



Exampro GCSE Chemistry

GCSE Metals Questions

Name:

Class:

Author: **Mr Morton**

Date:

Time: **459**

Marks: **459**

Comments:

Q1. Cassiterite is an ore of the metal tin.

(a) What is an ore?

.....
.....

(2)

(b) Some metals are obtained by removing oxygen from the metal oxide.

What name do we give to this chemical reaction?

.....

(1)

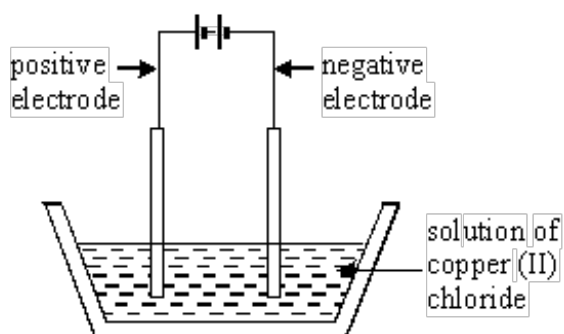
(c) Name **one** metal which must be extracted from its melted ore by electrolysis rather than by using carbon.

.....

(1)

(Total 4 marks)

Q2. Copper metal can be extracted from a solution of copper(II) chloride.



Copper chloride is an ionic compound.

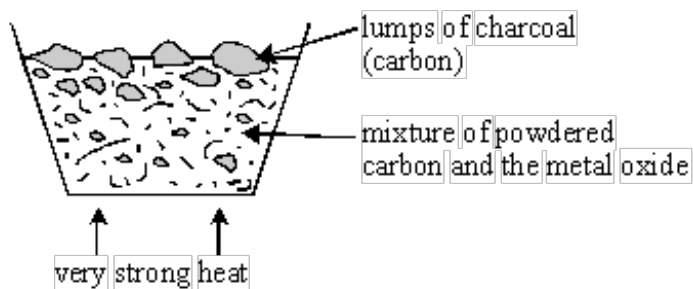
State where the copper would collect and explain your answer fully.

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.....
.....

(Total 2 marks)

Q3. A student was trying to extract the metals from lead oxide and aluminium oxide.

She heated each oxide with carbon in a fume cupboard as shown below.



She was able to extract lead from lead oxide but not aluminium from aluminium oxide.

(i) Explain the results of these experiments.

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.....
.....
.....
.....

(ii) Complete this word equation for the reaction between lead oxide and carbon.



(Total 5 marks)

Q4. (a) Sulphur is a yellow element. It is a non-metal.

(i) Complete the sentence.

In an element, all the atoms

.....

(1)

(ii) Give **two** properties you would expect sulphur to have because it is a non-metal.

1.

.....

2.

.....

(2)

(b) Use the names of metals from the box to complete the table.

copper iron magnesium manganese zinc

Use	Name of metal
for electric wiring in a house
for manhole covers
to galvanise iron

(3)

(c) Copper is used to make hot water pipes. Both iron and steel are cheaper.

Suggest **two** reasons why copper is used rather than iron or steel.

1.
.....
2.
.....

(2)

(d) The drawing shows a container of a compound called sodium chloride.



(i) Which other element has combined with sodium to form this compound?

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(1)

- (ii) For every atom of sodium, how many atoms of the other element have combined with it?

.....

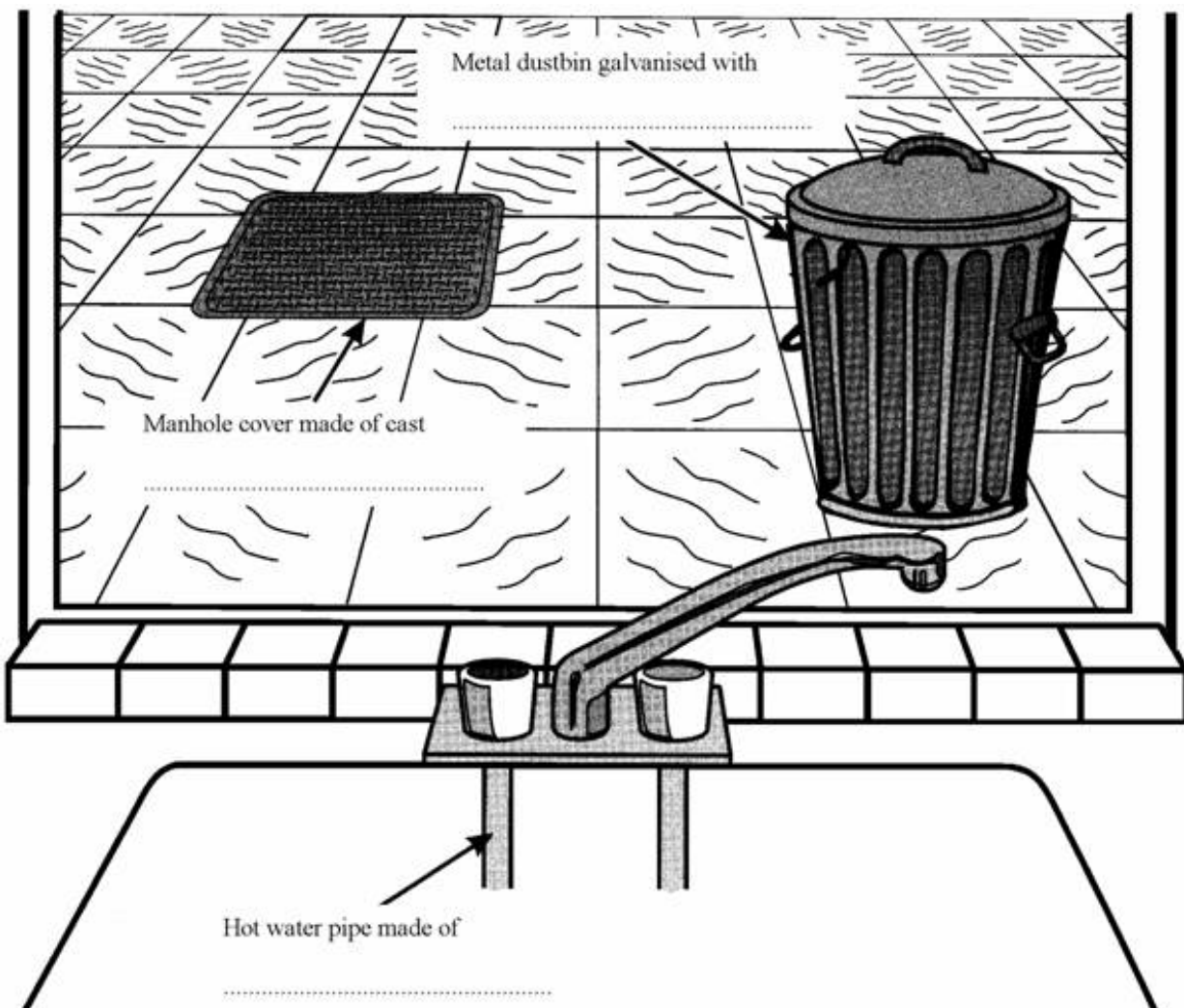
(1)
(Total 10 marks)

##

The word box contains the names of some metals.

aluminium	copper	iron	manganese	zinc
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- (i) The drawing shows the view from a window. Choose from the names of metals in the box to complete the **three** spaces.



(3)

- (ii) What is the name of the metal in the word box which has the chemical symbol Fe?

.....

(1)

(iii) What is the name of **one** metal in the word box which often has coloured compounds?

.....

(1)

(Total 5 marks)

Q6. Use the Reactivity Series of Metals on the Data Sheet to help you to answer this question.

The table gives information about the extraction of some metals.

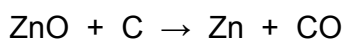
Metal	Date of discovery	Main source	Main extraction method
Gold	Known to ancient civilisations	In the Earth as the metal itself	Physically separating it from the rocks it is mixed with
Zinc	1500	Zinc carbonate	Reduction by carbon
Sodium	1807	Sodium chloride	Electrolysis

(a) Explain why gold is found mainly as the metal itself in the Earth.

.....
.....

(1)

(b) One of the reactions involved in producing zinc is represented by this equation.



Explain why carbon can be used to extract zinc.

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.....

(1)

(c) Sodium is one of the most abundant metals on Earth.

Explain, as fully as you can, why sodium was not extracted until 1807.

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(2)
(Total 4 marks)

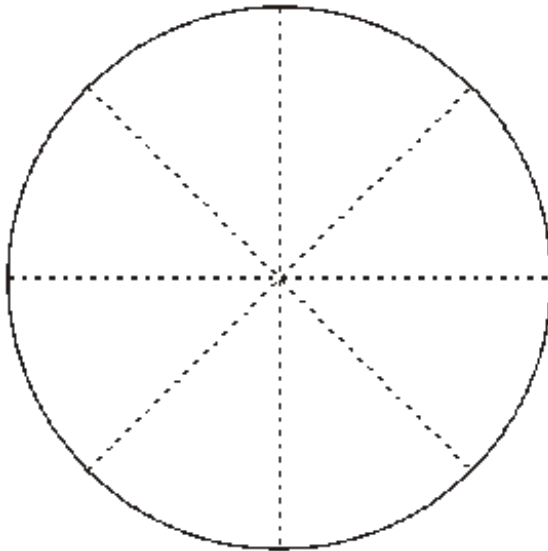
Q7. The table shows the % composition by mass of modern British coins.

COIN	% COMPOSITION BY MASS			
	copper	nickel	tin	zinc
£1	70	5.5	–	24.5
20p	84	16	–	–
5p, 10p, & 50p				
1p & 2p (until 1991)	97	–	0.5	2.5
1p & 2p (1992 onwards)	Copper plated steel			

(a) Use the Data Sheet to help you to complete the table by filling in the information about 5p, 10p and 50p coins which are made of cupronickel.

(1)

(b) Shade the pie chart to represent the % of copper in a £1 coin.



(1)

(c) Name the metal present in:

(i) all these coins,

.....

(1)

(ii) a £1 coin but **not** in a 20p coin.

.....

(1)

(d) The following is a list of properties.

- bends easily
- good conductor of electricity
- hard
- high melting point
- poor conductor of heat
- unreactive

From this list, choose two properties which coinage metals should have. For each property, give a reason for your answer.

Property 1

Reason

Property 2

Reason

(2)
(Total 6 marks)

Q8. (a) The list below gives six substances.

- aluminium
- beer
- copper
- milk
- 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.

