AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.2.2 HOW BONDING AND STRUCTURE ARE RELATED TO THE PROPERTIES OF SUBSTANCES (PACK 3)

SCORE	PERCENTAGE
/231	%

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Q1.

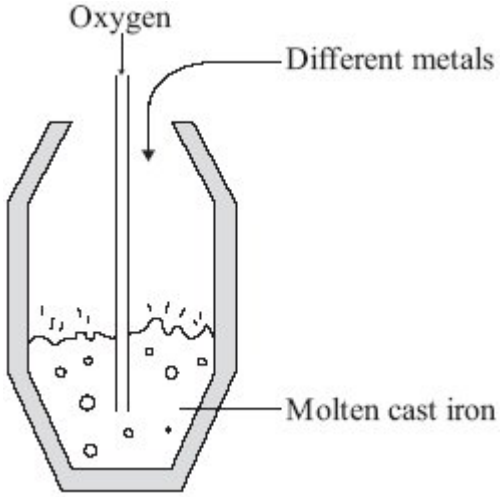
The demand for iron and steel is high.

(a) Iron that is extracted from its oxide by carbon reduction in a blast furnace is called cast iron. Cast iron contains about 4% carbon. This carbon makes cast iron very brittle.

Carbon steels can be made by the following processes.

- Blowing oxygen into molten cast iron to remove most of the carbon.
- Adding a calculated amount of carbon.

Sometimes different metals may also be added to the molten carbon steels.



(i) Suggest how blowing oxygen into molten cast iron removes most of the carbon.

_____

_____

_____

_____

(2)

(ii) Why are different metals sometimes added to molten carbon steels?

_____

_____

(1)

(b) The percentage of iron and steel recycled in the UK has been increasing.

Year	%iron and steel recycled
1998	25

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2000	35
2002	42
2004	46
2006	57

The UK government has set targets for the percentage of iron and steel to be recycled.
In 2006 the target was exceeded.

Suggest **two** reasons why the UK government wants to encourage recycling of iron and steel.

1. _____

_____

2. _____

_____

(2)

(Total 5 marks)

Q2.

Perfumes contain a mixture of chemicals.



The main ingredients of perfumes are a solvent and a mixture of fragrances.

(a) A sample of the solvent used in one perfume contained 0.60 g of carbon, 0.15 g of hydrogen and 0.40 g of oxygen.

Relative atomic masses: H = l; C = 12; O = 16.

Calculate the empirical (simplest) formula of the solvent.

You must show all of your working to gain full marks for this question.

_____

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_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Solvent molecules evaporate easily.

Explain why substances made of simple molecules evaporate easily.

_____

_____

_____

_____

_____

(2)

(c) Most companies claim that their perfumes have been tested on skin. A study was made of the tests they used. The study found that each company used different tests.

The perfumes were tested in the companies' own laboratories and **not** by independent scientists.

Some companies did not give any information about the tests that they had used.

(i) Suggest why companies test their perfumes on skin.

_____

_____

_____

(1)

(ii) Did the study show that the tests made by the different companies were valid and reliable?

Explain your answer.

_____

_____

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_____

_____

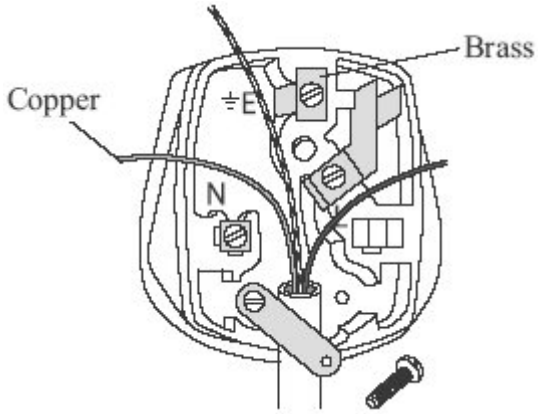
_____

(2)

(Total 9 marks)

Q3.

Copper metal is used for electric wires.
An alloy of copper, called brass, is used for pins and terminals of electric plugs.



(a) Copper metal is relatively soft and flexible.

Give another reason why copper is used for electric wires.

_____

_____

(1)

(b) Brass is an *alloy*.

What is an *alloy*?

_____

_____

(1)

(c) Open-cast mining of copper ore makes a very large hole.

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(i) Suggest **one** environmental problem that is caused by open-cast mining of copper ore.

_____

_____

(1)

(ii) Some copper ores contain copper sulfide, CuS.

Copper sulfide is heated in air to produce copper and sulfur dioxide.

$$CuS + O_2 \rightarrow Cu + SO_2$$

Suggest **one** environmental problem caused by heating copper sulfide in air.

_____

_____

(1)

(d) The amount of copper-rich ores is estimated to last only a few more years. New houses need several kilometres of copper wire.

(i) Explain why the need to use so much copper will cause a problem in the future.

_____

_____

(1)

(ii) Suggest **two** ways in which society could overcome this problem.

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1. _____

_____

2. _____

_____

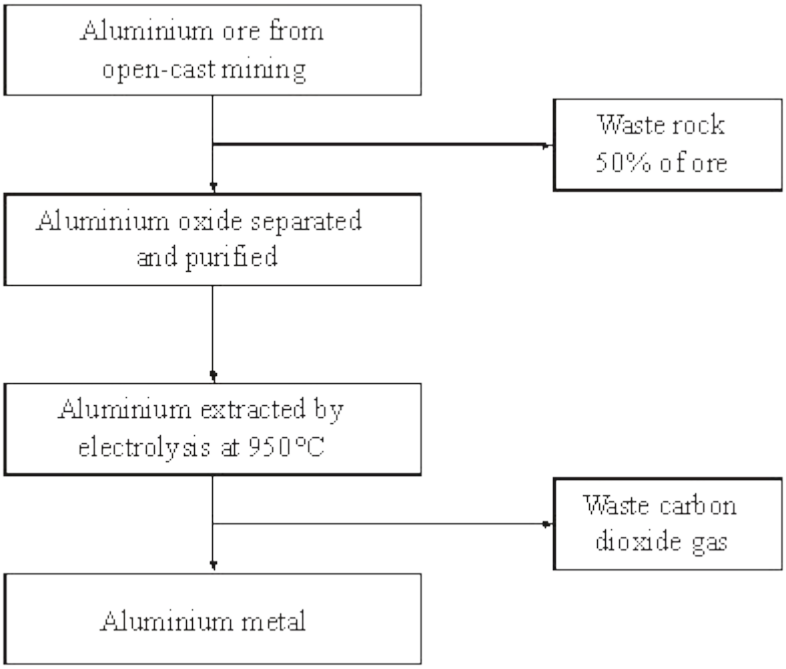
(2)

(Total 7 marks)

Q4.

Aluminium has many uses because of its low density, good electrical conductivity, flexibility and resistance to corrosion.

The main steps in the extraction of aluminium are shown in the flow chart.



(a) Use the information in the flow chart to suggest the benefits of recycling aluminium.

_____

_____

_____

_____

_____

_____

(3)

(b) Pure aluminium is rarely used for the construction of large objects. Small amounts of other metals are usually mixed with aluminium.

Explain why.

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_____

_____

_____

_____

(2)

(Total 5 marks)

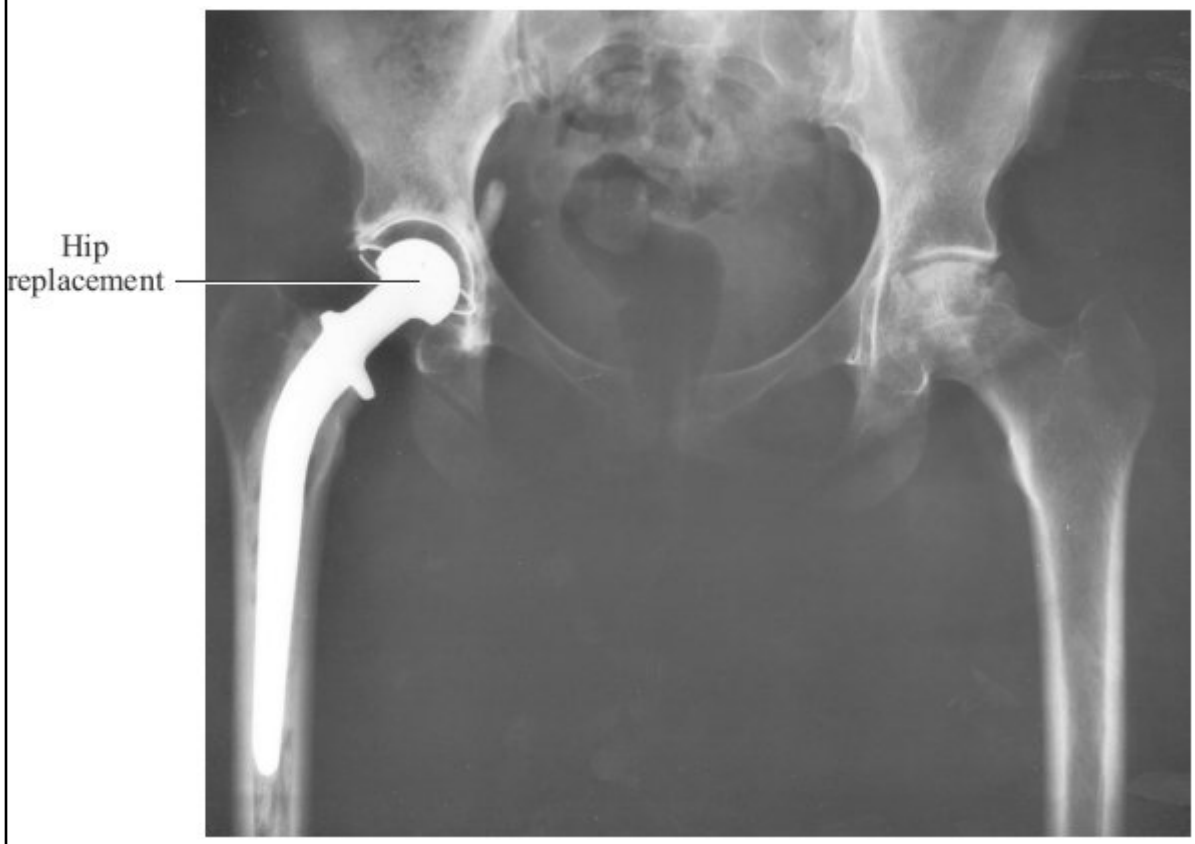
Q5.

