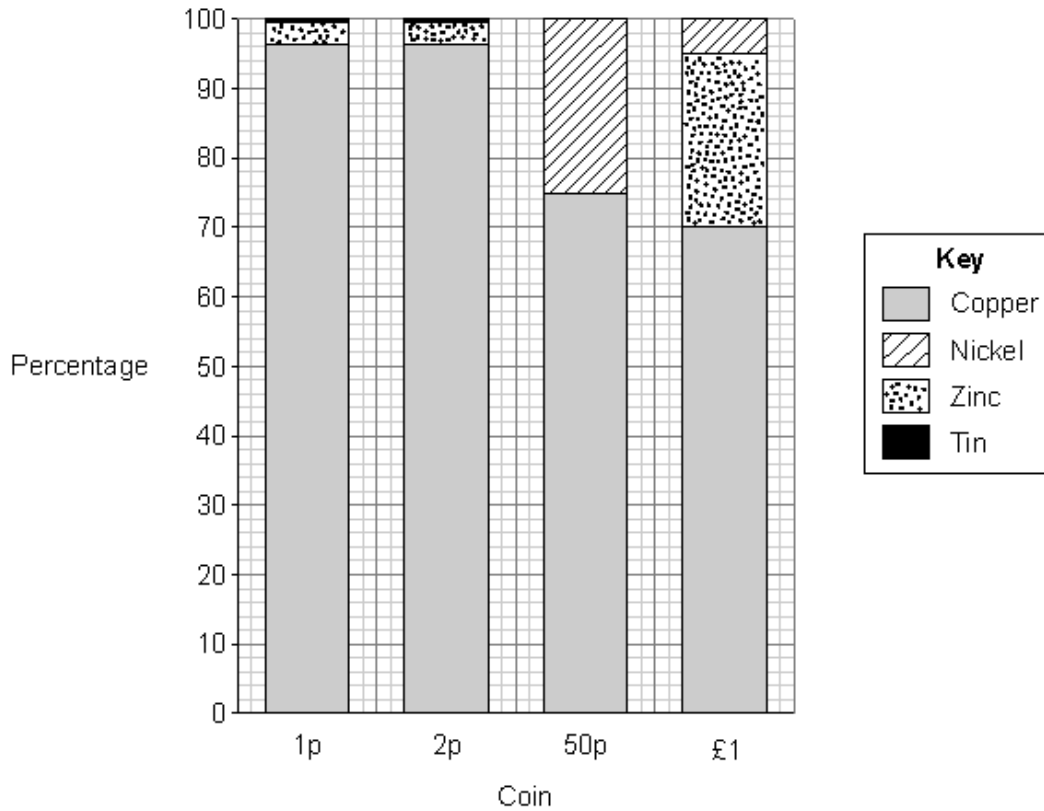


Q1. This is a headline from a newspaper.

**‘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.

.....

.....

.....

.....