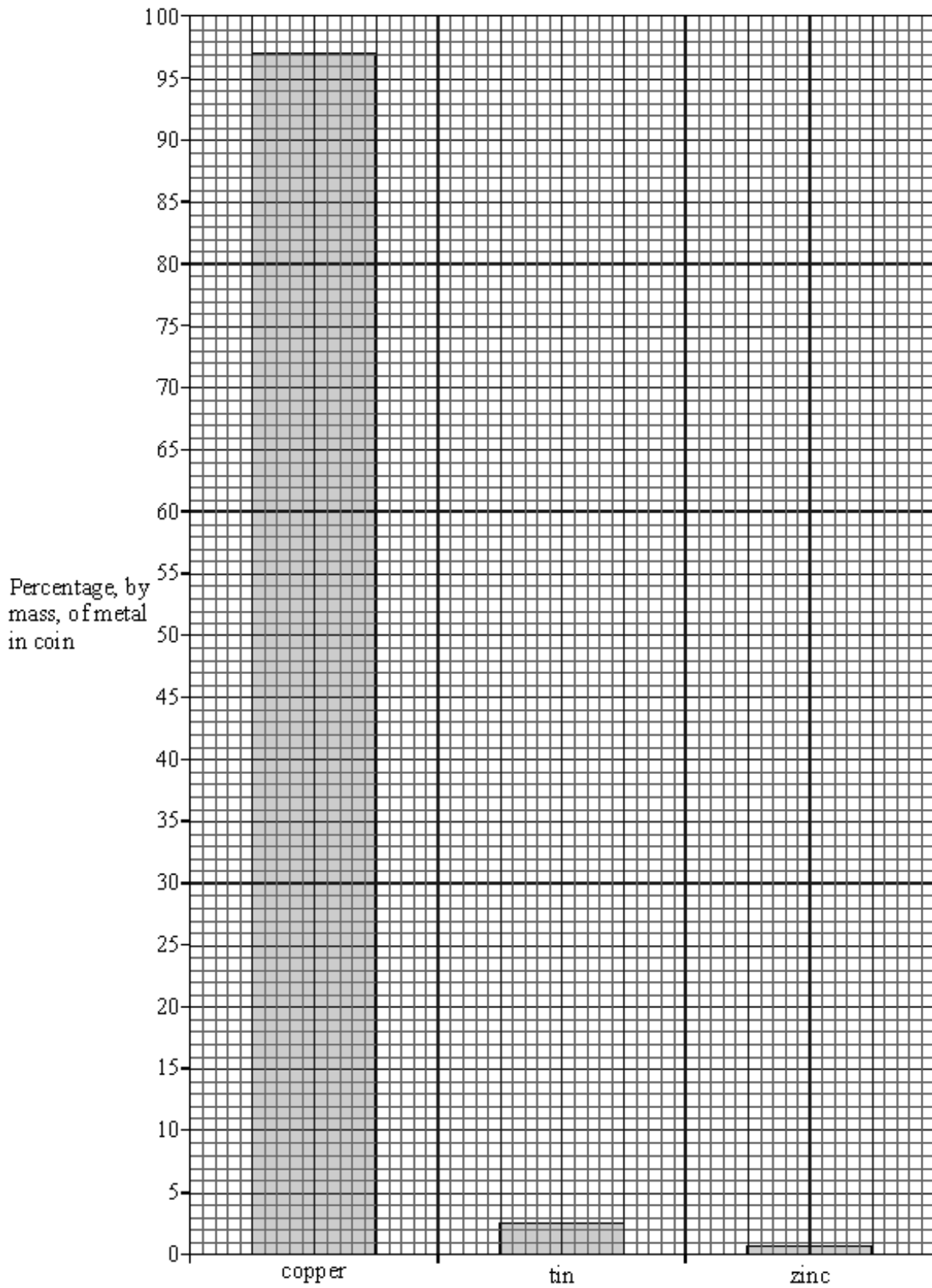
- brittle
- can be hammered into shape
- dull
- good conductors of electricity
- poor conductors of electricity
- shiny

Put each property into the correct column.

PROPERTIES OF METALS	PROPERTIES OF NON-METALS

(3)
(Total 6 marks)

Q9. The chart below shows the metals which are present in a coin.



(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.

.....
.....

(2)

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

.....
.....
.....
.....
.....

(3)

(Total 6 marks)

Q10. One step in the manufacture of lead is the reduction of lead oxide with carbon. Lead and carbon dioxide are the products of this reaction.

- (a) Write a word equation for this reaction.

.....

(1)

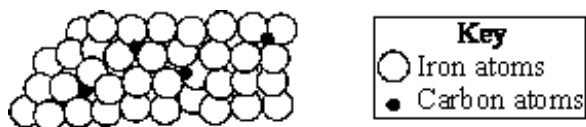
- (b) What is meant by “reduction”?

.....

(1)

(Total 2 marks)

Q11. The diagram shows the arrangement of atoms in an *alloy*.



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

.....
.....

(2)

(b) Name the alloy represented in the diagram.

.....

(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?

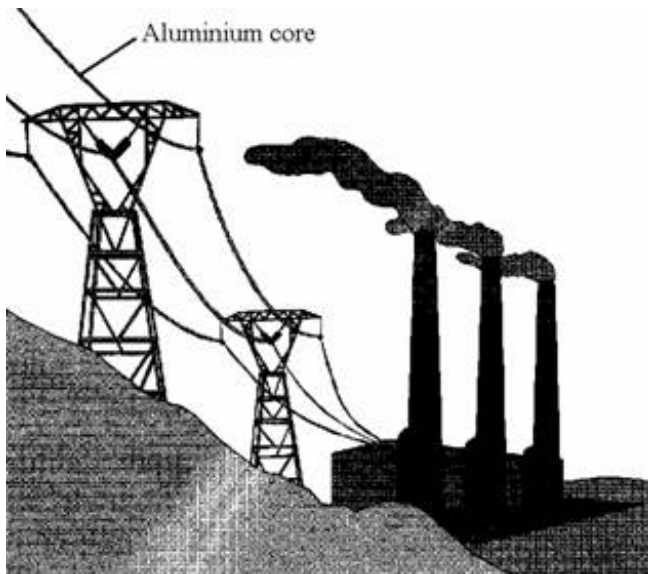
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(1)

(Total 5 marks)

Q12.

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



.....
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(2)

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



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.

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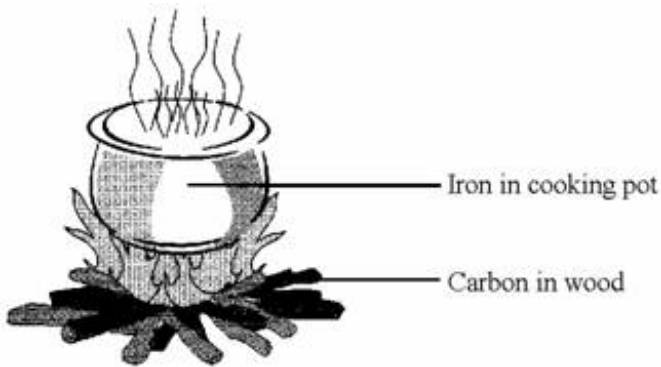
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(5)
(Total 7 marks)

Q13. The uses of *elements* depend on their properties.



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

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.....

(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.

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)

Q14. Transition elements and their compounds have many uses.

Iron oxide and cobalt oxide have been added to the glazes on pottery for hundreds of years.



(a) State why transition metal oxides are added to pottery glazes.

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(1)

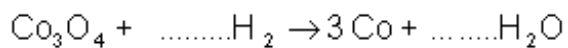
(b) Use the table of ions on the Data Sheet to help you work out the formula of iron(III) oxide.

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(1)

(c) Cobalt oxide is reacted with hydrogen to form cobalt.

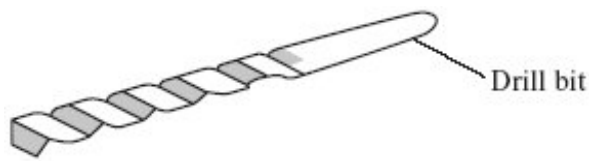
(i) Balance the equation for this reaction.



(1)

(ii) Cobalt is mixed with other transition metals to make alloys.

These alloys are used to make cutting tools which remain sharp at very high temperatures. They can cut through other metals.



Suggest **two** properties of transition metals that make them suitable for making cutting tools.

1

.....

2

.....

(2)
(Total 5 marks)

Q15. 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*.

.....

(1)

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

.....

(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)

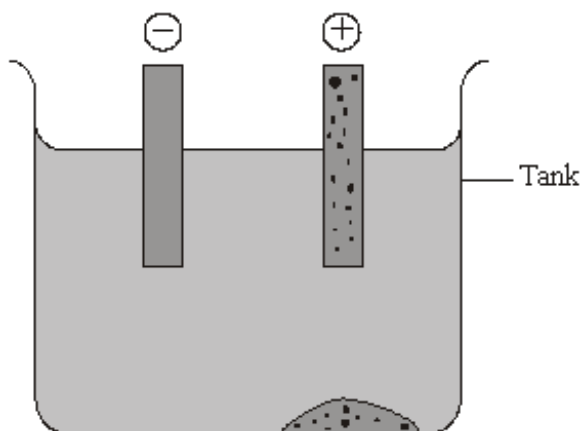
(ii) Suggest why aluminium is more expensive than iron.

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(1)

(Total 6 marks)

Q16. The diagram shows a method used to purify copper.



Choose words or phrases from the box to complete the sentences below.

bottom of the tank	cracking	displacement	electrolysis
negative electrode	positive electrode	surface of the solution	

This method of purifying copper is called

The impure copper is made the and the pure copper collects at the

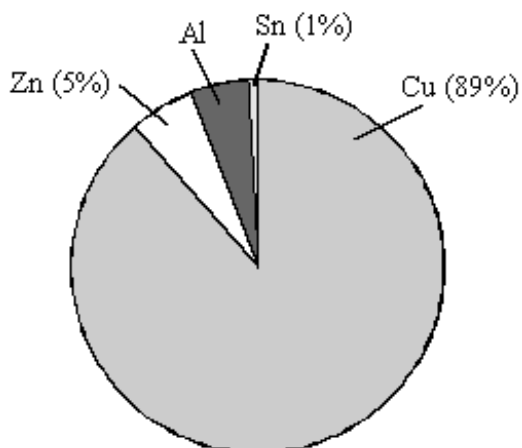
The impurities collect at the

(Total 4 marks)

Q17. 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.