Read this passage about metals.

Metals are crystalline materials. The metal crystals are normally about 20 000 nm (nanometres) in diameter. The atoms inside these crystals are arranged in layers.

A new nanoscience process produces nanocrystalline metals. Nanocrystalline metals are stronger and harder than normal metals.

It is hoped that nanocrystalline metals can be used in hip replacements.



The use of nanocrystalline metals should give people better hip replacements which last longer.

(a) State why metals can be bent and hammered into different shapes.

_____

_____

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(1)

(b) How is the size of the crystals in nanocrystalline metals different from the size of the crystals in normal metals?

_____

_____

(1)

(c) Hip joints are constantly moving when people walk.

Suggest and explain why the hip replacement made of nanocrystalline metal should last longer than one made of normal metals.

_____

_____

_____

_____

(2)

(Total 4 marks)

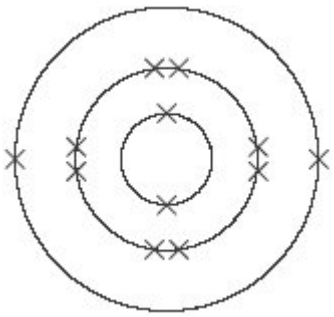
Q6.

(a) Write a balanced symbol equation for the reaction between magnesium (Mg) and oxygen (O_2) 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

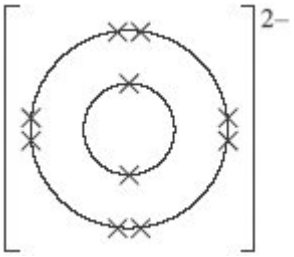
Draw a similar diagram to show the electronic structure of an oxygen atom.
The atomic (proton) number of oxygen is 8.

(1)

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

The diagram shows the electronic structure of an oxide ion.

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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.

_____

_____

_____

_____

(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)

Q7.

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*?

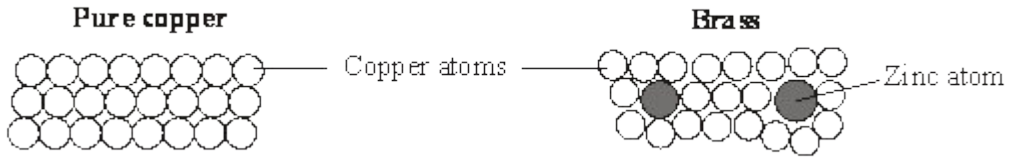
_____

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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?

_____

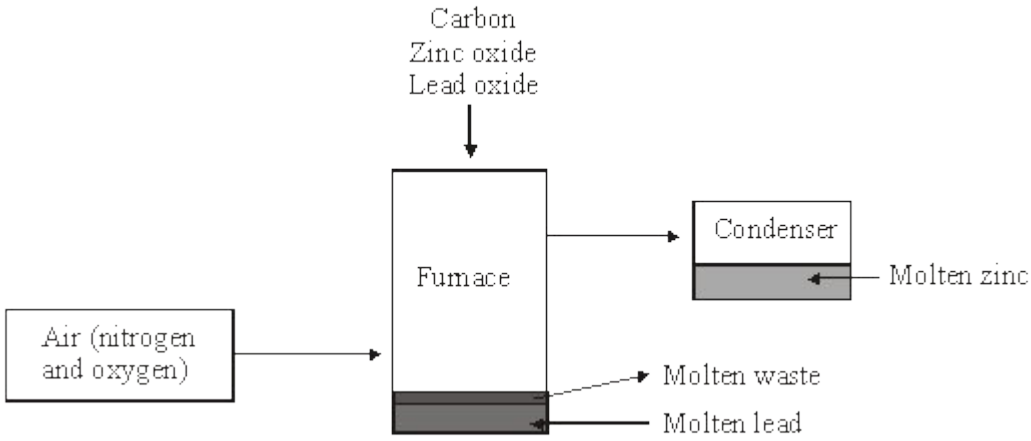
_____

_____

_____

(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**

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

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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.

_____

_____

_____

_____

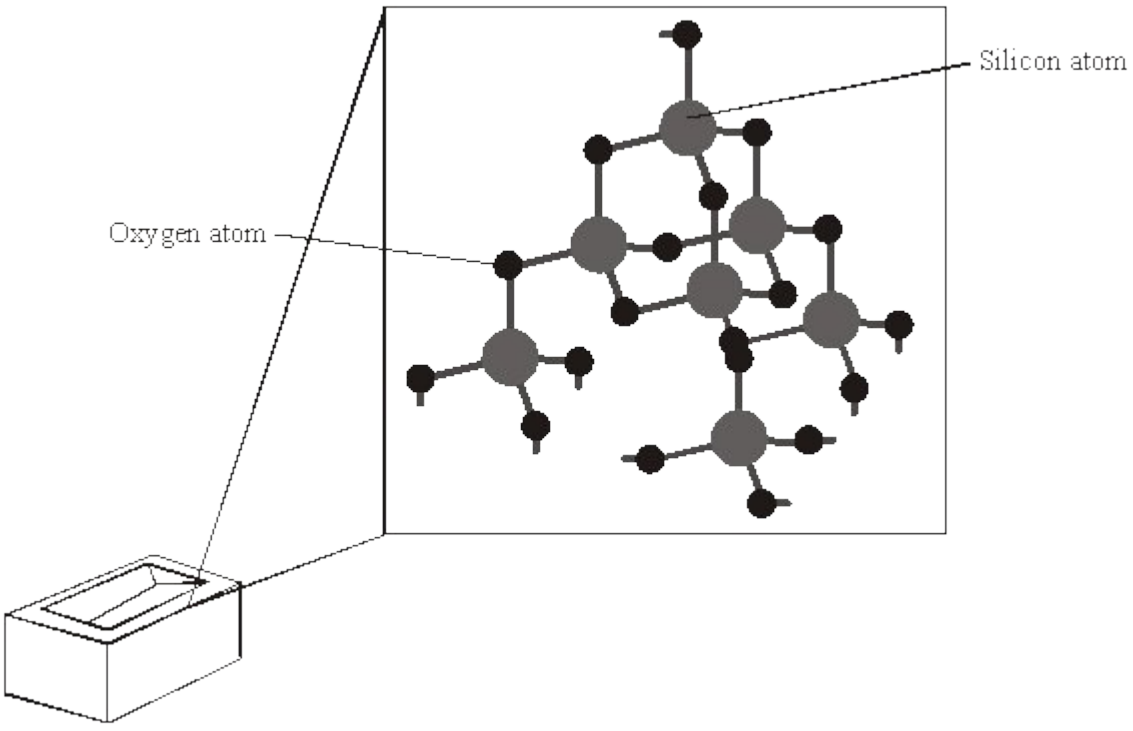
(2)

(Total 6 marks)

Q8.

Bricks made from silica (silicon dioxide) are used to line furnaces that operate at high temperatures.

Part of the structure of silica is shown in the diagram.



Use words from the box to complete the sentences.

covalent	**giant**	**low**	**small**
four	**high**	**six**	**weak**

One reason for using silica to make bricks for high-temperature furnaces is that silica has

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a _____ melting point.