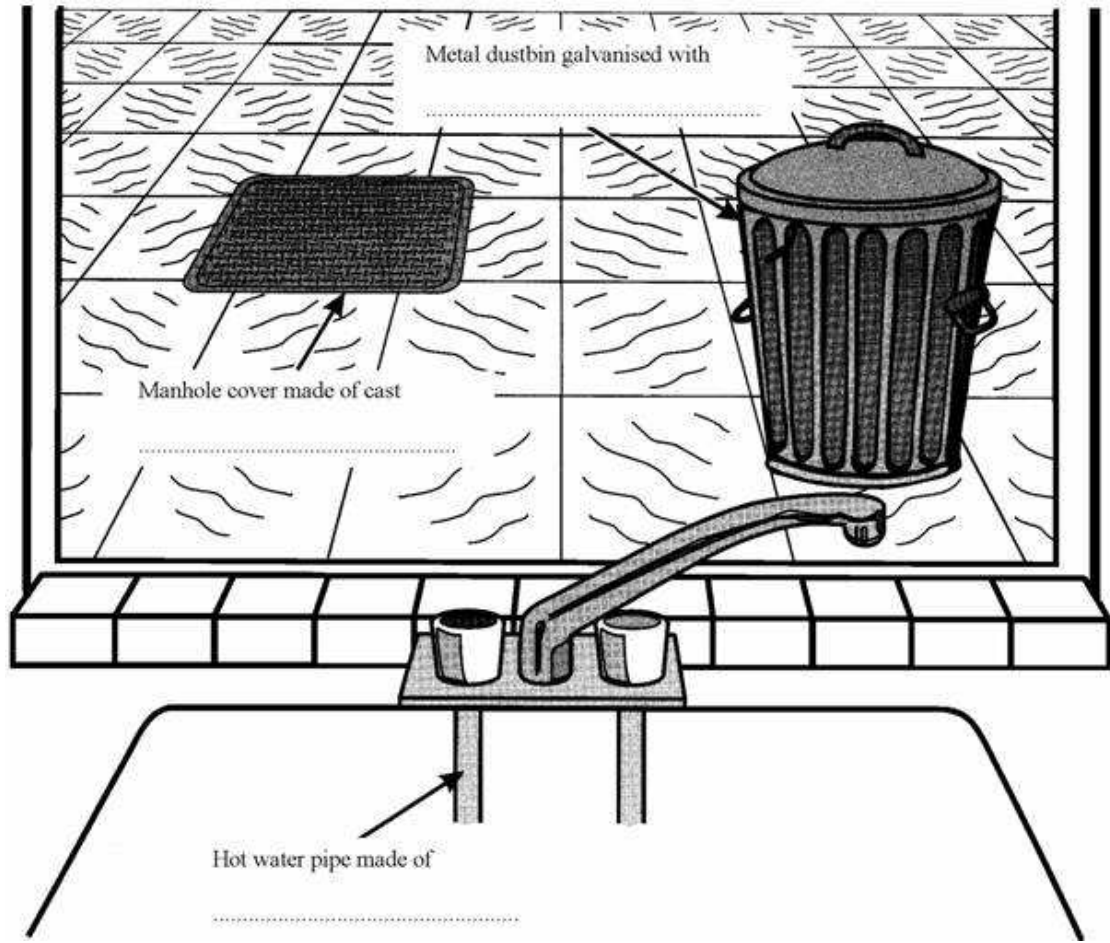
(2)  
(Total 5 marks)

##

The word box contains the names of some metals.

aluminium	copper	iron	manganese	zinc
-----------	--------	------	-----------	------

- (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)

**Q3.** Metals and their alloys have many uses.

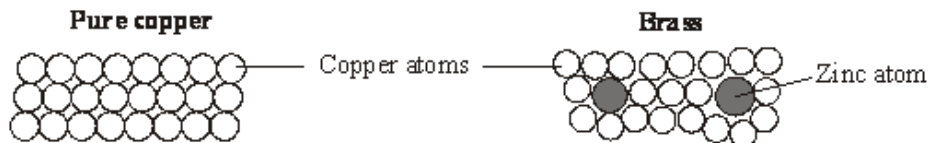
(a) Dentists use a smart alloy to make braces that gently push teeth into the right position.

What is meant by a *smart alloy*?

.....  
 .....

(1)

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

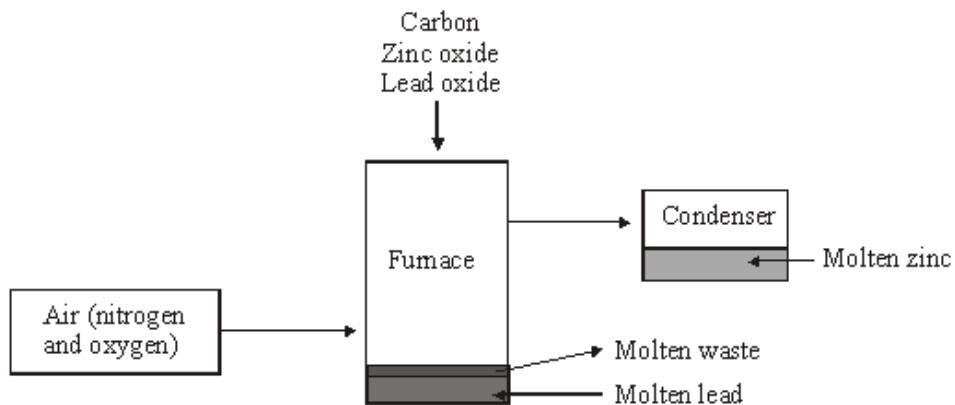


Why are the physical properties of brass different from the physical properties of pure copper?