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(1)

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

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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)

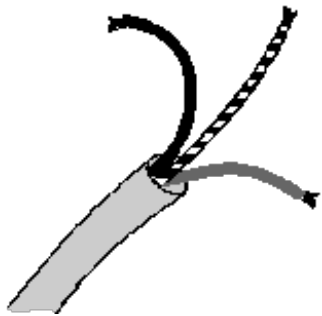
- (ii) Explain how oxygen can be removed from zinc oxide to make zinc. Use the reactivity series on the Data Sheet to help you.

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(2)
(Total 6 marks)

Q18. The properties of transition metals make them useful elements.

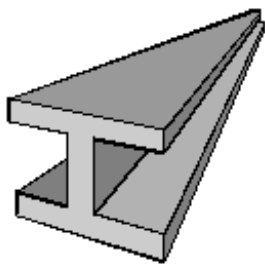
- (a) Why is copper used for electrical wiring?



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(1)

(b) Why is iron used for girders in buildings?



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(1)

(c) Why are transition metal compounds added to glazes for pottery?



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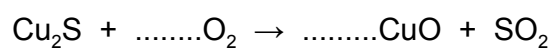
(1)

(Total 3 marks)

Q19. 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.

(a) In the first stage of extraction the copper sulfide is heated in air.

(i) Balance the symbol equation for the reaction.



(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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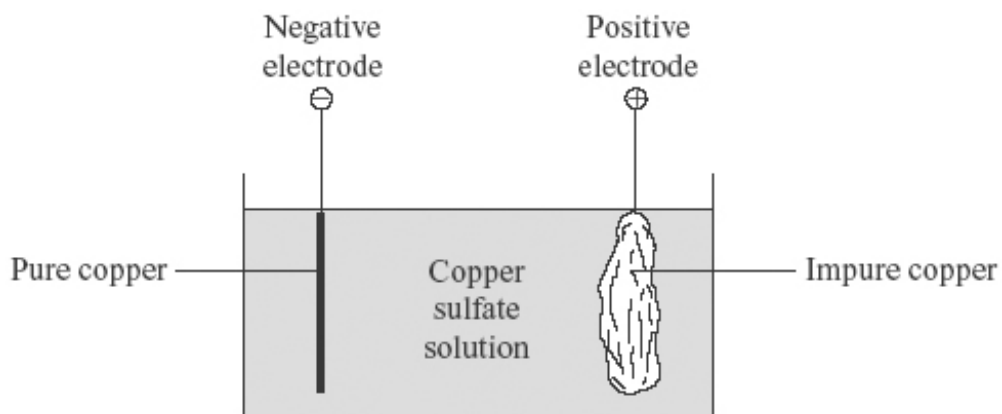
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(2)

- (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?

.....

(1)

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

.....

(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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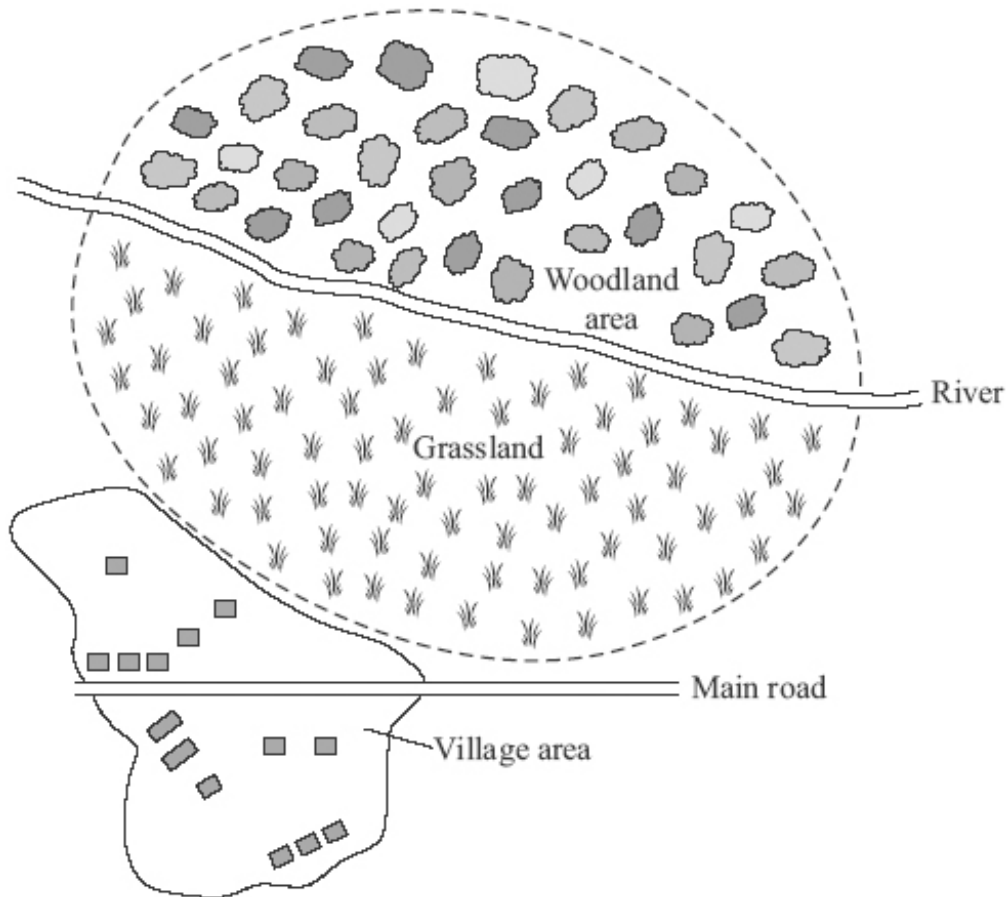
(3)
(Total 10 marks)

Q20. 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.

.....

.....

(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

.....

(2)

- (b) Iron ore contains the compound iron oxide, Fe_2O_3 .

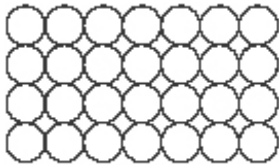
- (i) Iron is extracted from its oxide in the blast furnace.

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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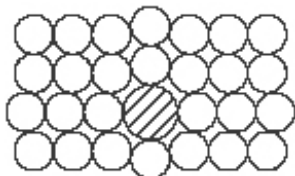
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(2)

- (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.

.....

(2)
 (Total 8 marks)

Q21. Many everyday items are made from iron.

- (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?

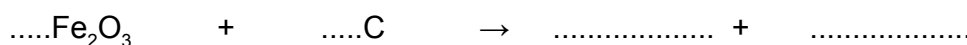
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(1)

- (iii) The word equation for this reaction is:

iron oxide + carbon \rightarrow iron + carbon dioxide

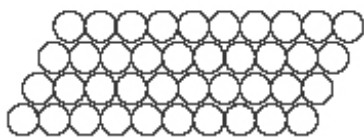
Complete and balance the symbol equation for this reaction.



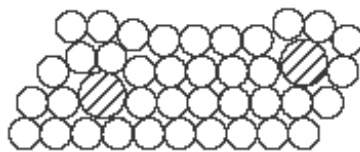
(2)

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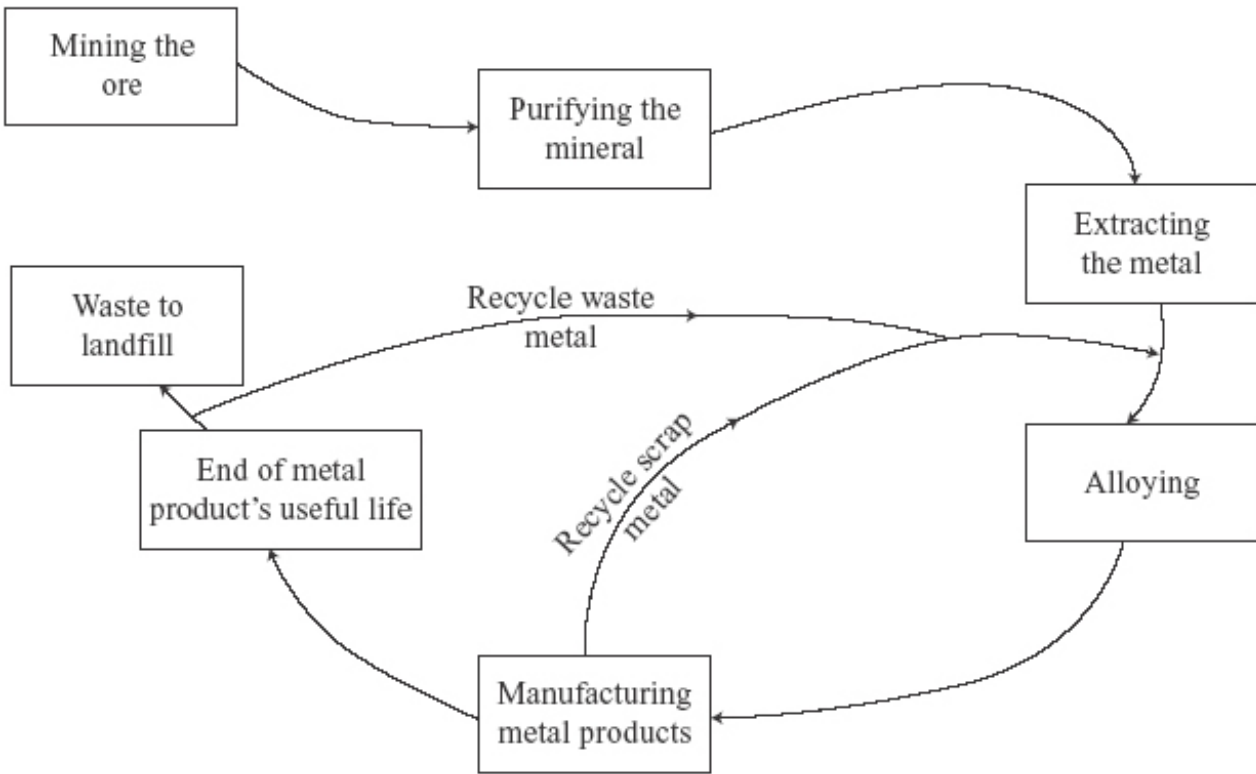
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(c) The diagram shows the way in which iron is extracted, used and recycled.