Silica has this property because it is a _____ structure in which each

silicon atom is joined to _____ oxygen atoms by

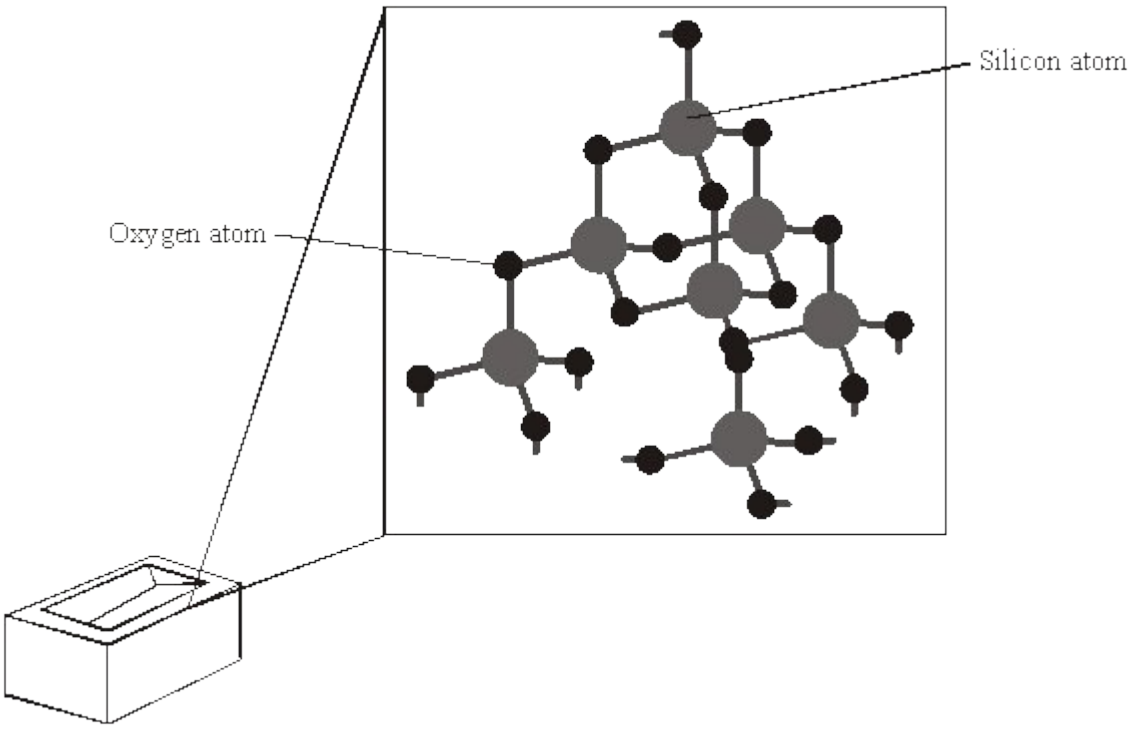
_____ bonds.

(Total 4 marks)

Q9.

Bricks made from silica (silicon dioxide) are used to line furnaces that operate at high temperatures.

Part of the structure of silica is shown in the diagram.



Suggest and explain why silica is used to make bricks for high-temperature furnaces. In your answer, you should refer to the structure of, and bonding in, silica.

_____

_____

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_____

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_____

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_____

(Total 4 marks)

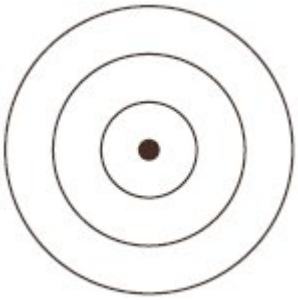
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Q10.

Aluminium is a useful metal.

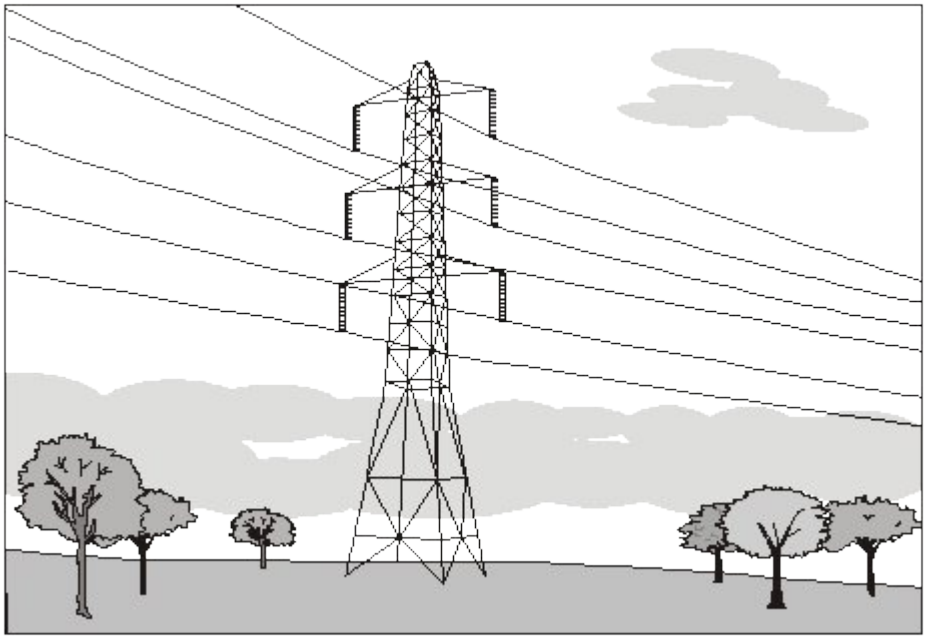
(a) The atomic number (proton number) of aluminium is 13.

Complete the diagram to show the electronic structure of an aluminium atom.
Use crosses (x) to represent the electrons.



(1)

(b) Aluminium is used as the electrical conductor for overhead power cables.



Explain why metals are good conductors of electricity.

_____

_____

_____

_____

(2)

(Total 3 marks)

Q11.

Many everyday items are made from iron.

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(a) Haematite is an *ore* of iron. Haematite contains iron oxide, Fe_2O_3.

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

_____

_____

(1)

(ii) Iron can be produced by reacting iron oxide with carbon in a blast furnace.

What type of reaction produces the iron?

_____

_____

(1)

(iii) The word equation for this reaction is:

iron oxide + carbon → iron + carbon dioxide

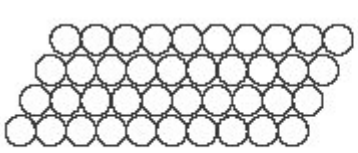
Complete and balance the symbol equation for this reaction.

___Fe_2O_3 + ___C → _____ + _____

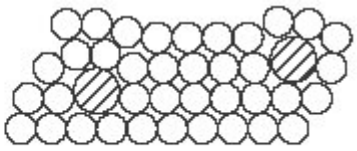
(2)

(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.

_____

_____

_____

_____

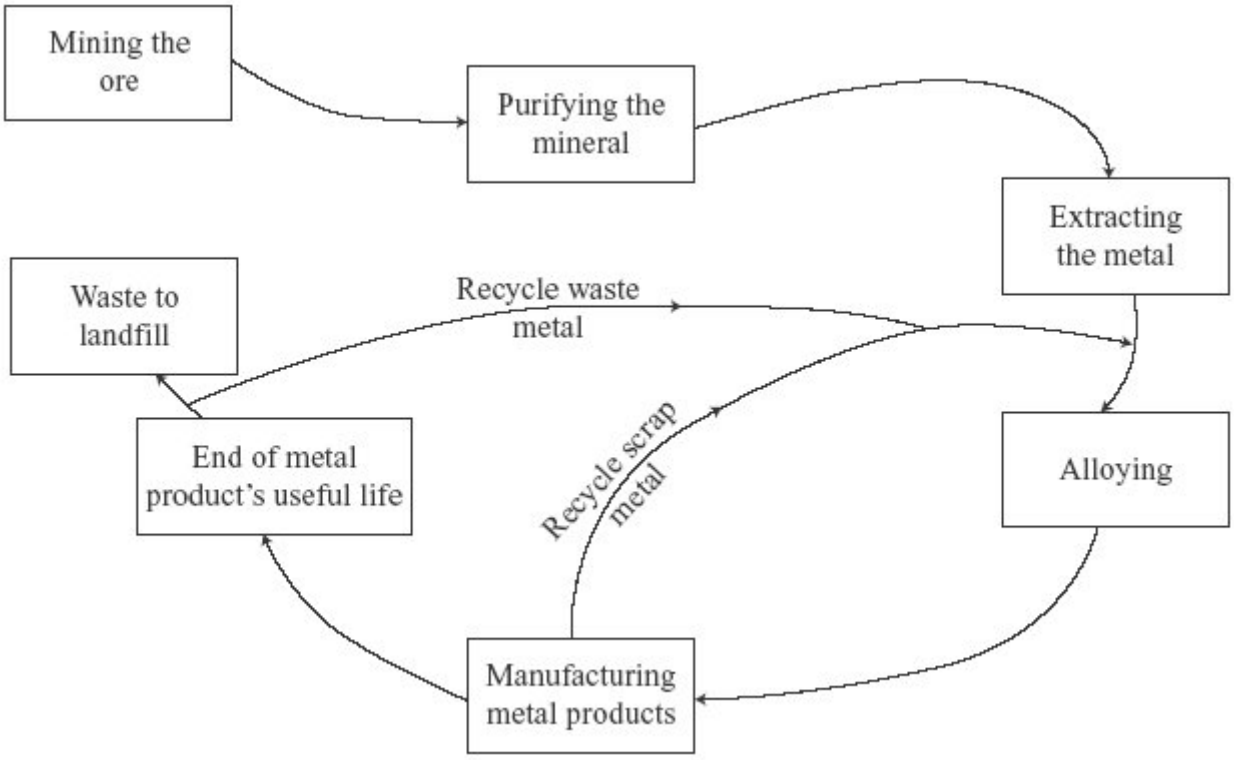
_____

_____

(3)

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

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

_____

_____

_____

_____

_____

_____

(3)

(Total 10 marks)

Q12.