.....  
 .....

(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
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.

.....

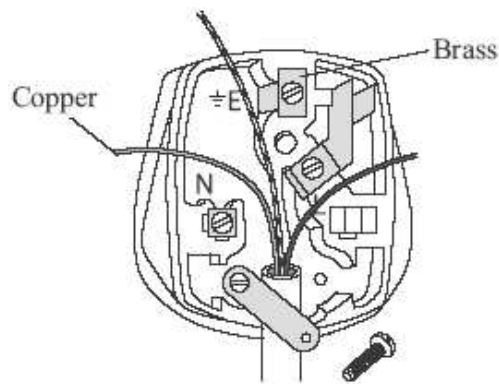
.....

.....

.....

(2)  
(Total 6 marks)

**Q4.** 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.



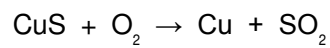
- (i) Suggest **one** environmental problem that is caused by open-cast mining of copper ore.

.....  
.....

(1)

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

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



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.

.....  
.....

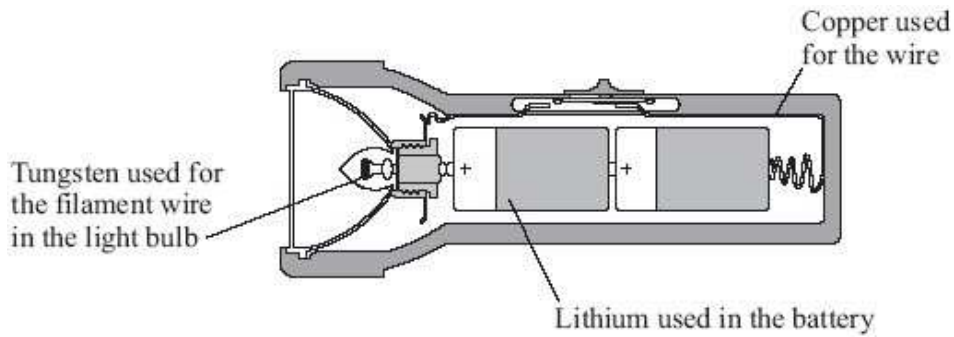
(1)

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

- 1 .....
- .....
- 2 .....
- .....

(2)  
(Total 7 marks)

**Q5.** The diagram shows a circuit that is used in a torch. Electrons flow through this circuit.

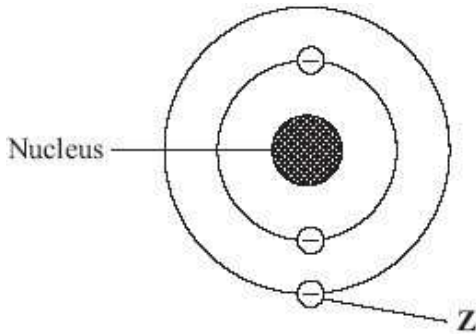


(a) Why is copper used for the wire?

.....

(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.

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

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

**most reactive** .....

.....

**least reactive** .....

(2)

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

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

.....

.....

(1)

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

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

Argon is used in the light bulb because it is

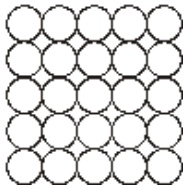
dense. solid. unreactive.
---------------------------------

(1)

(Total 6 marks)

**Q6.** 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

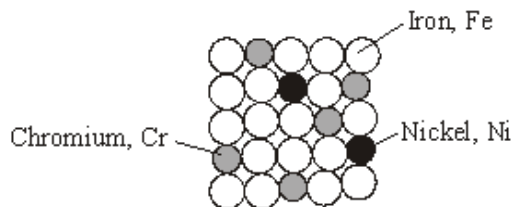
atoms
compounds
metals

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)

**Q7.** 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)

**Q8.** Many everyday items are made from iron.

- (a) Haematite is an *ore* of iron. Haematite contains iron oxide,  $\text{Fe}_2\text{O}_3$ .

- (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?