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

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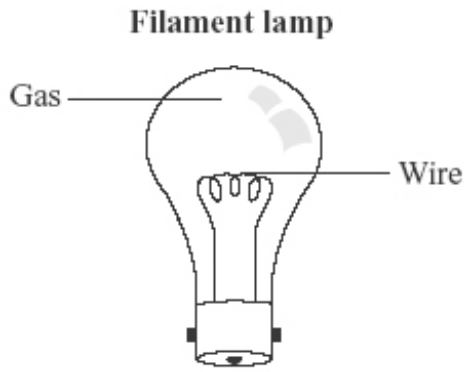
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(3)
(Total 10 marks)

Q22. When electricity passes through a thin wire, the wire gets hot. If the wire gets very hot, it may glow. This idea is used in filament lamps.



(a) The table shows some metals and their melting points.

Metal	Melting point in °C
Aluminium	660
Copper	1084
Iron	1540
Tungsten	3410

Which metal in the table should be used to make the wire in a filament lamp?

Give a reason for your answer.

.....

.....

.....

.....

(2)

(b) The table shows some gases.

Gas
Argon
Carbon dioxide
Oxygen
Sulfur dioxide

Which gas in the table should be used in a filament lamp?

Give a reason for your answer.

.....

.....

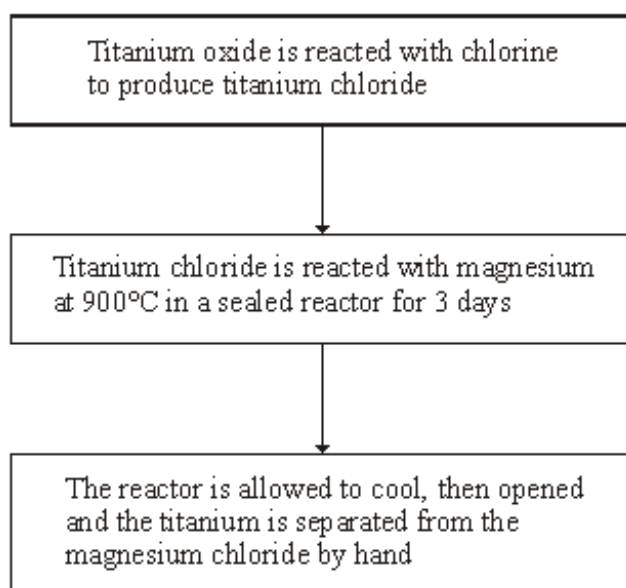
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(2)
(Total 4 marks)

Q23. 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.

.....

(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)

Q24. Metals and their alloys have many uses.

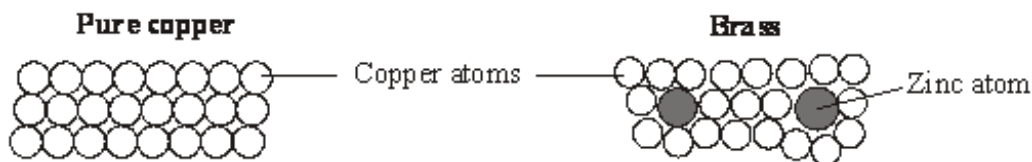
- (a) Dentists use a smart alloy to make braces that gently push teeth into the right position.

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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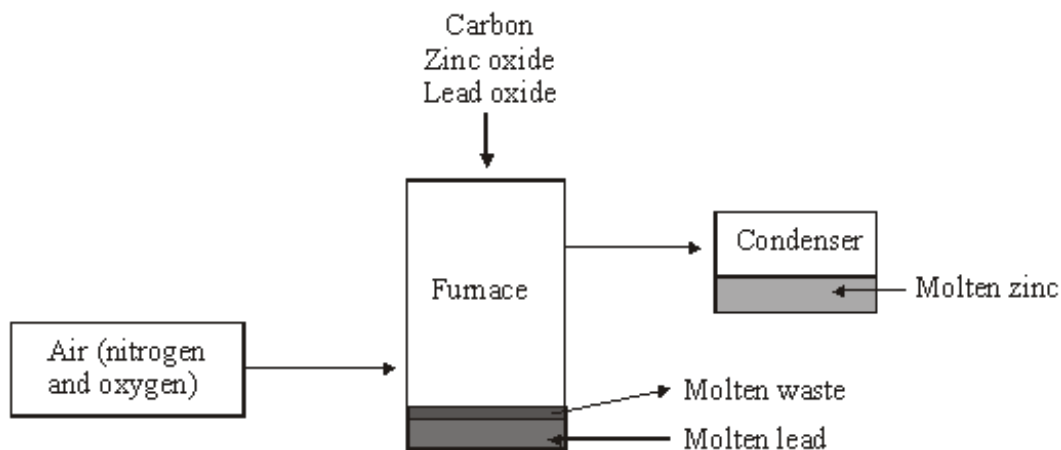
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(2)

(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 |
|------|----------|--------|

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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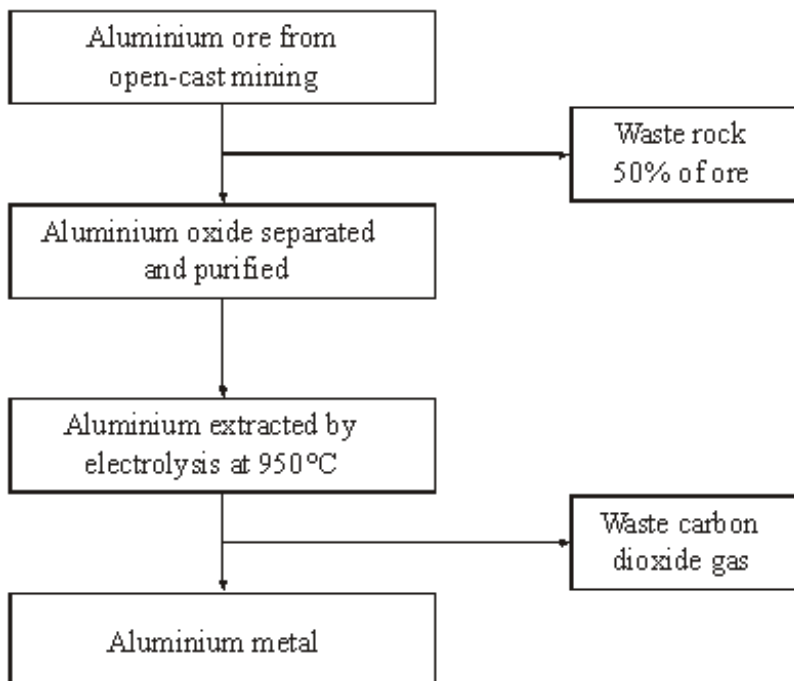
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(2)
(Total 6 marks)

Q25. 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.

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(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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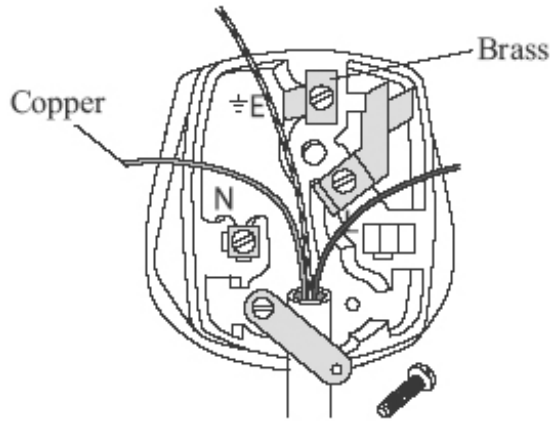
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(2)

(Total 5 marks)

Q26. 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.

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.....

(1)

(b) Brass is an *alloy*.

What is an *alloy*?

.....
.....

(1)

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



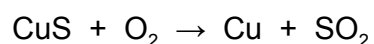
(i) Suggest **one** environmental problem that is caused by open-cast mining of copper ore.

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.....

(1)

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

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



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.

1

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2

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(2)
(Total 7 marks)

Q27. (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)

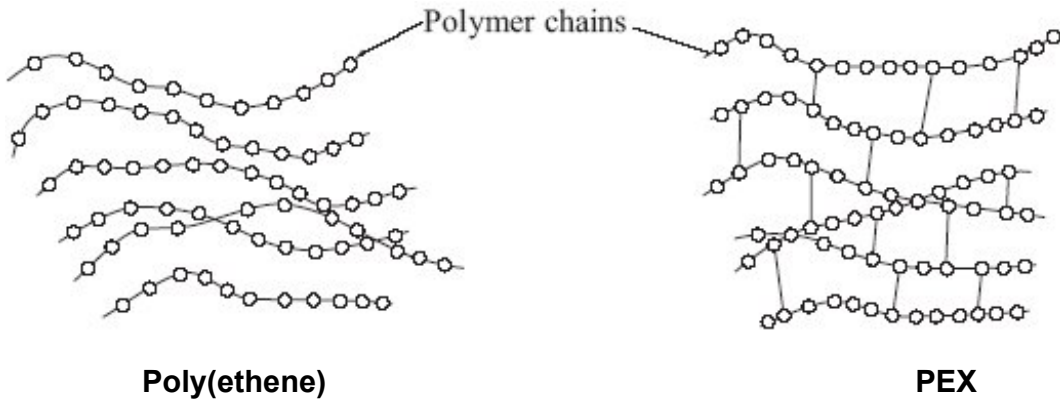
(ii) PEX is a shape memory polymer. What property does a shape memory polymer have?

.....

.....

(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.

.....

.....

.....

.....

.....

- (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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.....

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.....

.....

.....

(4)
(Total 10 marks)

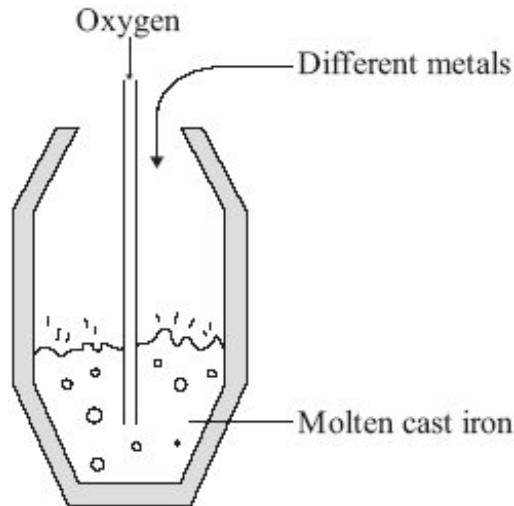
Q28. The demand for iron and steel is high.