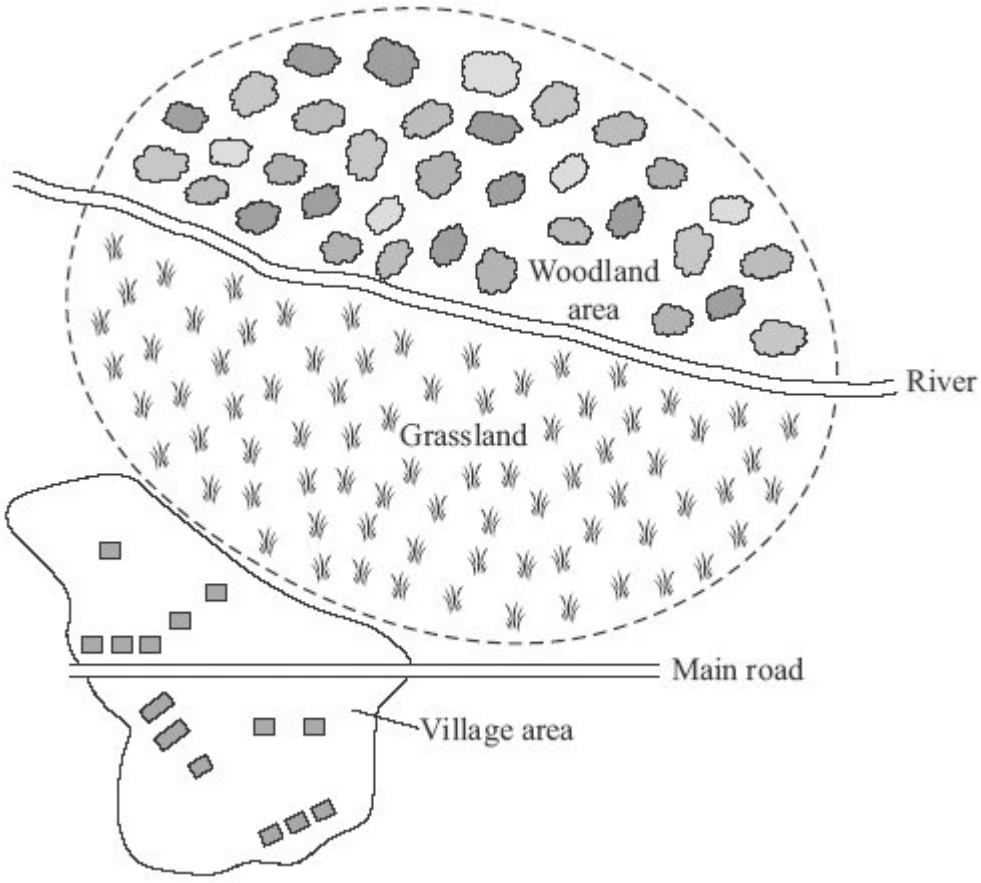
Iron ore is the main source of iron.

(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.

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

_____

_____

(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. _____

_____

2. _____

_____

(2)

(b) Iron ore contains the compound iron oxide, $Fe_{2=}O_3$.

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

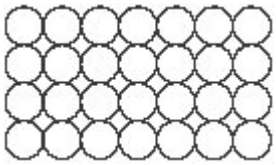
Complete the word equation for the extraction of iron.

iron oxide + _____ → iron + carbon dioxide

(1)

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(ii) This diagram represents pure iron.



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

_____

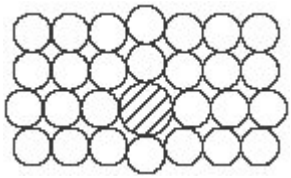
_____

_____

_____

(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.

_____

_____

_____

_____

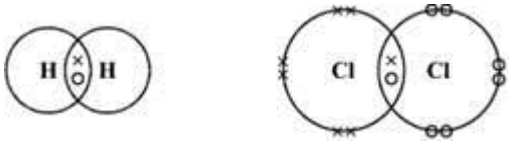
(2)

(Total 8 marks)

Q13.

Hydrogen chloride (HCl) can be made by the reaction of hydrogen (H_2) with chlorine (Cl_2).

(a) The diagrams represent molecules of hydrogen and chlorine.



Draw a similar diagram to represent a molecule of hydrogen chloride (HCl).
You need show only the outer energy level (shell) electrons.

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(1)

(b) The word equation for the reaction of hydrogen with chlorine is shown below.

hydrogen + chlorine → hydrogen chloride

Write a balanced symbol equation for this reaction.

_____

(2)

(c) Hydrogen chloride gas reacts with magnesium to form the ionic compound called magnesium chloride. Use the table of ions on the Data Sheet to help you to write the formula of magnesium chloride.

_____

(1)

(d) Why does magnesium chloride have a much higher melting point than hydrogen chloride?

_____

_____

_____

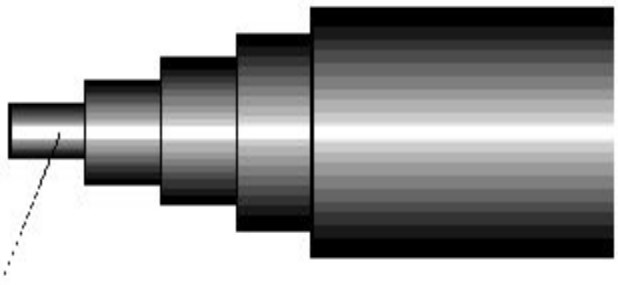
_____

(2)

(Total 6 marks)

Q14.

The drawing shows a high quality wire used to make electrical connections on a hi-fi system.



Multi-strand "OFC" copper
to maitain high signal purity

(a) Copper is used because it is a very good conductor of electricity. Copper is a typical metal.

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(i) Describe the structure and bonding in a metal. You may wish to draw a diagram to help you to answer this question.

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

_____

_____

_____

_____

_____

_____

(3)

(ii) Explain, by reference to your answer to part (a)(i), why copper conducts electricity.

_____

_____

(1)

(iii) Explain, by reference to your answer to part (a)(i), why copper can be drawn into wires.

_____

_____

(1)

(b) The copper used to make this wire is “OFC” copper. This stands for ‘oxygen free copper’.

(i) It is thought that when molten copper is cooled and solidified it can take in some oxygen from the air. This may slightly decrease the conductivity of the copper.

Suggest why the conductivity might be decreased.

_____

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_____

_____

_____

(2)

(ii) To make it oxygen free, the copper is heated in an atmosphere of hydrogen.

Explain how this will remove the oxygen.

_____

_____

_____

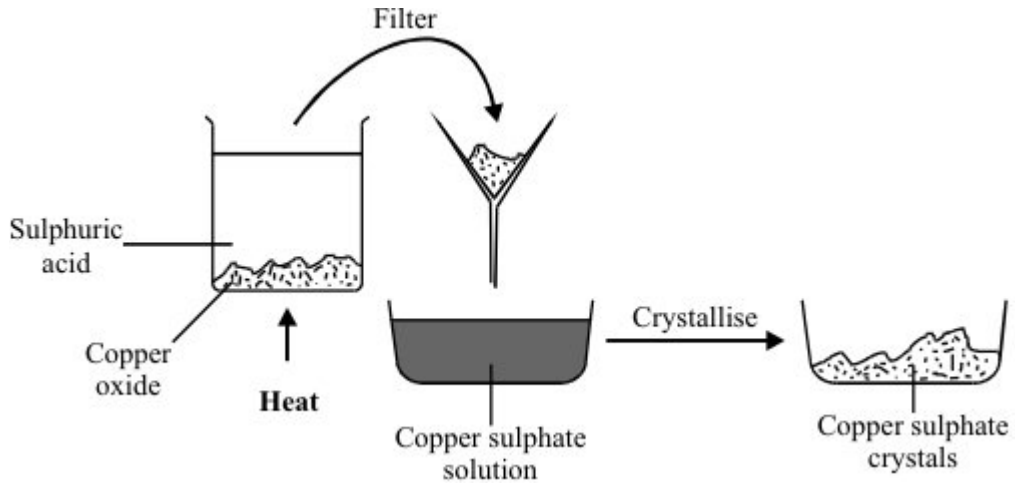
_____

(1)

(Total 8 marks)

Q15.

