



Exampro GCSE Chemistry

C1 Chapter 3 Higher

Name:

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Class:

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Author:

Date:

Time: 53

Marks: 53

Comments:

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**Q1.** Metals are extracted from their ores.

Many copper ores contain only 2% of copper compounds.

(a) Copper is now extracted from ores containing a low percentage of copper compounds.

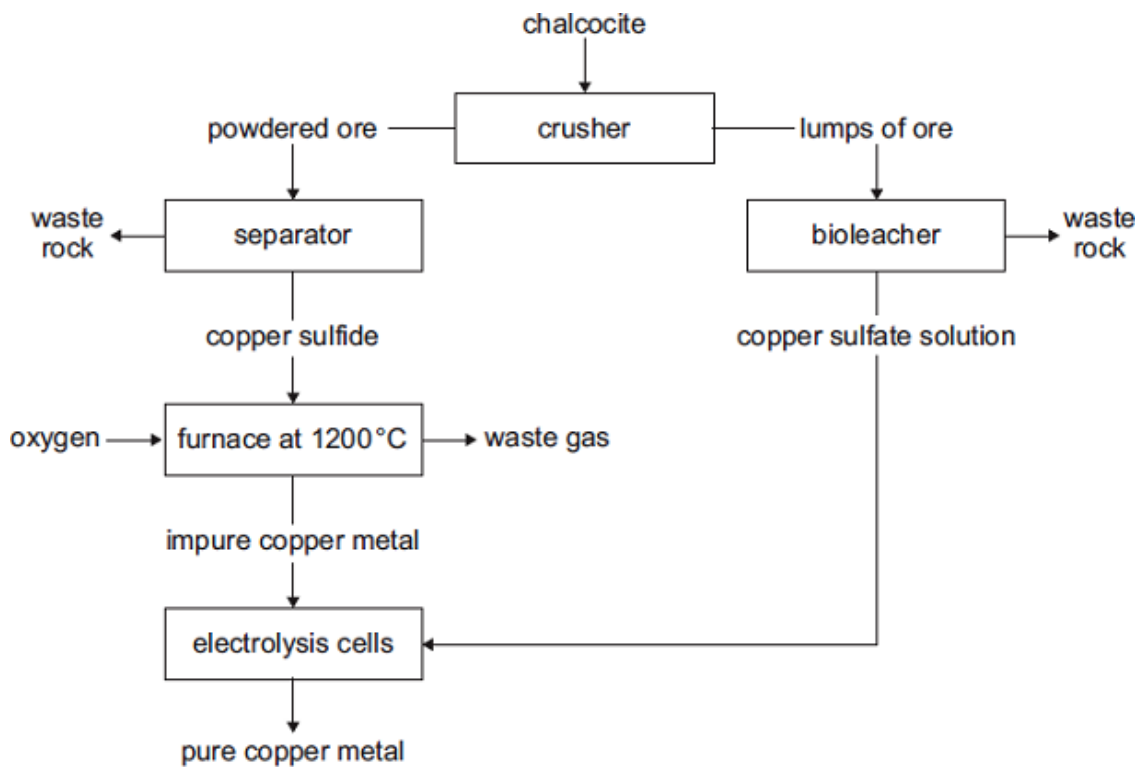
Suggest **two** reasons why.

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

(2)

(b) Chalcocite, an ore of copper, contains copper sulfide.

The flow diagram shows how copper metal is extracted from chalcocite.



(i) Suggest **one** reason why it is difficult to dispose of the waste rock.

.....  
.....

(1)

- (ii) The reaction in the furnace could cause environmental pollution.  
Explain how.

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

(2)

- (iii) The extraction of pure copper is expensive.  
Give **one** reason why.

.....  
.....

(1)

- (iv) Pure copper is produced by electrolysis of copper sulfate solution.

Which electrode do the copper ions move towards?  
Give a reason for your answer.