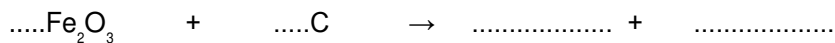
.....  
.....

(1)

(iii) The word equation for this reaction is:

iron oxide + carbon → iron + carbon dioxide

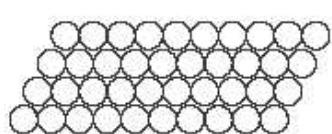
Complete and balance the symbol equation for this reaction.



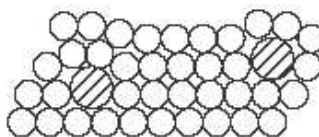
(2)

(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



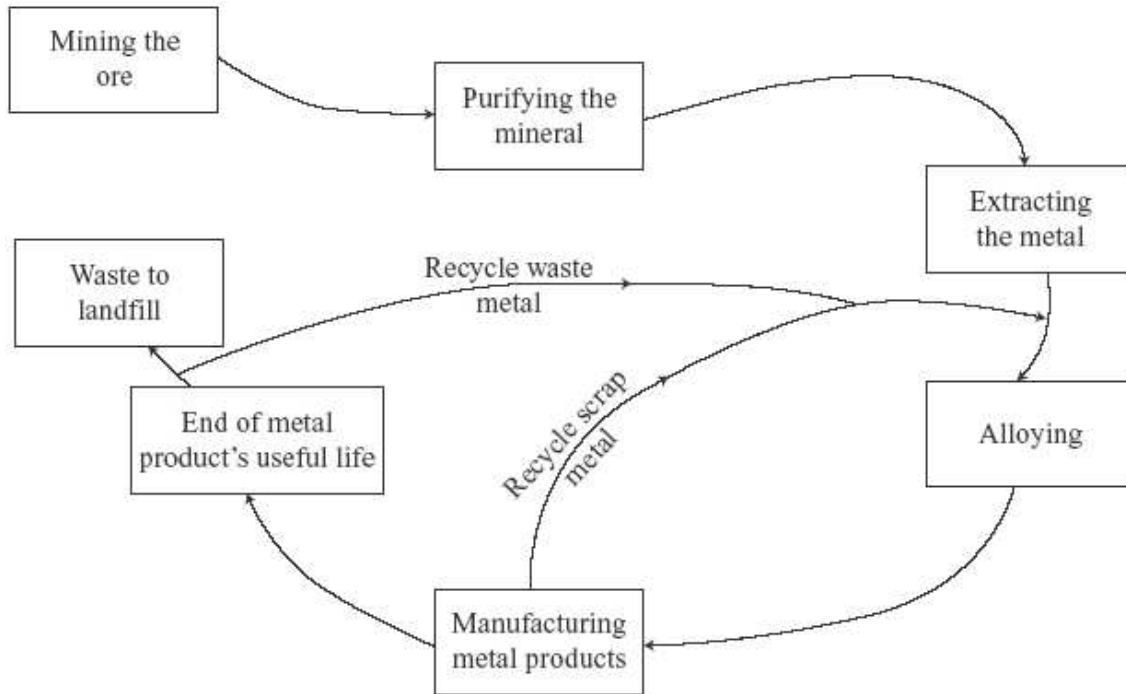
Cast iron

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.



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

.....

.....

.....

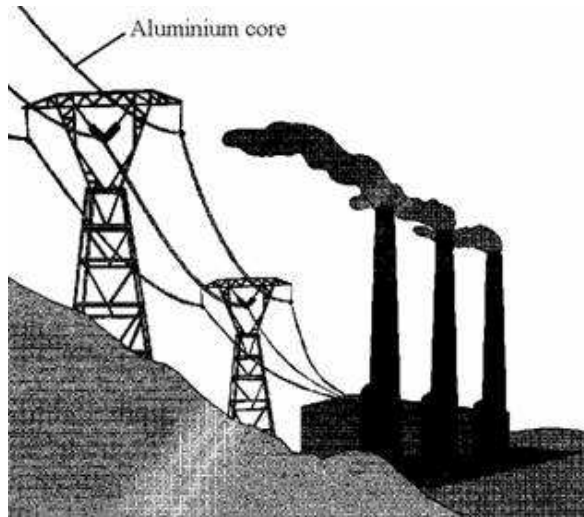
.....