(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.

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

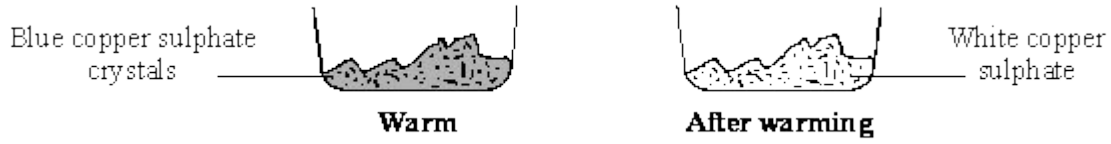
In the chemical equation what does (aq) mean?

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_____

(1)

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



_____

_____

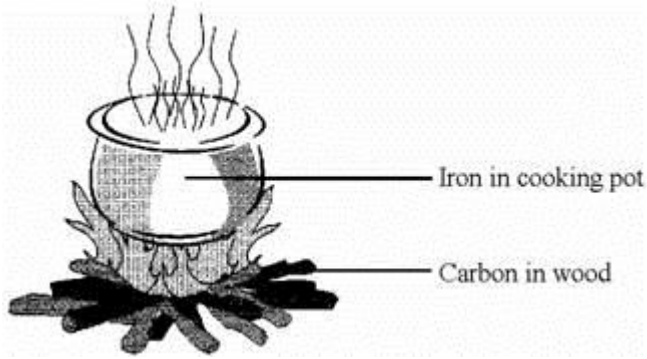
_____

(2)

(Total 5 marks)

Q16.

The uses of *elements* depend on their properties.



(a) Carbon and iron are both *elements.* What is an *element?*

_____

_____

(1)

(b) Complete the sentences by crossing out the words that are wrong. The first one has been done for you.

~~Non-Metals~~	Metals	can be hammered into shape.
Non-Metals	Metals	often have low melting point.
Non-Metals	Metals	are good conductors of heat.

(2)

(c) In the box are the names of three metals.

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copper	iron	sodium

Which **one** of these is **not** a good metal for making the cooking pot? Give a reason for your answer.

Metal _____

Reason _____

_____

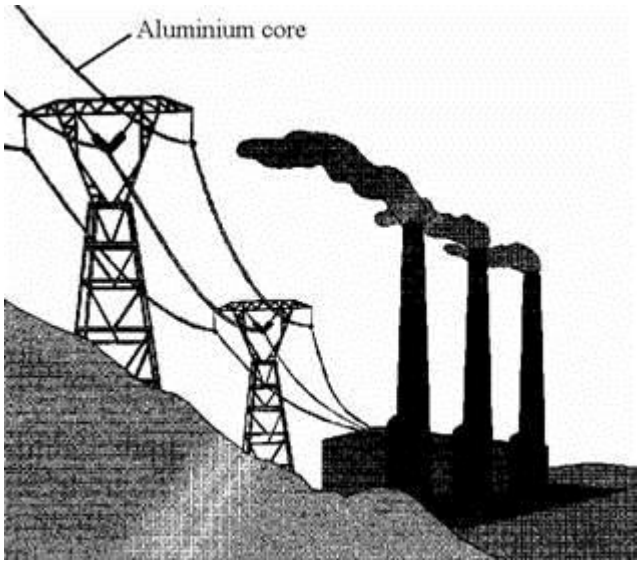
_____

(2)

(Total 5 marks)

Q17.

(a) Aluminium is more expensive than iron. Why is aluminium and not iron used for the central core in power cables?



_____

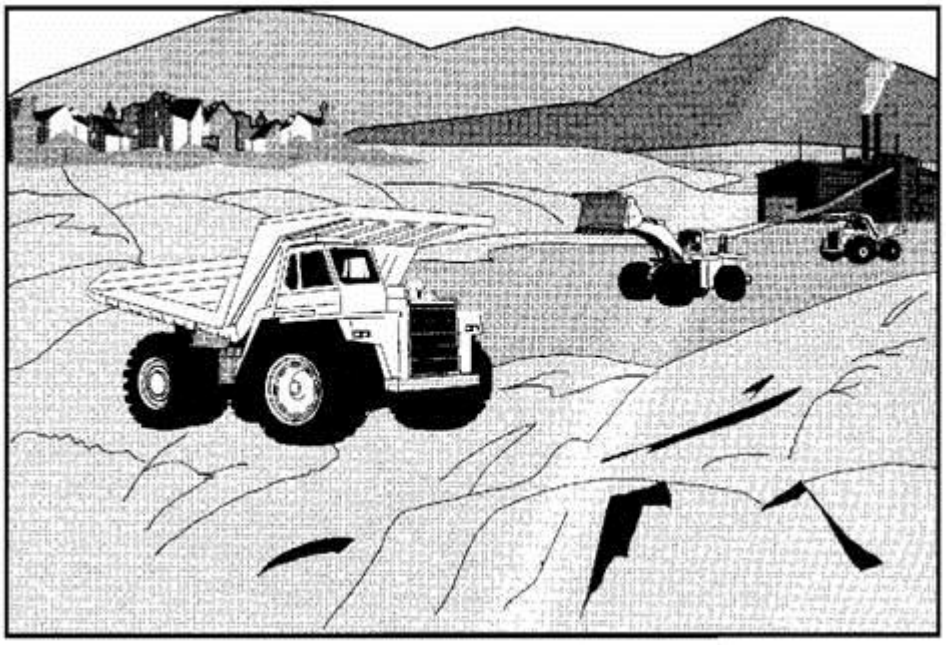
_____

_____

(2)

(b) Many industrial processes involve the removal of minerals by quarrying.

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All quarrying has some effect on the environment and on people's lives. Make comments about the social, economic, health, safety and environmental effects of quarrying.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 7 marks)

Q18.

Calcium tablets are taken to build and maintain strong bones and teeth.

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(a) These tablets react with hydrochloric acid in the stomach.

$CaCO_3(\quad) + 2HCl(aq) \rightarrow CaCl_2(\quad) + H_2O(\quad) + CO_2(\quad)$

(i) Add all these missing state symbols [aq g l s] to the balanced chemical equation.

(2)

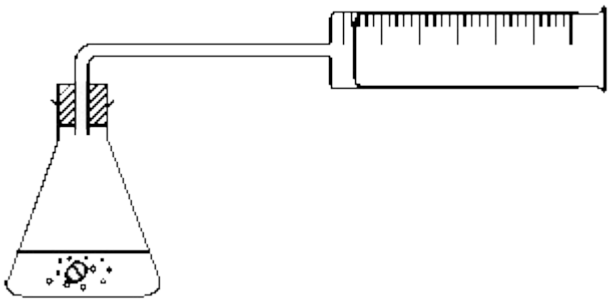
(ii) The calcium salt that is formed is absorbed during digestion. What is the name of the calcium salt?

_____

_____

(1)

(b) The volume of carbon dioxide produced by one calcium tablet in the stomach can be found as shown.

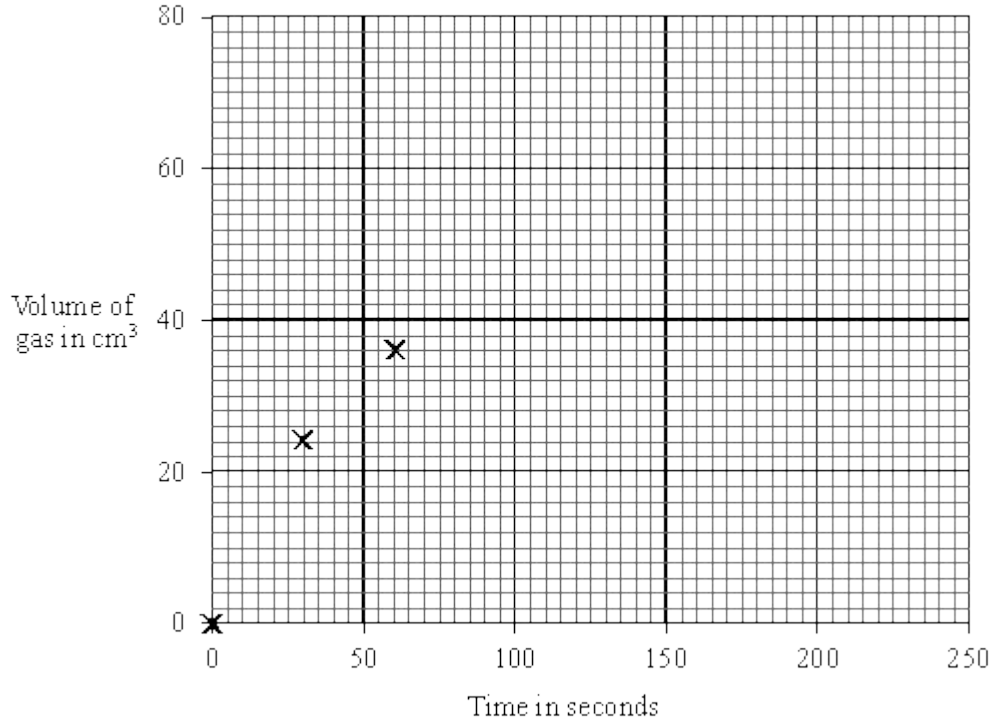


The volume of carbon dioxide was recorded every 30 seconds until the reaction stopped.