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

(2)

- (v) Large areas of land are contaminated with copper compounds.  
Phytomining can be used to remove these copper compounds from the land.

What is used in phytomining to remove copper compounds from the land?

.....  
.....

(1)

**(Total 9 marks)**

- Q2.** Cans for food and drinks are made from steel or aluminium.  
The main metal in steel is iron.



By Sun Ladder (Own work) [CC-BY-SA-3.0 or GFDL],  
via Wikimedia Commons

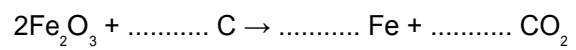
- (a) Iron is extracted by heating a mixture of iron oxide and carbon in a blast furnace.

- (i) Name this type of reaction.

.....

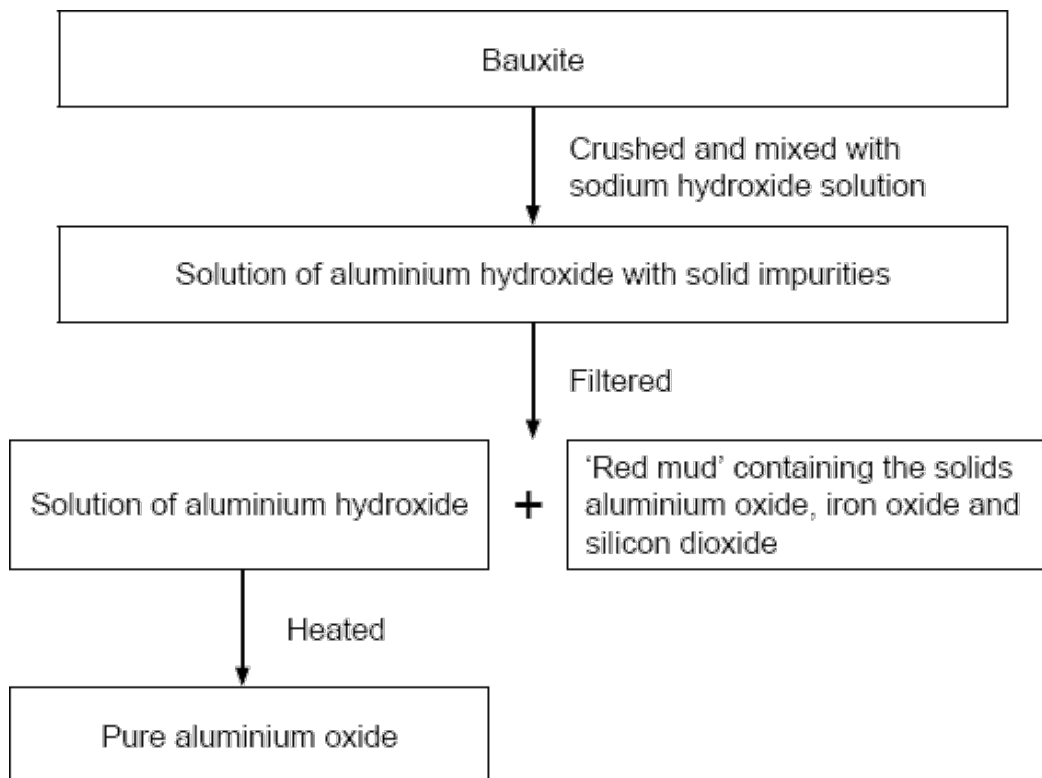
(1)

- (ii) Balance the symbol equation for this reaction.



(1)

- (b) Aluminium ore, bauxite, contains aluminium oxide, iron oxide and silicon dioxide. Aluminium is extracted by electrolysis of aluminium oxide.



The 'red mud' which is dumped in very large ponds contains:

Name of solid	Percentage (%)
Aluminium oxide	10
Iron oxide	65
Silicon dioxide	25

- (i) 100 tonnes of bauxite produced 50 tonnes of pure aluminium oxide and 50 tonnes of 'red mud'.