.....

.....

(3)  
(Total 10 marks)

- Q9.** (a) Aluminium is more expensive than iron. Why is aluminium and not iron used for the central core in power cables?



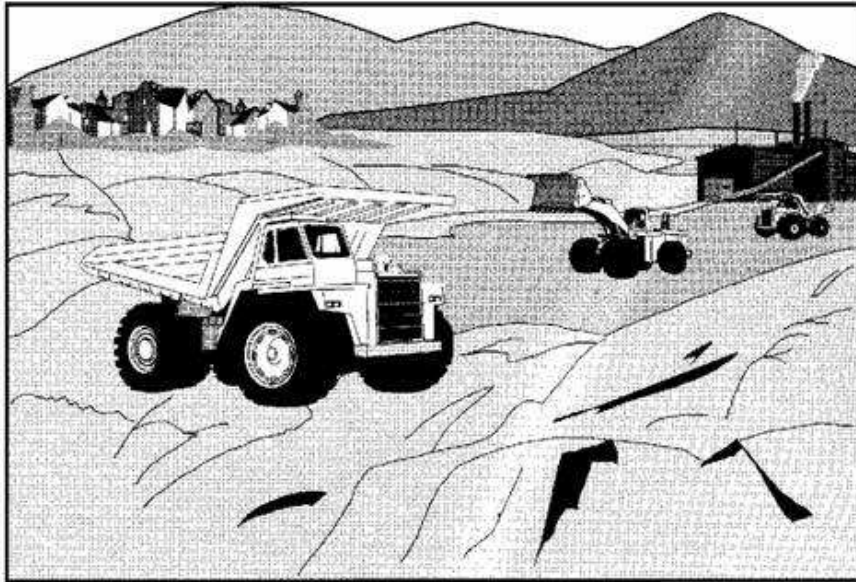
.....

.....

.....

(2)

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



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.

.....

.....

.....

.....

.....

.....

.....

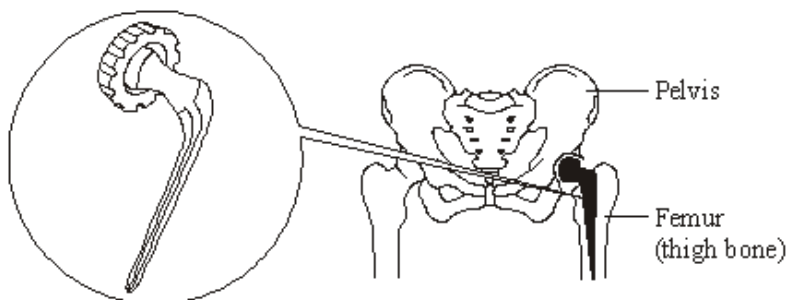
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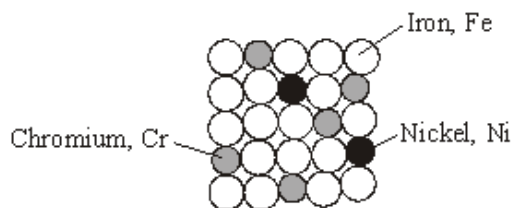
(5)  
(Total 7 marks)

**Q10.** 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.

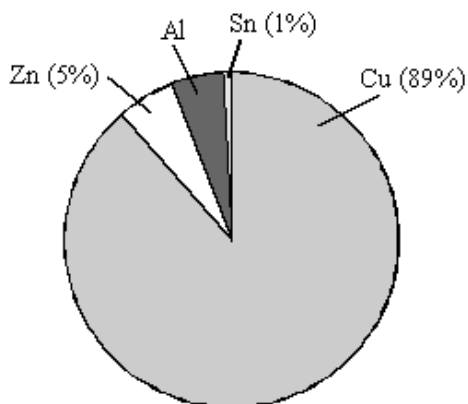
.....  
.....  
.....  
.....

(2)  
(Total 6 marks)

**Q11.** The 50 Eurocent coin is made from an alloy called 'Nordic Gold'.



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



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

.....

(1)

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

.....  
.....

Mass of zinc = ..... g

(2)

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

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

.....