- (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
2000	35
2002	42
2004	46
2006	57

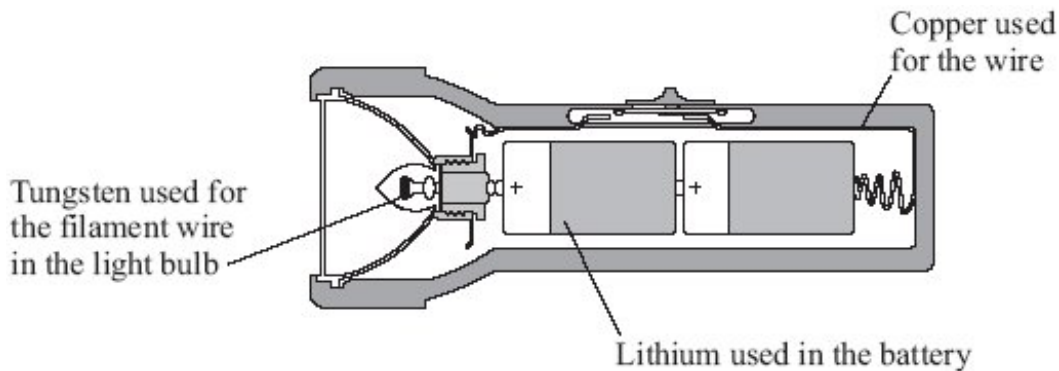
The UK government has set targets for the percentage of iron and steel to be recycled. In 2006 the target was exceeded.

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

- 1
-
- 2
-

(2)
(Total 5 marks)

Q29. The diagram shows a circuit that is used in a torch. Electrons flow through this circuit.

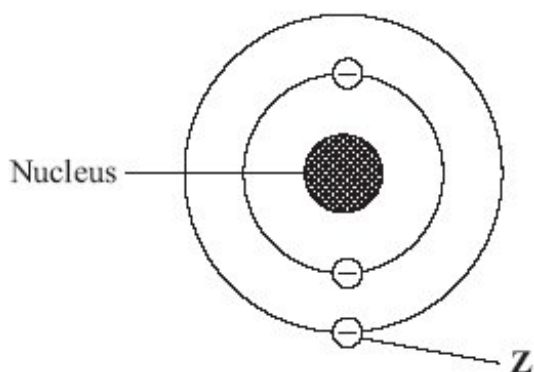


(a) Why is copper used for the wire?

-

(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 slowly to form a thin oxide layer on surface
Lithium	179	1317	Reacts rapidly to form oxide
Tungsten	3370	5930	Reacts only 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.

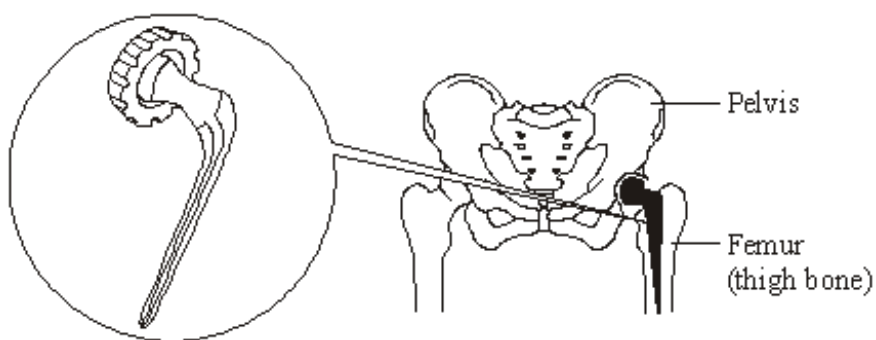
Draw a ring around the correct word in the box to complete the sentence.

Argon is used in the light bulb because it is

dense.
solid.
unreactive.

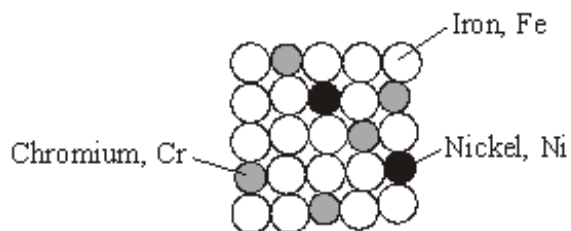
(1)
(Total 6 marks)

Q30. The hip joint between the femur and pelvis sometimes has to be replaced. Early hip replacement joints were made from stainless steel.



Stainless steel is an alloy of iron, chromium and nickel.

The diagram below represents the particles in stainless steel.



Particle diagram of stainless steel

(a) Use the particle diagram to complete the percentages of metals in this stainless steel.

The first one has been done for you.

Element	Percentage (%)
Iron, Fe	72
Chromium, Cr	
Nickel, Ni	

(2)

(b) Pure iron is a relatively soft, metallic element.

(i) Why is iron described as an *element*?

.....
.....

(1)

(ii) Suggest why pure iron would **not** be suitable for a hip replacement joint.

.....
.....

(1)

(iii) Use the particle diagram to help you to explain why stainless steel is harder than pure iron.

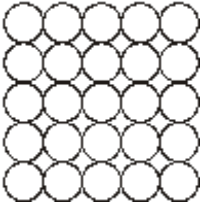
.....
.....
.....
.....

(2)

(Total 6 marks)

Q31. 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

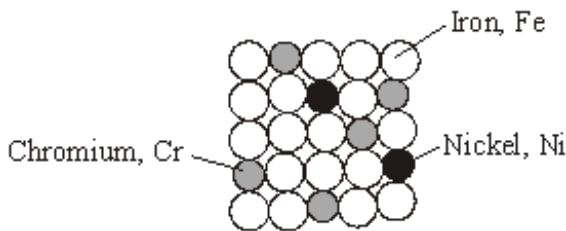
atoms
compounds
metals

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)

Q32. Copper is a widely used material.

One method of obtaining copper involves roasting copper(I) sulfide in air.



- (a) (i) Sulfur dioxide released into the air can cause acid rain.

State **one** problem caused by acid rain.

.....

.....

(1)

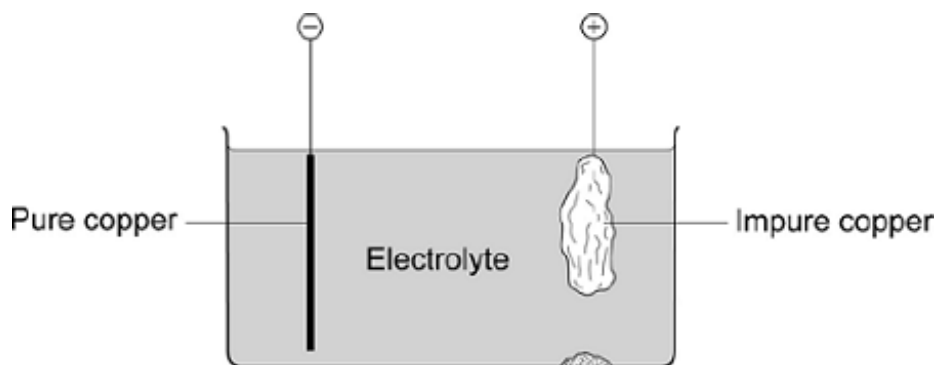
- (ii) The sulfur dioxide produced is soluble in water.

Write a chemical equation for the reaction of sulfur dioxide with water.

.....

(1)

- (b) The copper produced by roasting copper(I) sulfide is impure. It can be purified using the apparatus shown in the diagram.



- (i) Describe how copper is purified using the apparatus shown.

.....

.....

.....

.....

.....

.....

.....

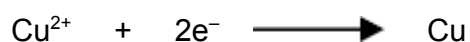
.....

.....

.....

(5)

- (ii) The ionic half equation for the reaction at the negative electrode is:

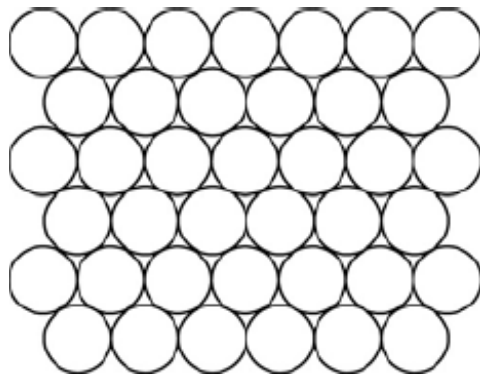


Write the ionic half equation for the reaction at the positive electrode.

.....

(2)

(c) The diagram shows the structure of a metal such as copper.



Use the diagram to help you explain why:

(i) copper is malleable

.....
.....
.....
.....

(2)

(ii) copper is an element.

.....
.....

(1)

(d) Copper is often alloyed with other metals, such as tin. Alloys of copper are harder than pure copper.

Explain why alloys of copper are harder than pure copper.

You may draw a diagram to help explain your answer.

.....
.....
.....
.....

(2)
(Total 14 marks)

Q33. Copper is found in the Earth's crust as an ore containing copper sulfide. Large areas of land, where this ore was once quarried, are contaminated with low percentages of copper sulfide. Copper would be too expensive to extract from this contaminated land using the traditional method of quarrying and then heating in a furnace.

(a) The percentage of copper ore in the contaminated land is low.

(i) It would be too expensive to extract from this land by the traditional method.

Explain why.

.....
.....

(1)

(ii) Extracting copper from this land by the traditional method would have a major environmental impact.

Give **one** reason why.

.....
.....

(1)

- (b) One way to extract the copper from land that contains low percentages of copper sulfide is by bioleaching. Bioleaching uses bacteria. The bacteria produce a solution of copper sulfate.

It is possible to get copper from a solution of copper sulfate using scrap iron.

- (i) It is economical to use scrap iron to get copper.

Give **one** reason why.

.....
.....