What percentage of aluminium oxide did the bauxite contain?

.....

Answer = ..... %

(1)

- (ii) Apart from the solids shown in the table, name **one** other substance that would be in the 'red mud'.

.....

(1)

(iii) The purification of the aluminium oxide is usually done near to the bauxite quarries.

Suggest **one** reason why.

.....

(1)

(c) Aluminium is used to make many things including cans.

During one year in the USA:

- 100 billion aluminium cans were sold
- 55 billion aluminium cans were recycled.

Give **one** environmental impact of recycling aluminium cans and **one** ethical or social impact of recycling aluminium cans.

Environmental .....

.....

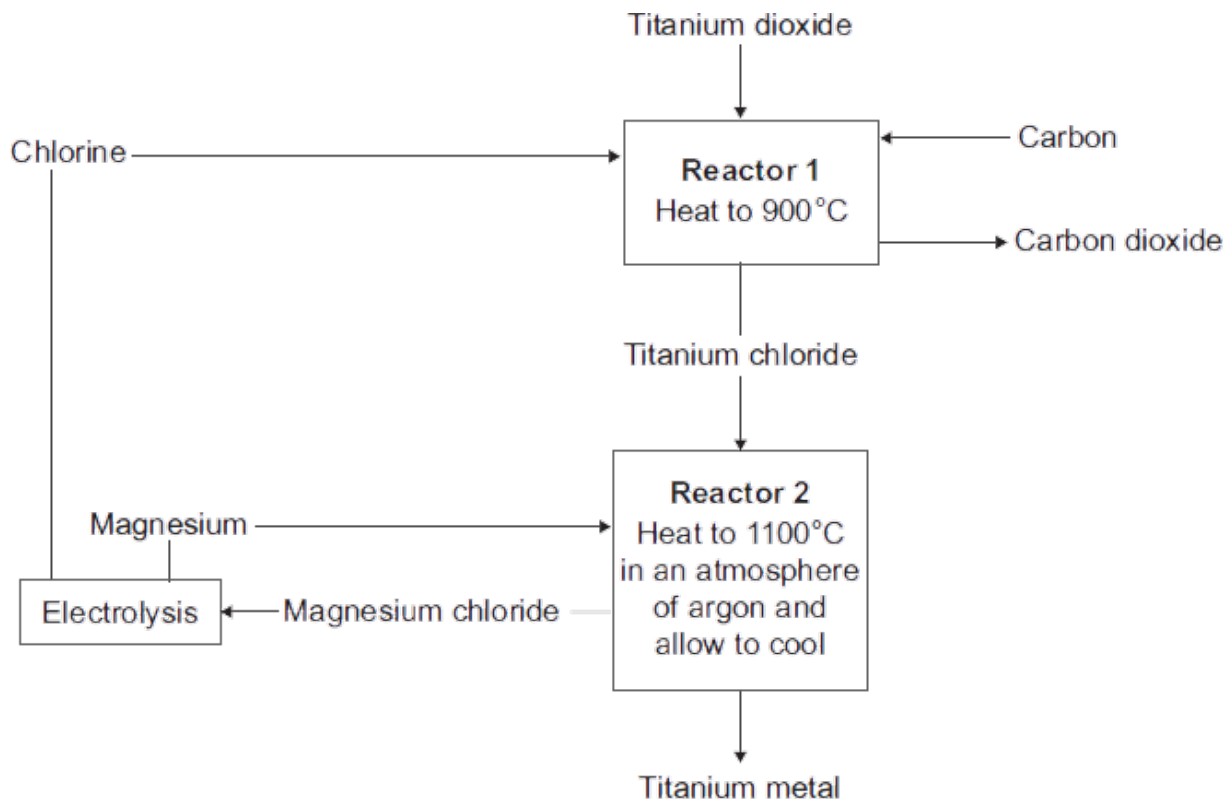
Ethical or social .....