(1)

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

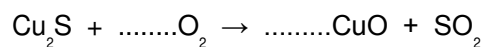
.....  
.....  
.....

(2)  
(Total 6 marks)

**Q12.** 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.

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

(2)

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

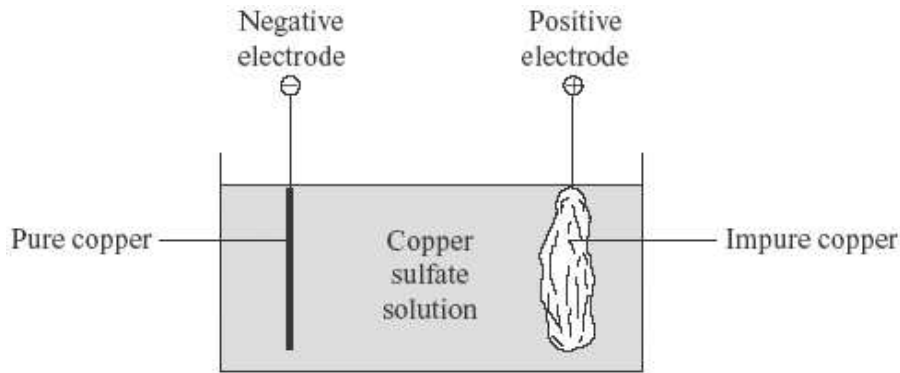
Describe and explain what happens during this reaction.

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

(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.

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

(3)

(Total 10 marks)

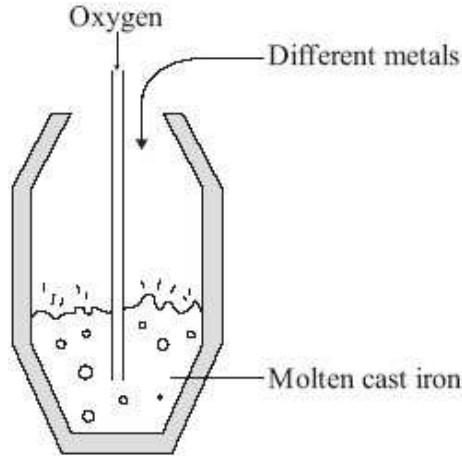
**Q13.** The demand for iron and steel is high.

- (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)

**Q14.** 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)

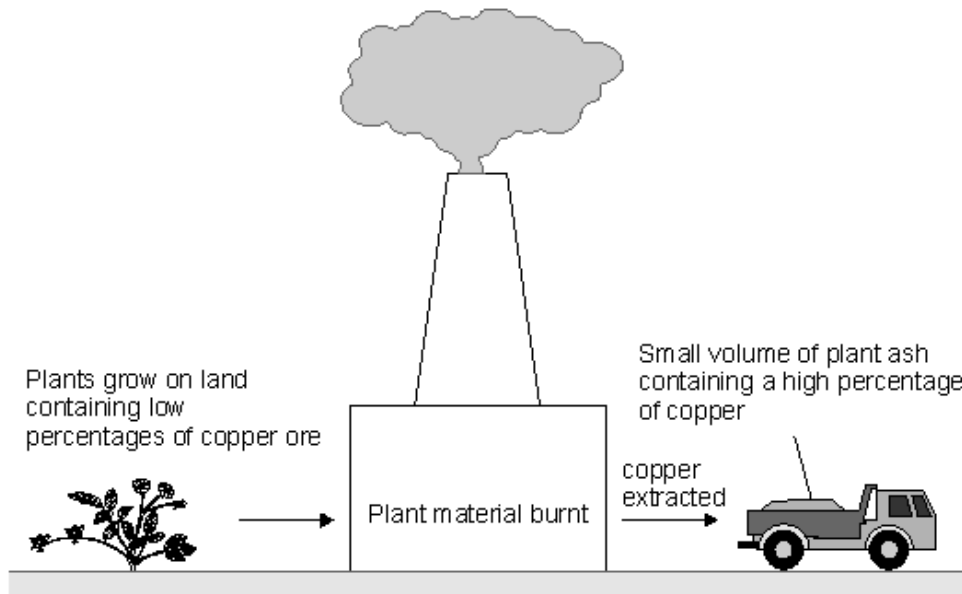
- (ii) Why can iron be used to get copper from copper sulfate solution?

