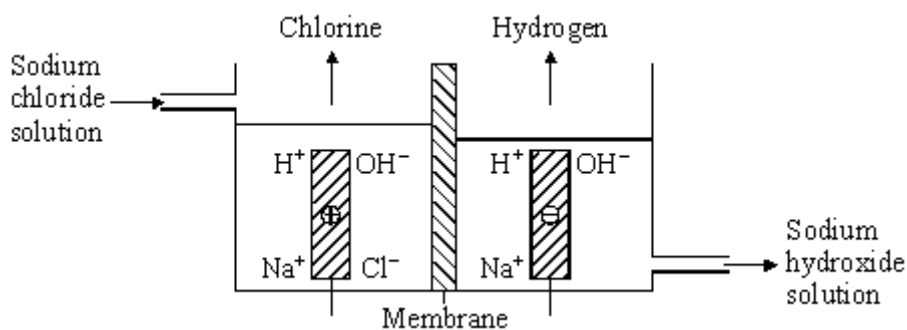
\_\_\_\_\_ (1)

(iii) Why do these sodium and chloride particles bond?

\_\_\_\_\_

\_\_\_\_\_ (1)

(d) Sodium chloride solution is electrolysed to form three products, hydrogen, chlorine and sodium hydroxide.



Describe how each of these products are formed.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_