(1)

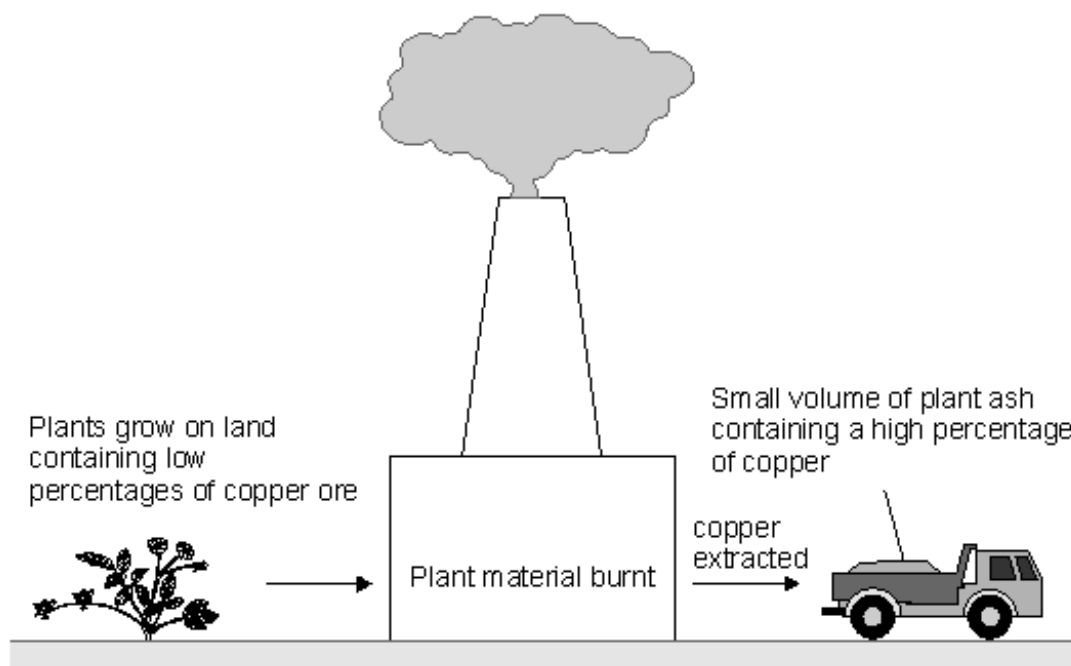
- (ii) Why can iron be used to get copper from copper sulfate solution?

.....
.....

(1)

- (c) A new way to extract the copper from land that contains low percentages of copper sulfide is phytomining.

Phytomining uses plants. Plants are grown on this land and absorb copper compounds through their roots.



- (i) Use this information to give **two** advantages of phytomining compared to the traditional method.

.....

.....

.....

.....

(2)

- (ii) Use this information to suggest **one** disadvantage of phytomining compared to the traditional method.

.....

.....

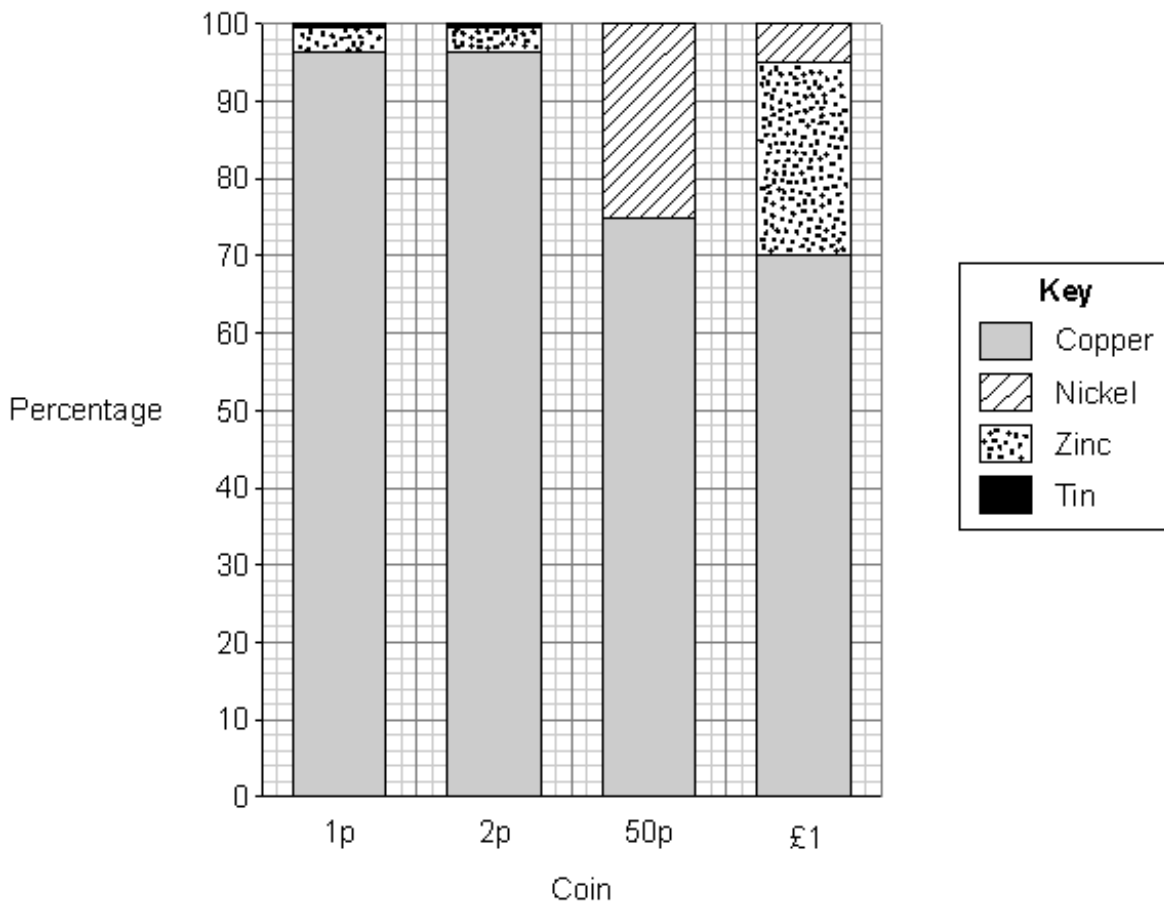
(1)

(Total 7 marks)

Q34. This is a headline from a newspaper.

‘Why is a 2p coin made in 1991 now worth 3.3p?’

- (a) The bar chart shows the percentages of metals in UK coins in 1991.



Use the bar chart to answer these questions.

(i) Which metal is in all of these coins? (1)

(ii) Which coin does **not** contain zinc? (1)

(iii) What is the percentage of nickel in a 50p coin? % (1)

(b) Suggest **two** reasons why a 2p coin made in 1991 is now worth 3.3p.

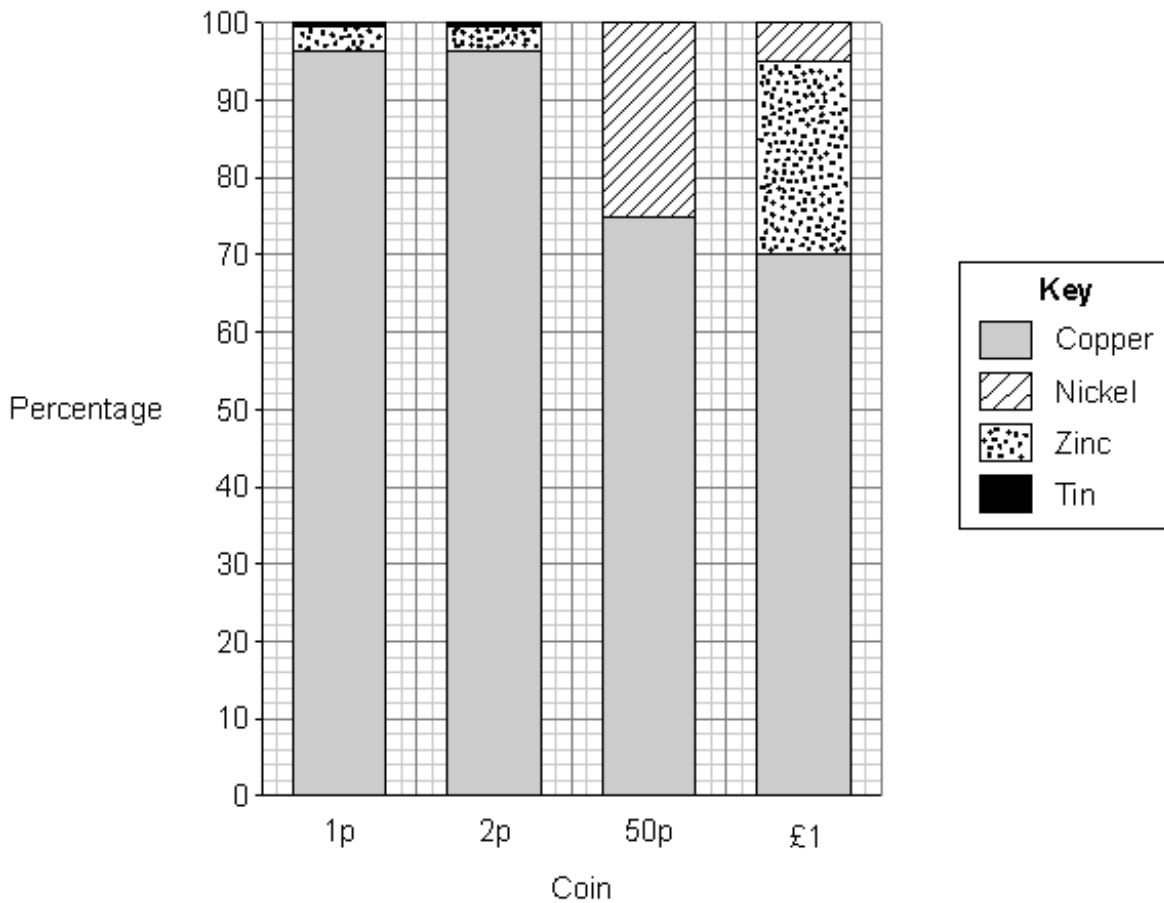
.....
.....
.....
.....

(2)
(Total 5 marks)

Q35. This is a headline from a newspaper.

‘Why is a 2p coin made in 1991 now worth 3.3p?’

(a) The bar chart shows the percentages of metals in UK coins in 1991.



Use the bar chart to answer these questions.

- (i) Which metal is in all of these coins? (1)
- (ii) Which coin does **not** contain zinc? (1)
- (iii) What is the percentage of nickel in a 50p coin? % (1)

(b) Suggest **two** reasons why a 2p coin made in 1991 is now worth 3.3p.

.....
.....
.....
.....