.....  
 .....

(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)**

- M1.** (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]**

- M2.** (i) zinc  
*accept Zn* 1
- iron only  
*accept Fe* 1
- copper  
*accept Cu*  
*do not credit iron* 1
- (ii) iron 1
- (iii) copper **or** iron or manganese  
*accept Cu or Fe or Mn* 1
- [5]**

- M3.** (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 / O<sub>2</sub> / 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]

- M4.** (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]

- M5.** (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]

- M6.** (a) atoms

1



(b) mixture	1
metal	1
structure	1
smart	1

(c) (i) any <b>two</b> from:	
• saves raw materials / iron ore	
• saves energy / fuels <i>accept cheaper / saves money</i>	
• make new / useful items	
• make money / it is economic	
• <u>reduces</u> pollution <i>allow less harmful for the environment</i>	
• decreases cost of steel cans	
• reduces carbon dioxide emissions	
• decreases waste materials / use of landfill	2

(ii) any <b>one</b> from:	
• provide information / education of the need to recycle	
• legislate against / charge for waste	
• reward / pay people to recycle <i>accept fine people for not recycling</i>	
• put labels on the cans	
• provide recycling bags / bins / areas	1

[8]

<b>M7.</b> (a) lead oxide + carbon = lead + carbon dioxide (A symbol equation was accepted if correct)	1
---	---

(b) oxygen removed (or addition of electrons)	1
---	---

[2]

- M8.** (a) (i) contain enough metal to make it economical / worth while to extract 1
- (ii) reduction 1  
*accept displacement*  
*accept redox*
- (iii)  $\text{Fe} + \text{CO}_2$  1  
*do not accept  $\text{Fe}_2 / \text{Fe}_4$*
- correct balancing 1  
*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*
- (b) **Pure Iron**
- (in pure metal all the atoms are the same size and) able to slip / slide over each other – (property soft) 1  
*OWTTE*  
*ignore references to molecules / particles*  
*if they say 'move' both times, allow **one** mark but 'crack' or 'split' is wrong..*
- Cast iron**
- (in cast iron) different sized atoms / larger atoms **or** structure is distorted / disrupted 1  
*OWTTE*
- so it is difficult for layers of atoms to slip / slide over each other 1  
*OWTTE*
- (c) any **three** from: 3
- 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*

[10]

- M9.** (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]

**M10.** (a) (Chromium =) 20 1

in correct order

(Nickel =) 8

*accept Chromium = 8 **and** Nickel = 20 for 1 mark*

1

(b) (i) (because iron is made up of only) one type of atom 1

(ii) not strong

*ignore soft / corrosive / flexible*

*accept it rusts / corrodes **or** that it could wear away*

*accept could change shape / bend*

*accept layers / atoms could slide (over each other)*

1

(iii) has different sized atoms / particles

**or**

structure is different/distorted / disrupted

*accept not in layers **or** not regular*

1

so it is difficult for layers / atoms / particles to slip / slide (over each other)

*accept layers cannot slip / slide*

1

[6]

**M11.** (a) (i) 5(%) 1

(ii) 0.35

$$\frac{5}{10} \times 7$$

*for 1 mark*

2

(b) (i) reduction 1

*accept (it's) reduced*

*do **not** accept redox / deoxidation*

- (ii) heat with / reduce / react with **or** (chemical) reaction 1
- with a metal / element / substance higher in reactivity
- ignore displace*
- accept higher named elements **or** symbol*
- accept carbon monoxide / coal / coke*
- correct word equation for 2 marks*
- correct formulas for 1 mark*
- correct balanced symbol equation for 2 marks* 1

**or**

electrolysis:

molten (1)

electrolysis (1)

[6]

- M12.** (a) (i)  $\text{Cu}_2\text{S} + 2\text{O}_2 \rightarrow 2\text{CuO} + \text{SO}_2$  1
- accept fractions and multiple*
- (ii) any **two** from:
- sulfur dioxide  
*accept sulphur dioxide / sulphur oxide / SO<sub>2</sub>*
  - 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]

**M13.**

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

1

carbon dioxide / CO<sub>2</sub> / 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]

**M14.**

(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]