Time in seconds	0	30	60	90	120	150	180	210	240
Volume of gas in cm^3	0	24	36	46	52	56	59	60	60

(i) Complete the graph of these results.

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(3)

(ii) Describe **one** way in which this reaction can be made to go faster.

_____

_____

(1)

(iii) A calculation, using the mass of this tablet, showed that 80 cm^3 of carbon dioxide would be produced if the tablet was pure calcium carbonate. What do the results show about the purity of the tablet? Explain your answer by calculating the purity of this tablet.

_____

_____

_____

_____

_____

_____

(3)

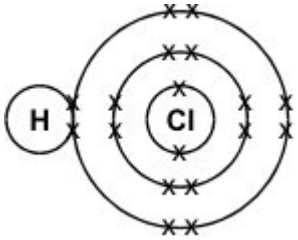
(Total 10 marks)

Q19.

The hydrogen halides (hydrogen fluoride, hydrogen chloride, hydrogen bromide and hydrogen iodide) are important chemicals.

The diagram below represents a molecule of hydrogen chloride.

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(i) What type of particles are represented by the crosses (X)?

_____

(1)

(ii) What type of chemical bond holds the atoms in this molecule together?

_____

(1)

(iii) Would you expect hydrogen chloride to be a gas, a liquid or a solid, at room temperature and pressure? Explain your answer.

_____

_____

_____

(3)

(Total 5 marks)

Q20.

The extract below was taken from a leaflet on the uses of platinum. One of the uses described was in making electrodes for spark plugs in car engines. The spark plug produces the spark which ignites the fuel in the engine.

Spark Plugs

The electrodes in a spark plug have to conduct electricity very well. Since they project into the combustion chamber of the engine, they must also be able to withstand extremely high temperatures in a very corrosive atmosphere.

Nickel-based plugs have been produced for many years. They only last a fairly short time. As the electrodes wear, combustion becomes less efficient and the petrol is not burnt completely.

Platinum and other precious metals can now be used in spark plugs. These last much longer and are more efficient. This can help to reduce air pollution.

The table below gives some information about platinum and nickel.

	MELTING POINT (° C)	BOILING POINT (° C)	POSITION IN REACTIVITY SERIES	COST (£/kg)
nickel	1455	2920	Higher than gold	2.5

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platinum	1769	4107	below gold	6110

(a) Compare nickel and platinum for use in making the electrodes in spark plugs.

A good answer should give advantages and disadvantages of each metal linking these to the properties of the metals. Marks will be given for the way in which you organise your answer.

You will need a sheet of lined paper.

(8)

(b) (i) Describe the structure and bonding in metals.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(ii) Explain why metals such as nickel and platinum are good conductors of electricity.

_____

_____

_____

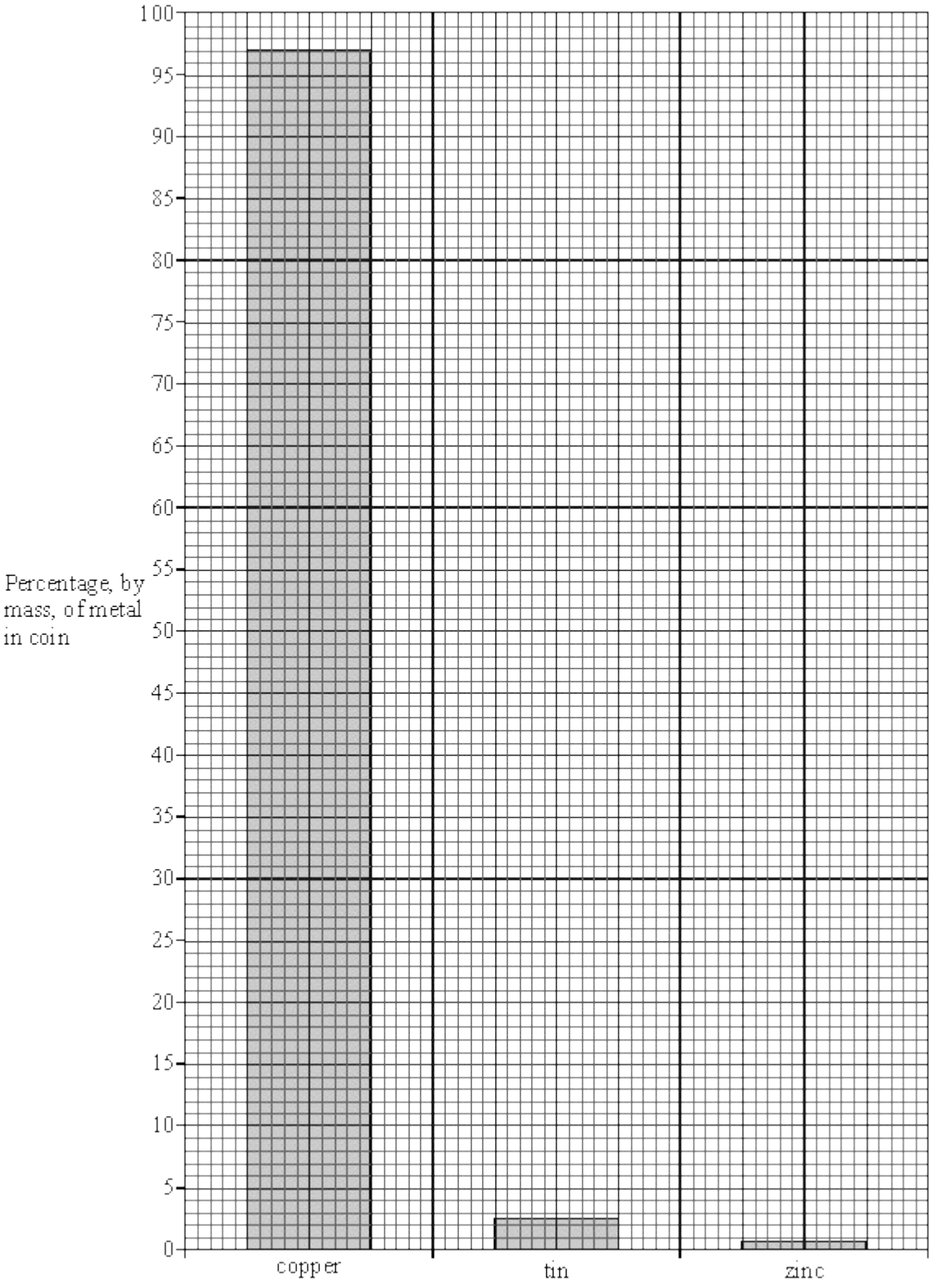
(2)

(Total 13 marks)

Q21.

The chart below shows the metals which are present in a coin.

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(a) Identify the alloy used to make this coin.

_____

(1)

(b) The mass of the coin is 2.5 g.
Calculate the mass of copper in this coin.

_____

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_____

(2)

(c) Suggest what properties would make an alloy suitable for making a coin.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q22.

Read the following information about an element X.

The element X melts above 600°C. It conducts electricity at room temperature. It burns in oxygen to form an oxide. When the oxide is mixed with water it turns Universal Indicator blue.

The oxide of X is a white solid at room temperature. It has the formula XO and contains the ion X^{2+}.

The element X reacts with chlorine to form a chloride with a high melting point. The chloride conducts electricity when molten and it is soluble in water.

(a) From the information give **three** pieces of evidence which suggest that X is a metal.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(b) In which Group of the Periodic Table should X be placed? Give a reason for your answer.

Group _____

Reason _____

_____

(2)

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(c) Predict the formula for the chloride of X. _____

(1)

(Total 6 marks)

Q23.

The following passage was taken from a chemistry textbook.

Germanium is a white, shiny, brittle element. It is used in the electronics industry because it is able to conduct a small amount of electricity.

It is made from germanium oxide obtained from flue dusts of zinc and lead smelters. The impure germanium oxide from the flue dusts is changed into germanium by the process outlined below.