(2)
(Total 5 marks)

M1. (a) *ideas that it is a*

- compound of metal/metal oxide/combined (NOT mixed) cpd/
named cpd $O^{2-}/S^{2-}/CO_3^{2-}$ etc
- found naturally/in rocks/in Earth's Crust
for 1 mark each

2

(b) reduction (accept smelting/refining but not electrolysis)
for 1 mark

1

(c) One example. Al or above in Reactivity Series
ie Group I or II metals NOT Pb/Cu or compounds
for 1 mark

1

[4]

M2. copper collects at the negative electrode
copper positive ions
each for 1 mark

[2]

- M3.** (i) idea that:
- carbon is above lead in the reactivity series } NOT
for 1 mark
- carbon is below aluminium in the reactivity series } OXIDE
for 1 mark
- carbon can remove oxygen from/reduce lead oxide
 or cannot remove oxygen from aluminium oxide
 not aluminium more reactive than lead
for 1 mark
- OR similar ideas in comparing bond strengths 3
- (ii) (carbon + lead oxide) → *lead + *carbon dioxide
each for 1 mark
- accept correct formulae CO₂ and CO **NOT** carbon oxide 2

[5]

- M4.** (a) (i) are identical / the same
*or have the same number of protons /
 the same proton number / electrons
 not similar* 1
- (ii) any **two** of
- low melting point
 low boiling point
 brittle (solid)
do not credit just solid
- poor conductor of heat
or heat insulator
- poor conductor of electricity
*or electrical insulator
 accept just poor / low conductor or just insulator once only*

dull surface

or not shiny

cannot be hammered / bent (into shape)

or not malleable

cannot be stretched (into shape)

or not ductile

does not make a clanging
sound (when struck)

or not sonorous

acidic oxides

low density

2

(b) copper

1

iron

correct symbols

1

zinc

1

(c) can be bent (easily)

or malleable

or can be joined easily

do not credit just can be joined

not reactive

or does not corrode

or does not react (with hot water)

accept does not rust

2

(d) (i) chlorine

do not credit chloride

1

(ii) one / 1

same number / amount

1

[10]

M5.	(i) zinc	<i>accept Zn</i>	1	
	iron only	<i>accept Fe</i>	1	
	copper	<i>accept Cu</i> <i>do not credit iron</i>	1	
	(ii) iron		1	
	(iii) copper or iron or manganese	<i>accept Cu or Fe or Mn</i>	1	

[5]

M6.	(a) unreactive / near bottom of reactivity series		1	
	(b) carbon more reactive / higher up reactivity series		1	
	(c) very reactive / near top of reactivity series		1	
	cannot use displacement methods / can only be extracted by electrolysis / had to wait discovery of electricity		1	

[4]

##

(a)	75% Cu, 25% Ni	<i>for 1 mark</i>	1	
(b)	70% segment shaded	<i>for 1 mark</i>	1	

- (c) (i) copper
for 1 mark 1
- (ii) zinc
for 1 mark 1
- (d) 1. hard so will not wear away/scratch
for 1 mark 1
2. unreactive
so does not corrode/dissolve/or other
acceptable reason
(not does not react unless acceptable reason)
- (If given hard and unreactive allow 1 mark)
for 1 mark 1

[6]

##

- (a) elements: aluminium, copper,
compounds: pure water, sodium chloride,
mixture: beer, milk
2/3 correct gains 1 mark
4/5 correct gains 2 marks
all correct gains 3 marks 3
- (b) metals: can be hammered into shape,
good conductor of electricity, shiny
non metals: brittle, dull, poor conductors of electricity
2/3 correct gains 1 mark
4/5 correct gains 2 marks
all correct gains 3 marks 3

[6]

- M9.** (a) coinage bronze 1
- (b) $(97/100) \times 2.5 = 2.425$
each line for 1 mark 2

(c)	3 points from the following: hard wearing, resistant to corrosion, low in reactivity low density abundant metal/low cost shiny/appearance not brittle (Other properties of metals treated as neutral)	3	[6]
M10.	(a) lead oxide + carbon = lead + carbon dioxide (A symbol equation was accepted if correct)	1	
	(b) oxygen removed (or addition of electrons)	1	[2]
M11.	(a) mixture <i>not compound</i>	1	
	of a metal with other element(s) / metals <i>not of elements</i> <i>not of a metal with other substances</i>	1	
	(b) steel <i>allow stainless steel</i>	1	
	(c) stronger / increased strength / harder / less malleable / less brittle <i>not corrosion / rusting</i>	1	
	(d) copper and zinc	1	[5]

- M12.** (a) any **two** points **one** mark each
accept comparison between aluminium and iron

aluminium has:

- a low density
accept lighter or fewer pylons
- a good conductor of electricity
- does not corrode **or** rust
*do **not** accept does not react with air*
*do **not** accept last longer*

2

OR

- iron has:
- high density
- is a less good conductor (of electricity)
- rusts or reacts with air

- (b) any **5** from:

- employment of people **or** cost of employment
- depletion or use of resources
*do **not** accept depletion here*
- cost of energy resources
- cost of machines **or** buildings
- pollution by noise from traffic **or** quarrying

- air pollution by dust **or** traffic fumes
- danger of traffic on roads
- damage to landscape (eyesore)
- damage to habitats of wildlife
- lowers the value of houses nearby
- subsidence **or** vibration can affect roads **or** houses
- providing raw materials
*do **not** accept danger **or** falling in*

5

[7]

M13. (a) made of atoms which contain the same number of protons
accept made of only one type of atom
accept cannot be broken down into anything simpler by chemical means

1

(b) non-metals

1

metals

1

(c) sodium

1

too reactive (with water **or** air)

*accept has a low melting point **or***
*will melt **or** not strong **or** will explode **or** will burn*
*do **not** accept dangerous (neutral)*
*do **not** accept iron as rusting **or***
*copper **or** sodium as expensive (neutral)*
*do **not** accept not a good conductor of heat*

1

[5]

M14. (a) colour

1

(b) Fe_2O_3 or $(\text{Fe}^{3+})_2 (\text{O}^{2-})_3$

2 and 3 should be below halfway on Fe and O

1

(c) (i) 4 4
or correct multiples 1

(ii) any **two** from:
ignore references to malleable / ductile / conductivity / stiff / boiling point / density

- high melting point
accept can withstand high temperatures
- strong / tough
accept not brittle
- hard
*do **not** accept flexible*
- not (very) reactive

2

[5]

M15. (a) (very) small percentage / amount (in the Earth's crust)
any indication that there is a small amount, eg not much (left)
accept rare (elements) / rarer
accept not commonly found
ignore cannot find easily
ignore hard to extract 1

(b) (i) oxygen / O₂ / O
*do **not** accept O²* 1

(ii) any **one** from:

- potassium / K
- sodium / Na
- calcium / Ca
- magnesium / Mg

symbols must be correct
write name and incorrect symbol,
ignore symbol 1

(c) (i) heating (with) **or** hot air blown into furnace
accept high temperatures or (very) hot 1

carbon / carbon monoxide / coke / coking coal
*do **not** accept coal / charcoal accept balanced equation only*

or
carbon reacts with O₂ **or** carbon / coke burning (1)
accept balanced equation only CO / CO₂

CO reacts with the ore (1)
for naming the reducing agent 1

(ii) cost of melting ore / electricity
makes aluminium expensive (owtte)
or (large amount of) electricity used
or because you have to use electrolysis
or aluminium is higher in the reactivity series
or aluminium is harder to reduce
or unable to reduce with carbon
or the cost of purifying the bauxite
*do **not** accept harder to extract / produce
more energy is **not** enough* 1

[6]

M16. electrolysis 1

positive electrode 1
accept anode 1

negative electrode
accept cathode

bottom of the tank 1

[4]

M17.	(a) (i) 5(%)	1	
	(ii) 0.35		
	$\frac{5}{10} \times 7$		
	<i>for 1 mark</i>	2	
	(b) (i) reduction		
	<i>accept (it's) reduced</i>		
	<i>do not accept redox / deoxidation</i>	1	
	(ii) heat with / reduce / react with or (chemical) reaction	1	
	with a metal / element / substance higher in reactivity		
	<i>ignore displace</i>		
	<i>accept higher <u>named</u> elements or symbol</i>		
	<i>accept carbon monoxide / coal / coke</i>		
	<i>correct word equation for 2 marks</i>		
	<i>correct formulas for 1 mark</i>		
	<i>correct <u>balanced</u> symbol equation for 2 marks</i>	1	
	or		
	electrolysis:		
	molten	(1)	
	electrolysis	(1)	[6]
M18.	(a) (good)conductor of electricity		
	<i>conductor of electricity and heat (+/-) = 0</i>		
	<i>accept can be drawn into wires or ductile</i>		
	<i>ignore flexible</i>	1	
	(b) strong		
	<i>accept tough or hard or high tensile strength</i>	1	
	(c) reference to <u>colour</u>	1	[3]

- M19.** (a) (i) $\text{Cu}_2\text{S} + 2\text{O}_2 \rightarrow 2\text{CuO} + \text{SO}_2$
accept fractions and multiple 1
- (ii) any **two** from:
- sulfur dioxide
accept sulphur dioxide / sulphur oxide / SO₂
 - causes acid rain
ignore other comments eg global warming / ozone / global dimming / greenhouse effect
 - consequence of acid rain eg kills fish / plants 2
- (b) any **two** from:
- heat (copper oxide with carbon)
 - oxygen is removed by carbon
accept copper (oxide) loses oxygen
- or**
- carbon gains oxygen*
accept carbon oxide
- or**
- carbon monoxide / carbon dioxide is produced
- or**
- carbon displaces copper
accept a correct word or balanced symbol equation
- because carbon is more reactive than copper
allow a correct comparison of reactivity 2
- (c) (i) electrolysis
accept electroplating 1
- (ii) (electrical) wiring / appliances / coins / pipes / cladding for buildings / jewellery / making alloys 1
- or**
- named alloys

(d) any **three** explanations from:

for recycling

- less acid rain (pollution)
- copper reserves last longer / conserved

or

do not run out

- energy for extraction (saved)

or

less energy required

- less mining / quarrying
- less waste (copper) / electrical appliances dumped

or

less landfill

against recycling

- collection problems
- transport problems
- difficult to separate copper from appliances
- energy used to melt the collected copper

ignore electrolysis / pollution

ignore ideas about less machinery / plant

ignore idea of cost

3

[10]

M20. (a) (i) any **one** from:

- iron ore is a limited resource / non-renewable
- iron is in high demand
- provide jobs
- economic advantage

1

(ii) any **two** from:

- would damage (wildlife) habitats / countryside / greenfield sites
- extra traffic
- visual (pollution) / eyesore
- noise (pollution) / sound (pollution)
- dust (pollution)
- river (pollution)
- carbon dioxide (from traffic) / adds to greenhouse effect / global warming
- damage roads / buildings by vibrations / shockwaves

2

(b) (i) carbon monoxide / carbon
accept formulae CO / C

1

(ii) atoms
accept (particles) are all the same (size) / type for one mark

1

are all the same (size) / type

1

(iii) any **two** from:

- impurities / carbon / different (sized) atoms **or** elements **or** metals
- changes the structure / disrupts the pattern or layers
- prevents layers sliding over each other
- it is an alloy

2

[8]