.....

(2)

(Total 7 marks)

**Q3.** Rutile is an ore of titanium. Rutile contains titanium dioxide.  
The flow chart shows how titanium metal is extracted from titanium dioxide.



(a) Titanium is much more expensive than iron.

Give **one** reason why.

.....  
.....

(1)

(b) Name the only waste product shown on the flow chart.

.....

(1)

(c) Describe the example of recycling shown on the flow chart.

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

(2)

(d) The air is removed from **Reactor 2**. An atmosphere of argon is used for the reaction between titanium chloride and magnesium metal.

Explain why.

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

(2)

(e) Titanium metal is produced by reacting titanium chloride with magnesium.

950 kg of titanium chloride was mixed with 240 kg of magnesium metal. The mixture was heated and produced 950 kg of magnesium chloride.

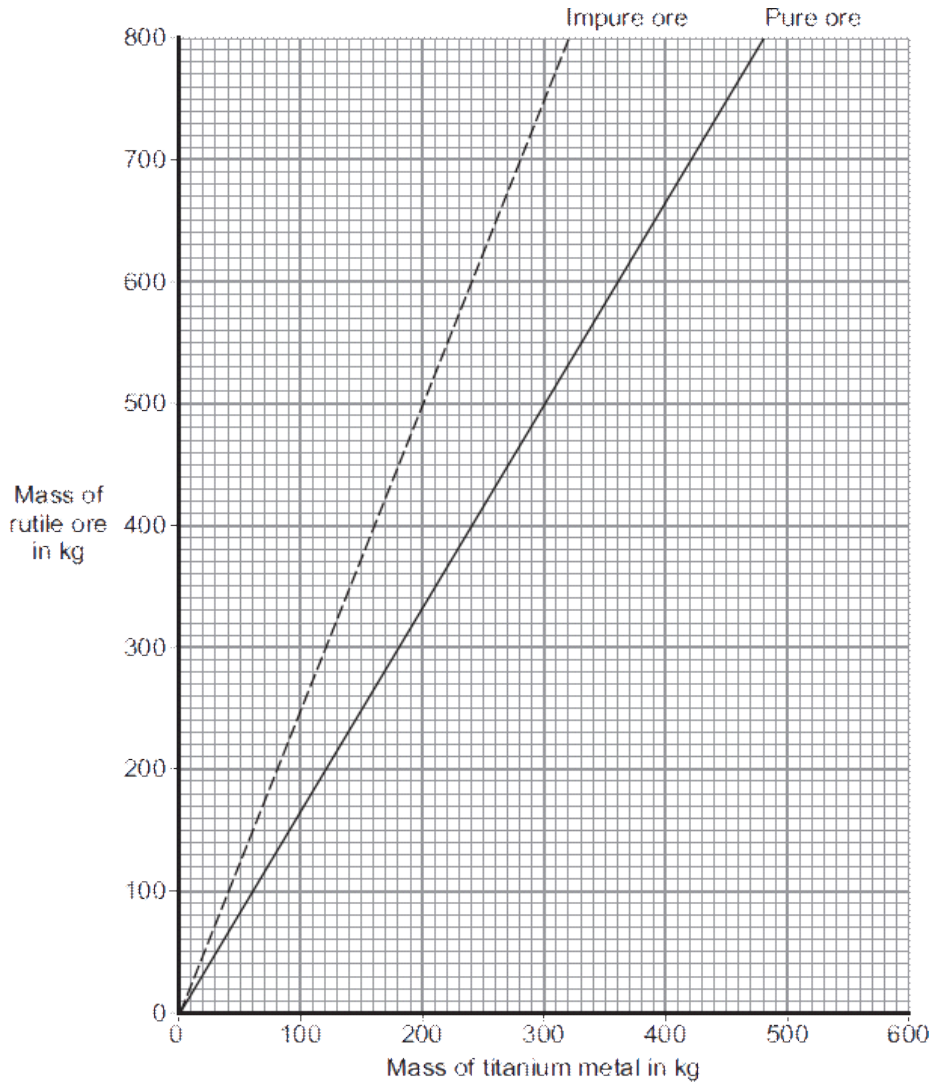
Calculate the mass of titanium metal produced.