STEP 1 The germanium oxide is reacted with hydrochloric acid to make germanium tetrachloride. This is a volatile liquid in which the germanium and chlorine atoms are joined by covalent bonds.

STEP 2 The germanium tetrachloride is distilled off from the mixture.

STEP 3 The germanium tetrachloride is added to an excess of water to produce germanium oxide and hydrochloric acid.

STEPS 1 to 3 are repeated several times.

STEP 4 The pure germanium oxide is reduced by hydrogen to form germanium.

(a) Balance the equation below which represents the reaction in step 1.

GeO_2 + _____ HCl → $GeCl_4$ + _____ H_2O

(1)

(b) Write a word equation for the reaction in step 3.

_____

(1)

(c) Suggest why steps 1 to 3 are repeated several times.

_____

_____

(1)

(d) The equation which represents the reaction in step 4 is shown below.

$GeO_2 + 2H_2 \rightarrow Ge + 2H_2O$

(i) Explain what is meant by the term 'reduced'.

_____

_____

(1)

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(ii) Calculate the mass of germanium which could be made from 525 g of germanium oxide. (Relative atomic masses: Ge = 73; O = 16).

_____

_____

_____

_____

Mass _____ g

(3)

(e) Germanium is difficult to classify as either a metal or a non-metal.

(i) Give as much evidence as you can from the information in this question to support the view that germanium is a metal. Explain your answer as fully as you can.

_____

_____

_____

_____

_____

(3)

(ii) Give as much evidence as you can from the information in this question to support the view that germanium is a non-metal. Explain your answer as fully as you can.

_____

_____

_____

_____

(3)

(Total 13 marks)

Q24.

(a) The list below gives six substances.

- aluminium
- beer
- copper
- milk

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- pure water
- sodium chloride

Put each substance in the correct column of the table.

ELEMENTS	COMPOUNDS	MIXTURES

(3)

(b) Elements can be divided into two groups, metals and non-metals.

The list below gives some properties of elements.

- brittle
- can be hammered into shape
- dull
- good conductors of electricity
- poor conductors of electricity
- shiny

Put each property into the correct column.

PROPERTIES OF METALS	PROPERTIES OF NON-METALS

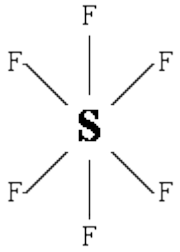
(3)
(Total 6 marks)

Q25.

Sulphur hexafluoride is a colourless, odourless, non-flammable gas, which is insoluble in water and extremely unreactive. It is used as an insulator in high voltage transformers and switchgear.

The diagram below represents a molecule of sulphur hexafluoride.

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(a) What type of chemical bond holds the sulphur and fluorine atoms together in sulphur hexafluoride molecules?

_____

(1)

(b) Explain why sulphur hexafluoride has a low boiling point.

_____

_____

(2)

(c) Explain how **three** of the properties of sulphur hexafluoride make it suitable for use as an insulator inside electrical transformers.

Property 1: _____

Explanation: _____

_____

Property 2: _____

Explanation: _____

_____

Property 3: _____

Explanation: _____

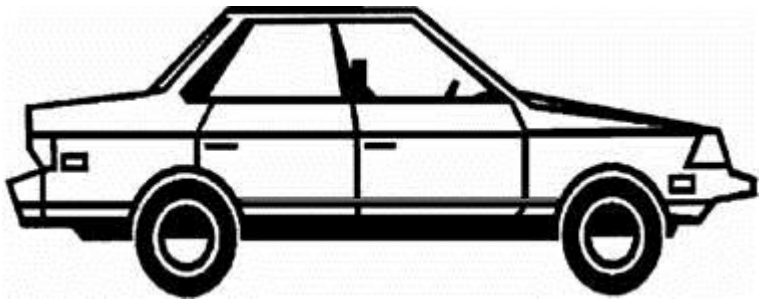
_____

(3)

(Total 6 marks)

Q26.

Iron is used (as steel) to make the body panels for cars.



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The iron panels have to be bendable so that they can be pressed into the shape required, but must also be strong. The panels must also be able to conduct electricity because they form part of the electrical circuits of the car.

(a) Iron is a typical metal. Describe the structure and bonding in a metal such as iron. You may use a diagram if you wish.

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Explain how the structure and bonding of iron:

(i) allows the body panels to conduct electricity;

_____

(2)

(ii) allows the body panels to be bent into shape;

_____

(1)

(iii) gives the body panels strength.

_____

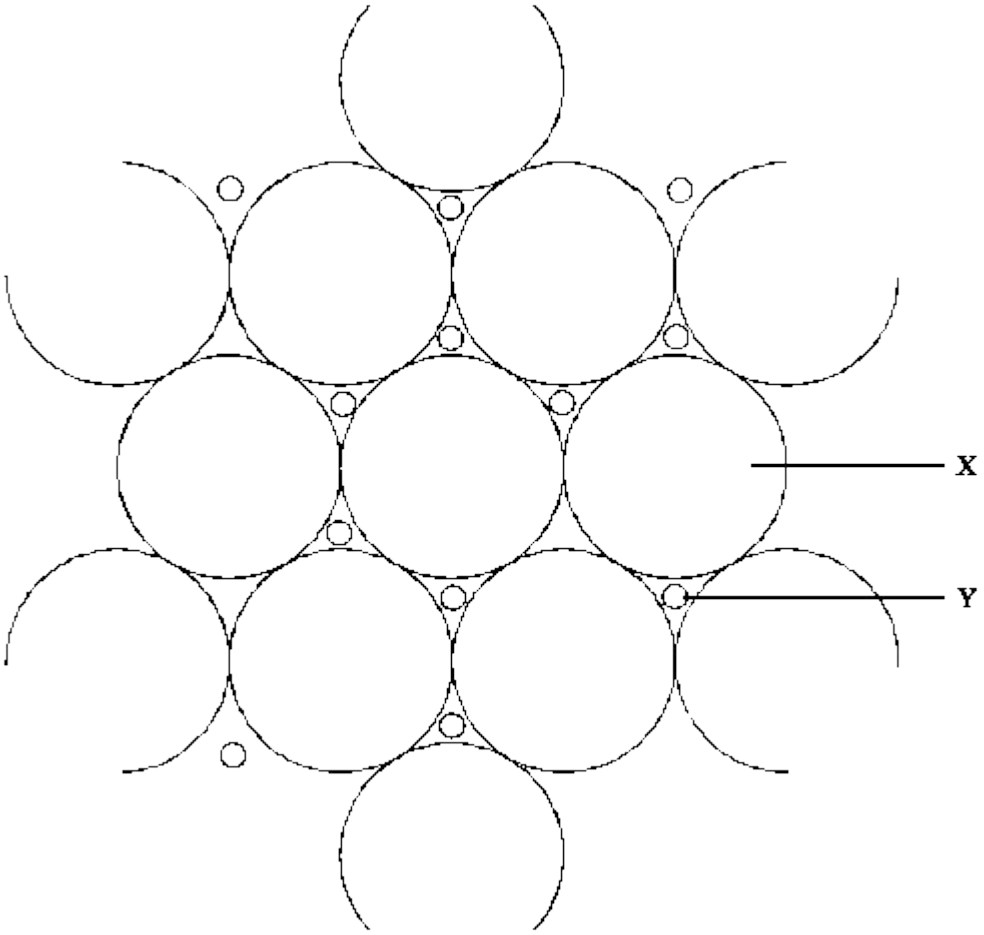
(1)

(Total 8 marks)

Q27.

The diagram shows a model of part of the giant lattice of a metal.

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(a) Name particles **X** and **Y**.

X _____

Y _____

(2)

(b) Explain, in terms of the giant structure above, why is it possible to bend a piece of metal.

_____

_____

_____

_____

(2)

(Total 4 marks)

Q28.

(a) Magnesium burns in oxygen, forming magnesium oxide.

This equation represents the reaction.

$Mg\ (s) + O_2\ (g) \rightarrow MgO\ (s)$

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(i) Balance the equation.

(1)

(ii) Give the meaning of the state symbols (s) and (g).

(s) _____

(g) _____

(2)

(b) Use the Formulae of Some Common Ions table on the Data Sheet to help you to answer this question.

Magnesium also reacts with chlorine to form magnesium chloride.

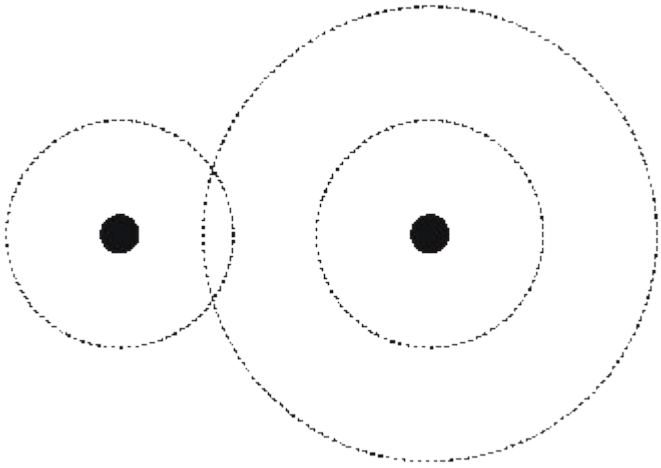
Give the formula of magnesium chloride _____

(1)

(Total 4 marks)

Q29.