- M21.** (a) (i) contain enough metal to make it economical / worth while to extract 1
- (ii) reduction
accept displacement
accept redox 1
- (iii) $\text{Fe} + \text{CO}_2$
do not accept $\text{Fe}_2 / \text{Fe}_4$ 1
- correct balancing
accept multiples and halves
- $2\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 4\text{Fe} + 3\text{CO}_2$
allow $\text{Fe}_2 / \text{Fe}_4$ as ecf 1
- (b) **Pure Iron**
- (in pure metal all the atoms are the same size and) able to slip / slide over each other – (property soft)
OWTTE
ignore references to molecules / particles
*if they say 'move' both times, allow **one** mark but 'crack' or 'split' is wrong..* 1
- Cast iron**
- (in cast iron) different sized atoms / larger atoms **or** structure is distorted / disrupted
OWTTE 1
- so it is difficult for layers of atoms to slip / slide over each other
OWTTE 1
- (c) any **three** from:
- conserves / saves resources / metal ores
 - saves energy resources (used for extraction / processing)
accept cheaper / saves money
 - decreases waste materials
 - decreases a named pollution
do not accept acid rain 3

- M22.** (a) tungsten 1
- has the high(est) melting point
*accept that metals other than tungsten
are likely to melt* 1
- (b) argon 1
- is an unreactive gas
*accept that gases other than argon are reactive
accept that argon is a noble gas or in Group 0* 1

[4]

- M23.** (a) any **one** from: 1
- light(er) / less dense
ignore stronger
 - resistant to acids / alkalis / chemical
accept resistant to corrosion
- (b) any **two** from: 2
- it must be clear
list principle applies
allow reverse argument
ignore reference to temperature*
- magnesium is more reactive than titanium
magnesium is above titanium in the reactivity series
 - titanium is more reactive than carbon
 - magnesium is more reactive than carbon
 - magnesium is most reactive
 - carbon is least reactive

(c) any **three** from:

it = titanium

ignore references to cost / easier / usefulness alone or references to incorrect processes

- takes a long time to process
- low abundance (of ore)
- small amount produced
- batch process used **or** blast furnace is continuous
- more stages used to manufacture titanium
allow ≥ 3 / many / several
- more energy used (per tonne of titanium)
allow high energy requirement
ignore references to temperature
- magnesium / chlorine is expensive
- labour intensive

3

[6]

M24. (a) (an alloy) that can return to its original shape (after being deformed / bent / twisted)

accept (on heating / cooling) it returns to its shape

1

(b) any **two** from:

- brass / it is a mixture
accept brass / it is not pure
- zinc changes structure / disrupts patterns or layers
- copper metal atoms / layers able to slide over each other
accept zinc prevents atoms / layers sliding over each other

2

(c) (i) oxygen / O₂ / O

1

(ii) lead remains (in furnace) because of its high boiling point

1

zinc boils / evaporates (out of furnace) because of its low boiling point 1 if neither mark awarded then allow 1 mark for different boiling points

ignore references to melting points

1

[6]

M25. (a) any **three** from:

- resources / aluminium / ores are conserved
accept converse argument
- less / no mining **or** less associated environmental problems
eg quarrying / eyesore / dust / traffic / noise / loss of land / habitat
ignore just pollution
- less / no waste (rock) / landfill
do not accept 'wastes 50% of the ore'
- no purification / separation (of aluminium oxide)
- (aluminium extraction / production) has high energy / electricity / heat / temperature requirements
- less carbon dioxide produced
accept no carbon dioxide produced
ignore references to cost

3

(b) statement
ignore density 1

linked reason

eg
(pure) Al / it is weak / soft (1)
as layers / rows can slide (over each other) (1)
or
alloy / other metals / they make it stronger / harder (1)
stops layers / rows sliding over each other (1)
accept disrupts the structure owtte if no other mark awarded
*accept to form an alloy **or** to change properties for 1 mark*

1

[5]

M26. (a) good (electrical) conductor
allow low reactivity / resistance to corrosion
*do **not** accept heat conductor* 1

(b) a mixture of metals
accept contains more than one type of metal 1

(c) (i) any **one** from:
• eyesore
• destruction of habitats
• pollution of water
• dust pollution
• noise
• traffic pollution 1

(ii) acid rain
allow sulfur dioxide is a pollutant 1

- (d) (i) running out of copper (ores) 1
- (ii) any **two** from:
- any specific example of using less copper
 - reuse / recycle
*allow do **not** throw copper / brass away*
 - use low-grade copper ores
 - use other metals / materials in place of copper
- 2

[7]

- M27.** (a) (i) many ethene / molecules / monomers
accept double bonds open / break 1
- join to form a long hydrocarbon / chain / large molecule
accept addition polymerisation
ignore references to ethane
correct equation gains 2 marks 1
- (ii) (can be deformed but) return to their original shape (when heated or cooled)
ignore 'it remembers its shape' 1
- (iii) cross links / extra bonds in PEX
accept inter-molecular bonds
ignore inter-molecular forces 1
- molecules / chains in PEX are held in position
accept rigid structure 1
- molecules / chains in PEX unable to slide past each other / move
it = PEX throughout 1

(b) any **four** from:

- less (hydrocarbon) fuels used
allow less energy
- less / no electrical energy used
allow no electrolysis
- reduce carbon / carbon dioxide emissions
allow less global warming
- reduce / no pollution by sulfur dioxide / acid rain
- continuous process
allow less / no transportation
- conserve copper which is running out or only low-grade ores available
- reduce the amount of solid waste rock that needs to be disposed
allow less waste
- reduce the need to dig large holes (to extract copper ores)
allow less mining
ignore costs / sustainability / non-renewable

4

[10]

M28.

- (a) (i) reacts with carbon / C
accept burns / oxidises carbon

1

carbon dioxide / CO₂ / gas is formed / given off
accept carbon monoxide / CO
accept correctly balanced equation for 2 marks
ignore state symbols

1

- (ii) change / improve properties
accept any specific property
accept to make alloys / special steels
ignore brittle

1

(b) any **two** from:

- to conserve ores / iron
accept ores / iron are non-renewable / non-sustainable
allow less quarrying / mining
- to prevent the use of landfills
allow reduce waste
- to conserve energy / fuel
accept fossil fuels are non-renewable
- to reduce carbon / carbon dioxide emissions
- to meet EU / International targets
ignore costs / demand

2

[5]

M29. (a) conducts (electricity) **or**
accept flexible

allows electrons / current to flow
ignore conducts heat

1

(b) electron

1

(c) (i) lithium>copper>tungsten **or**

Li>Cu>W

all correct

allow 1 mark for one metal in the correct position

2

(ii) has high / highest melting point

accept has high / highest boiling point

or

can withstand the highest temperature

1

(d) unreactive

1

[6]

M30.	(a) (Chromium =) 20	1
	in correct order	
	(Nickel =) 8	
	<i>accept Chromium = 8 and Nickel = 20 for 1 mark</i>	1
(b)	(i) (because iron is made up of only) one type of <u>atom</u>	1
	(ii) not strong	
	<i>ignore soft / corrosive / flexible</i>	
	<i>accept it rusts / corrodes or that it could wear away</i>	
	<i>accept could change shape / bend</i>	
	<i>accept layers / atoms could slide (over each other)</i>	1
	(iii) has different <u>sized</u> atoms / particles	
	or	
	structure is different/distorted / disrupted	
	<i>accept not in layers or not regular</i>	1
	so it is difficult for layers / atoms / particles to slip / slide (over each other)	
	<i>accept layers cannot slip / slide</i>	1

[6]

M31.	(a) atoms	1
(b)	mixture	1
	metal	1
	structure	1
	smart	1

(c) (i) any **two** from:

- saves raw materials / iron ore
- saves energy / fuels
accept cheaper / saves money
- make new / useful items
- make money / it is economic
- reduces pollution
allow less harmful for the environment
- decreases cost of steel cans
- reduces carbon dioxide emissions
- decreases waste materials / use of landfill

2

(ii) any **one** from:

- provide information / education of the need to recycle
- legislate against / charge for waste
- reward / pay people to recycle
accept fine people for not recycling
- put labels on the cans
- provide recycling bags / bins / areas

1

[8]

M32. (a) (i) killing trees **or** acidification of lakes **or** damage to building or statues

1

(ii) $\text{SO}_2 + \text{H}_2\text{O} \longrightarrow \text{H}_2\text{SO}_3$
accept reversible arrow

1

(b) (i) at the positive electrode, (impure) copper loses electrons
or forms positive ions **or** copper is oxidised

1

which go into the solution

1

the ions are attracted to / move to the negative electrode

1

where they gain electrons and are deposited as copper

1

impurities are not attracted to the negative electrode so collect at the bottom

1



1

+ 2e⁻ on right

or

- 2e⁻ on left

1

(c) (i) the atoms / ions are arranged in layers / rows

1

which means that the layers / rows can slide over each other

1

(ii) because all atoms are the same

1

(d) because the atoms / ions in alloys are different sizes
first mark can be given for diagram

1

which prevents the layers sliding

1

[14]

M33. (a) (i) because large amounts of energy would be needed to extract the copper

accept because it is labour-intensive to extract copper from this land

accept because copper would have to be extracted from a large area of land (owtte)

1

(ii) any **one** from:

- produces large amounts of solid waste
- atmospheric pollution from carbon dioxide / sulfur dioxide
- more lorries / traffic

1

- (b) (i) iron is cheap
accept iron is much more abundant than copper 1
- (ii) iron displaces copper from solutions of its salts
accept iron is more reactive than copper 1
- (c) (i) any **two** from:
- less expensive / energy to extract the small amounts of copper
 - plants will remove carbon dioxide from the atmosphere as they grow
 - can release energy when plants are burned
- 2
- (ii) not continuous as it takes a long time for plants to grow
accept supply not continuous as plants only harvested once / twice a year 1

[7]

- M34.** (a) (i) copper 1
- (ii) 50p 1
- (iii) 25 (%) 1

(b) any **two** from:

- high value of copper
*allow copper is expensive or contains other metals
(that may have higher value now)*
- less copper available **or** copper ores exhausted /
only low-grade ores available
allow copper is non-renewable
- high demand for copper
- inflation of prices

2

[5]

M35. (a) (i) copper

1

(ii) 50p

1

(iii) 25 (%)

1

(b) any **two** from:

- high value of copper
*allow copper is expensive or contains other metals
(that may have higher value now)*
- less copper available **or** copper ores exhausted /
only low-grade ores available
allow copper is non-renewable
- high demand for copper
- inflation of prices

2

[5]