.....

Mass = ..... kg

(1)

- (f) The graph shows the mass of titanium metal produced from a pure rutile ore and from an impure rutile ore.



The difference between the two lines represents the amount of waste rock in the impure ore.

300 kg of titanium metal was produced from the impure ore.

Calculate the mass of waste rock in the impure ore.

.....

Mass = ..... kg

(1)  
(Total 8 marks)



**Q4.** 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.

.....  
.....

(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?

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

(2)

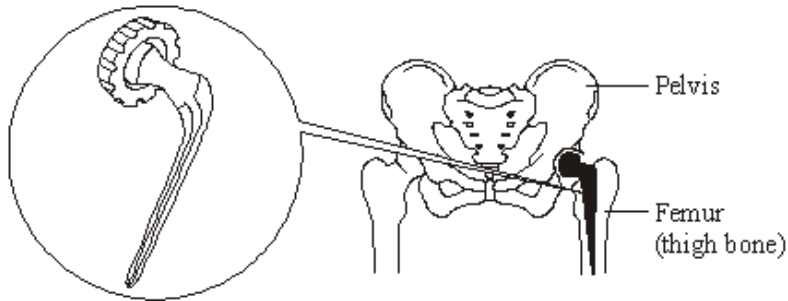
(ii) Suggest why aluminium is more expensive than iron.

.....  
.....

(1)

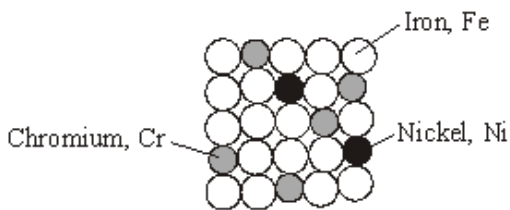
**(Total 6 marks)**

- Q5.** 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)

**Q6.** 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)

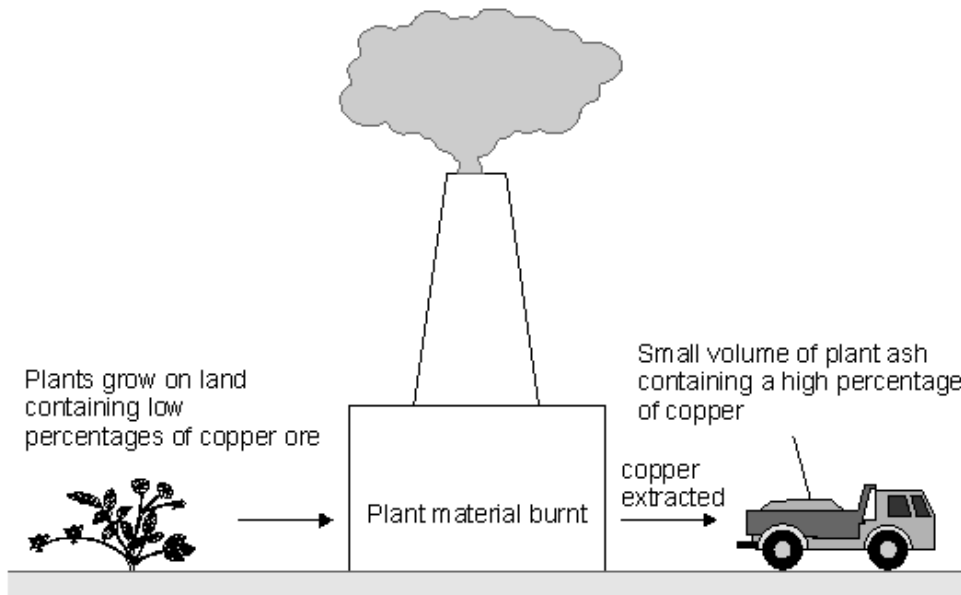
(ii) Why can iron be used to get copper from copper sulfate solution?