(i) Complete the drawing to show the electron structure of a hydrogen fluoride molecule. Draw electrons as dots or crosses.



(1)

(ii) Explain why hydrogen fluoride is a gas at room temperature.

_____

_____

_____

_____

(2)

(Total 3 marks)

Q30.

Electrons, neutrons and protons are sub-atomic particles.

(a) Complete the **six** spaces in the following table.

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Name of sub-atomic particle	Relative mass	Relative charge
_____	1	_____
_____	_____	0
_____	$\frac{1}{1840}$	_____

(3)

(b) An aluminium atom has 13 electrons. How are these arranged in shells around the nucleus?

_____

(1)

(c) Chromium atoms have 24 protons and 28 neutrons.

(i) How many electrons does each neutral chromium atom have?

_____

(1)

(ii) What is the mass number of chromium?

_____

(1)

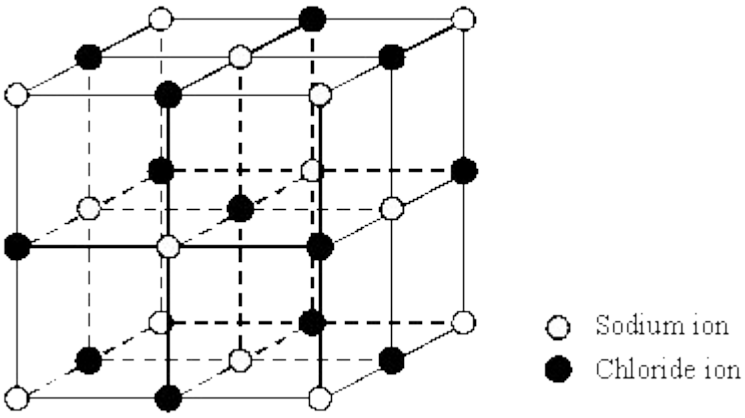
(d) What change occurs to an atom which undergoes the process of *reduction* in a chemical reaction?

_____

_____

(1)

(e) The diagram shows part of the ionic lattice of a sodium chloride crystal.



Explain why the ions in this lattice stay in place.

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_____

_____

_____

_____

_____

_____

(3)

(Total 10 marks)

Q31.

The drawing shows a container of a compound called magnesium chloride.



(i) How many elements are joined together to form magnesium chloride?

_____

(1)

(ii) Magnesium chloride is an ionic compound. What are the names of its ions?

_____ ions and _____ ions

(1)

(iii) How many **negative** ions are there in the formula for magnesium chloride?

_____

(1)

(iv) Complete the sentence.

Ions are atoms, or groups of atoms, which have lost or gained

_____ .

(1)

(v) Suggest **three** properties which magnesium chloride has because it is an ionic compound.

Property 1 _____

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_____

Property 2 _____

_____

Property 3 _____

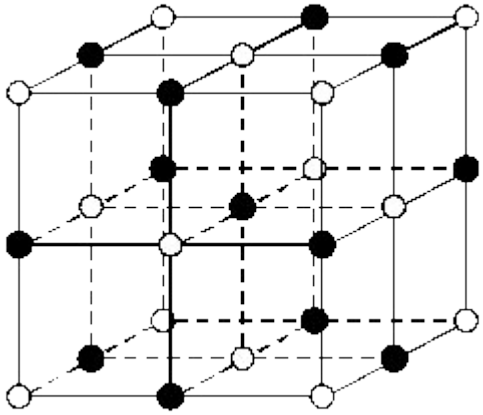
_____

(3)

(Total 7 marks)

Q32.

(a) The diagram shows part of the ionic lattice of a sodium chloride crystal.



(i) Complete the spaces in the table to give information about **both** of the ions in this lattice.

Name of ion	Charge
_____	_____
_____	_____

(2)

(ii) When it is solid, sodium chloride will not conduct electricity. However, molten sodium chloride will conduct electricity. Explain this difference.

_____

_____

_____

_____

(2)

(iii) Complete the sentence.

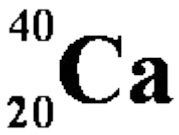
Sodium chloride conducts electricity when it is molten and when it is

_____

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(1)

(b) The symbol for a calcium atom can be shown like this:



(i) What is the mass number of this atom?

_____

(1)

(ii) What information is given by the mass number?

_____

_____

(1)

(c) Calcium burns in oxygen with a brick-red flame. The product is a white solid. It is calcium oxide and its formula is CaO.

(i) Balance the chemical equation for the reaction.

$$Ca(s) + O_2(g) \rightarrow CaO(s)$$

(1)

(ii) Describe, in terms of electrons, what happens to a calcium atom when it becomes a calcium ion.

_____

_____

_____

_____

(2)

(Total 10 marks)

Q33.

(a) By reference to their structure, explain how the particles in a piece of metal are held together and how the shape of the metal can be changed without it breaking.

(You may use a diagram in your answer.)

_____

_____

_____

_____

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_____

_____

_____

(5)

(b) Explain why metals are good conductors of electricity and suggest why this conductivity increases across the periodic table from sodium to magnesium to aluminium.

_____

_____

_____

_____

_____

_____

_____

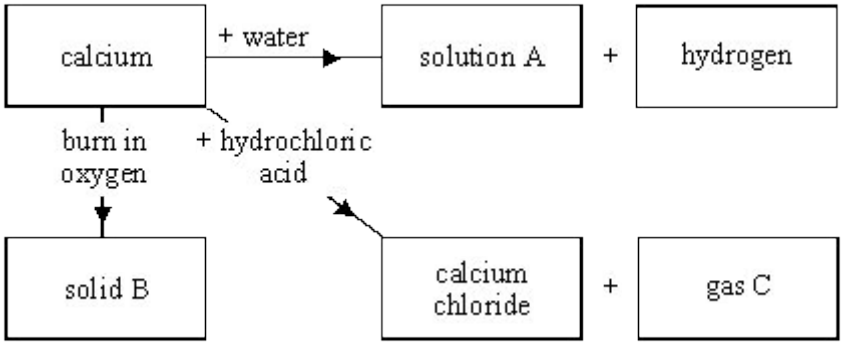
(4)

(Total 9 marks)

Q34.

(a) The chart shows the reactions of the metal calcium with water, oxygen and dilute hydrochloric acid.

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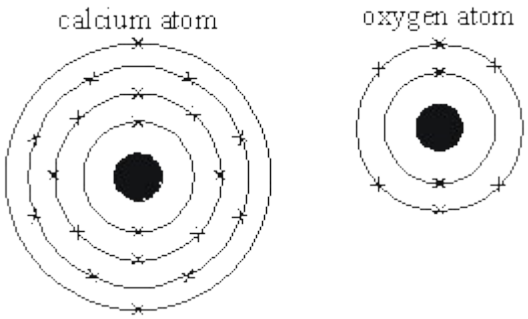
Name (i) solution A _____

(ii) solid B _____

(iii) gas C _____

(3)

(b) The diagrams below show the electronic structure of an atom of calcium and an atom of oxygen.



Describe fully what happens to its electrons when:

(i) a calcium atom forms a calcium ion. State the charge on the calcium ion formed.

_____

_____

_____

(3)

(ii) an oxygen atom forms an oxygen ion. State the charge on the oxygen ion formed.

_____

_____

_____

(3)

(c) Calcium oxide is an ionic compound. Why do ionic compounds have high melting points?

_____

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_____

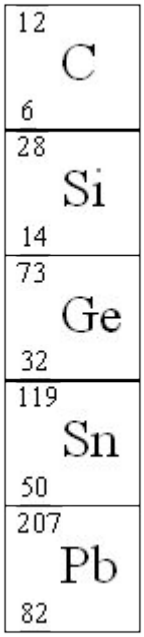
_____

(2)

(Total 11 marks)

Q35.

The diagram shows the elements in Group 4 of the periodic table.



Carbon is a non-metal and silicon is usually considered to be a non-metal.

Tin and lead have all the usual properties of metals.

Germanium has these properties:

- grey-white shiny solid
- melting point 937°C
- semi-conductor
- reacts with chlorine to form the chloride ($GeCl_4$) which is a liquid molecular compound
- germanium oxide reacts with acids to form a salt solution and water. It also reacts with alkalis.

(a) With reference to their structure, explain why tin and lead are good conductors of electricity.

_____

_____

_____

_____

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_____

_____

(3)

(b) Would you classify germanium as a metal or as a non-metal? Give your reasons.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

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