.....  
.....

(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)

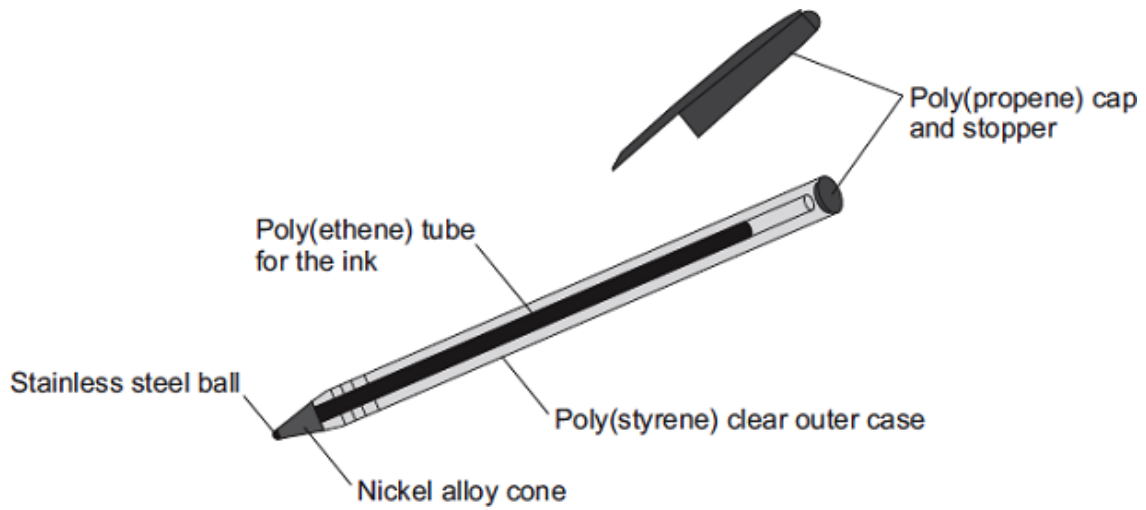
(ii) Use this information to suggest **one** disadvantage of phytomining compared to the traditional method.

.....  
.....

(1)

(Total 7 marks)

**Q7.** The diagram shows a ballpoint pen.



(a) Give **one** advantage and **one** disadvantage of recycling the materials from this type of ballpoint pen.

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

(2)

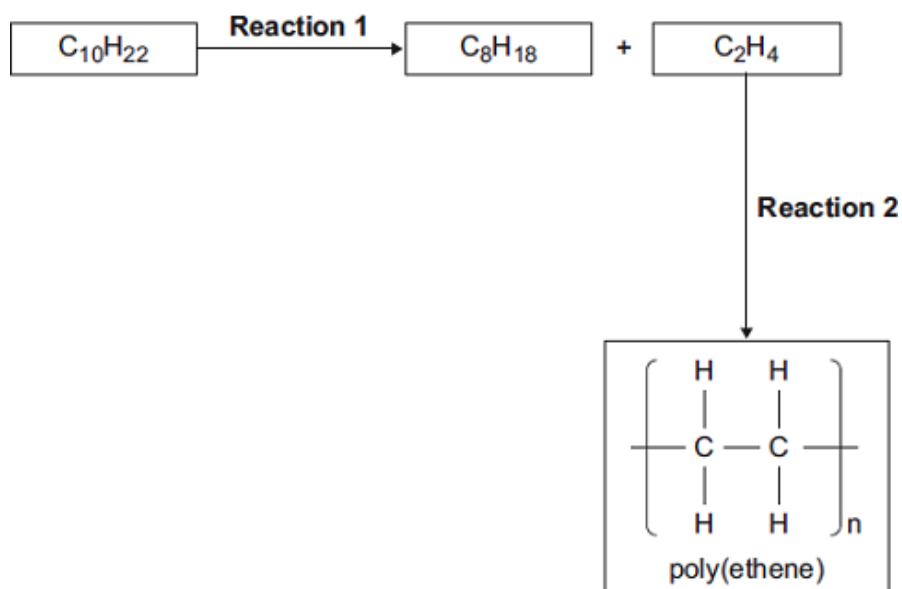
(b) Alloys are used to make the ballpoint pen.

Give **two** reasons why alloys are used in the ballpoint pen.

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

(2)

(c) Decane ( $C_{10}H_{22}$ ) can be used to produce poly(ethene).



(i) Describe the conditions needed for **Reaction 1**.

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

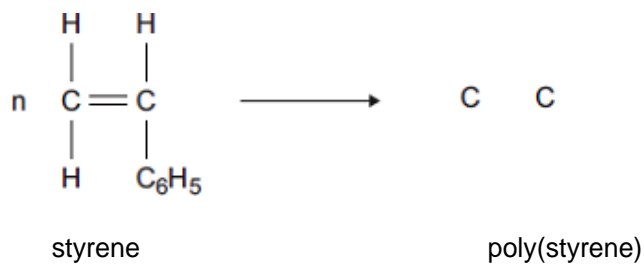
(2)

(ii) Describe, in terms of molecules, how poly(ethene) is produced in **Reaction 2**.

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

(2)

(d) Complete the displayed structure of the product in the equation.



(2)

(Total 10 marks)

- M1.** (a) any **two** from:
- copper / ores are running out / harder to find
  - there are no / very small amounts of high-grade copper ores left
  - copper metal is in demand
  - copper is expensive
  - now economical to extract copper from low-grade ores  
*it = copper*  
*allow new methods of extraction e.g. bioleaching and phytomining*  
*allow high-grade ores are running out for 2 marks* 2
- (b) (i) large amounts / 98% of rock to dispose of as waste  
*accept contains toxic (metal) compounds / bioleacher*
- or**  
waste rock takes up a lot of space 1
- (ii) (copper sulfide reacts with oxygen to) produce sulfur dioxide /  $\text{SO}_2$   
*allow (sulfur reacts with oxygen to) produce sulfur dioxide /  $\text{SO}_2$*  1
- that causes acid rain  
*allow description of effects of acid rain or sulfur dioxide*  
*if no other mark awarded allow  $\text{CO}_2$  produced which causes global warming or  $\text{CO}_2$  produced by burning fuel or heating the furnace for 1 mark* 1
- (iii) any **one** from:
- large amounts of fuels / energy used (for the furnace and electrolysis)  
*allow large amounts of electricity needed*  
*ignore high temperature / electrolysis unqualified*
  - (the extraction has) many steps / stages / processes  
*allow (extraction) is a long process / takes a lot of time*
  - large amounts of ore / material have to be mined  
*allow ores contain a low percentage of copper* 1
- (iv) (copper ions move towards) the negative electrode / *cathode* 1
- because copper ions /  $\text{Cu}^{2+}$  are positively charged **or** are oppositely charged **or** copper ions need to gain electrons  
*allow because metal ions are positive or opposites attract* 1

(v) (growing) plants

1

[9]

**M2.** (a) (i) reduction

*accept redox / smelting*

1

(ii) 3 4 3

1

(b) (i) 55

*ignore other units*

(ii) Water

*accept sodium hydroxide*

*accept correct formulae  $H_2O$  or  $NaOH$*

1

(iii) any **one** from:

- save energy / fuel for transporting the ore  
*accept less (cost of) transport allow transported quickly*
- (old) quarries nearby for waste/red mud

1

(c) **Environmental**

any **one** from:

- less mining / quarrying (of bauxite)  
*allow loss of habitat / less qualified noise pollution*
- less landfill space needed / used  
*allow less red mud / waste*
- less use of fossil fuels / energy
- less carbon dioxide produced

1

**Ethical or social**

any **one** from:

- saves resources  
*allow using resources more than once*
- creates (local) employment  
*if answers reversed and both correct award 1 mark*
- more people aware of the need for recycling  
*allow less qualified noise pollution if not given in environmental*

1



- M3.** (a) any **one** from:  
*ignore references to cost / mining / availability*
- there are many stages needed (to extract titanium)  
*allow longer / slower / more complicated process / batch process*
  - more energy / materials are needed (to extract titanium)  
*ignore higher temperature ignore reference to electrolysis*
  - titanium cannot be extracted by using carbon  
*do **not** accept titanium extracted by electrolysis*
- 1
- (b) carbon dioxide  
*allow CO<sub>2</sub>*
- 1
- (c) magnesium chloride is electrolysed / used / decomposed
- 1
- magnesium and / or chlorine are recycled / reused  
*allow the products of electrolysis are recycled  
word / symbol equation = 1 mark*
- 1
- (d) *accept titanium for magnesium*
- because oxygen / nitrogen (in air) would react with the magnesium  
**or**  
would produce magnesium oxide / nitride
- 1
- whereas argon is inert / unreactive **or** argon does not react with magnesium  
*ignore argon is in Group 0 / noble gas*
- 1
- (e) 240
- 1
- (f) 250  
*allow range 245 to 250*
- 1

- M4.** (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 / O<sub>2</sub> / O  
*do **not** accept O<sup>2</sup>* 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 O<sub>2</sub> **or** carbon / coke burning (1)  
*accept balanced equation only CO / CO<sub>2</sub>*
- 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]

- M5.** (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
- M6.** (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

[6]

- (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]

- M7.** (a) any **one** advantage from:
- conserves resources (of crude oil / metal ores)  
*ignore can be made into other items*  
*allow the materials (in the pen) are non-renewable*  
*allow less expensive than producing from the raw material*
  - reduces use of landfill  
*ignore less waste*
  - less use of fuels/energy
  - less carbon dioxide produced  
*ignore global warming unqualified*
- 1
- any **one** disadvantage from:
- made of different polymers / alloys / materials
  - difficulty / cost of separating the different materials  
*allow not all the materials can be recycled*
- 1
- (b) hard / strong / durable
- 1
- resistant to corrosion **or** unreactive  
*allow do not rust*  
*do **not** allow corrosive*
- 1
- (c) (i) vapours (of decane)  
*ignore pressure / hot / heat*  
*allow high temperature ( $\geq 150$  °C)*
- 1

passed over a catalyst **or** porous pot **or** aluminium oxide

*allow catalyst even if incorrectly named*

1

**or**

mixed with steam (1)

at a (very) high temperature (1)

*if temperature quoted, must be  $\geq 500\text{ }^{\circ}\text{C}$*

(ii) many monomers **or** many ethene molecules

1

join / bond

*allow addition polymerisation for second mark*

1

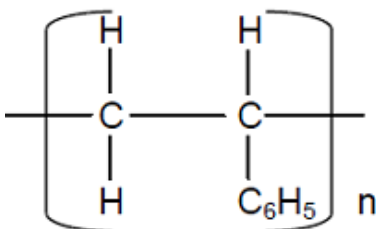
**OR**

monomers / ethene molecules (1)

form chains **or** very large molecules (1)

*if no other mark awarded allow double bond breaks / opens up **or** double bond forms a single bond for 1 mark*

(d)



*allow bonds that do not extend through brackets*

*7 single bonds are used and are in the correct places with no additional atoms (1)*

*the brackets and the n are in the correct place (1)*

2

[10]

