



# **GCSE Chemistry**

## **Metal Extraction**

### **Question Paper**

**Time available: 58 minutes**

**Marks available: 57 marks**

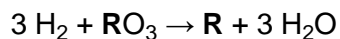
**[www.accesstuition.com](http://www.accesstuition.com)**

1.

This question is about the extraction of metals.

Element **R** is extracted from its oxide by reduction with hydrogen.

The equation for the reaction is:



(a) The sum of the relative formula masses ( $M_r$ ) of the reactants ( $3 \text{H}_2 + \text{RO}_3$ ) is 150

Calculate the relative atomic mass ( $A_r$ ) of **R**.

Relative atomic masses ( $A_r$ ): H = 1 O = 16

---

---

---

---

Relative atomic mass ( $A_r$ ) of **R** = \_\_\_\_\_

(2)

(b) Identify element **R**.

You should use:

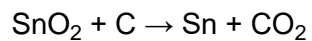
- your answer to part (a)
- the periodic table.

Identity of **R** = \_\_\_\_\_

(1)

(c) Carbon is used to extract tin (Sn) from tin oxide (SnO<sub>2</sub>).

The equation for the reaction is:



Calculate the percentage atom economy for extracting tin in this reaction.

Relative atomic masses ( $A_r$ ): C = 12 O = 16 Sn = 119

---

---

---

---

---

---

---

Percentage atom economy = \_\_\_\_\_ %

**(3)**

(d) Tungsten (W) is a metal.

Tungsten is extracted from tungsten oxide ( $WO_3$ ).

All other solid products from the extraction method must be separated from the tungsten.

The table below shows information about three possible methods to extract tungsten from tungsten oxide.

<b>Method</b>	<b>Reactant</b>	<b>Relative cost of reactant</b>	<b>Products</b>
1	Carbon	Low	Tungsten solid Carbon dioxide gas Tungsten carbide solid
2	Hydrogen	High	Tungsten solid Water vapour
3	Iron	Low	Tungsten solid Iron oxide solid

Evaluate the three possible methods for extracting tungsten from tungsten oxide.

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

(4)  
(Total 10 marks)

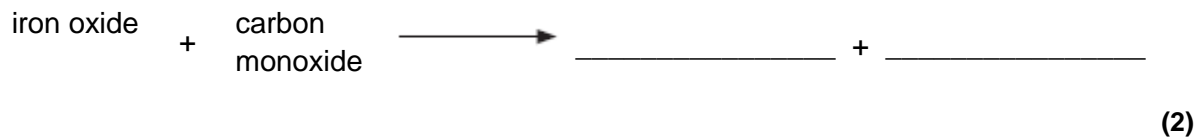
2.

Iron is extracted from iron oxide in the blast furnace.

(a) The equation for one of the reactions in the blast furnace is:



(i) Complete the word equation for this reaction.



(ii) Oxygen is removed from iron oxide in the blast furnace.

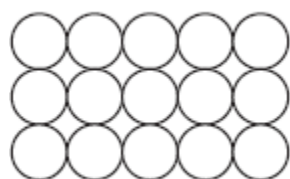
Draw a ring around the correct answer to complete the sentence.

The iron oxide is

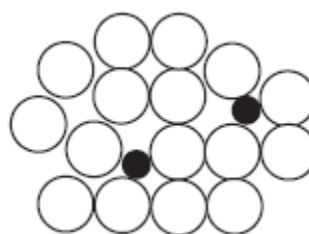
neutralised.  
oxidised.  
reduced.

(1)

(b) The diagrams represent pure iron and iron from the blast furnace.



Pure iron



Iron from the blast furnace

(i) Draw **one** line from each statement to the correct explanation.

**Statement**

**Explanation**

Pure iron is an element because .....

it is made of one sort of atom only.

it contains two elements not chemically combined.

Iron from the blast furnace is a mixture because .....

every atom has the same number of neutrons.

it contains two elements chemically combined.

(2)

(ii) Explain why iron from the blast furnace is harder than pure iron.

Use the diagrams on page 4 to help you.

---



---



---



---

(2)

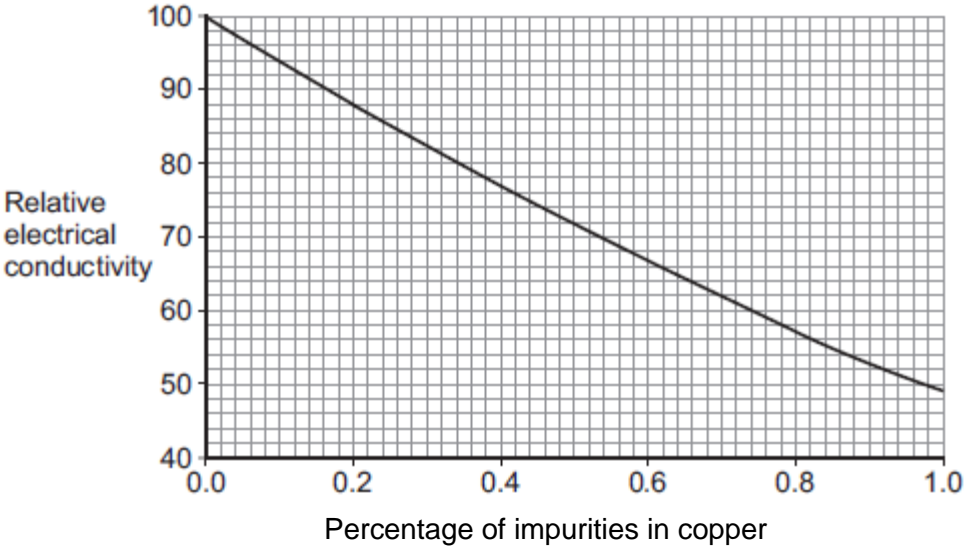
(Total 7 marks)

**3.**

This question is about copper.

(a) Most of the copper extracted is used in electric circuits.

The figure below shows how impurities change the electrical conductivity of copper.



Copper extracted by smelting is about 99% pure.

The 99% pure copper produced by smelting is purified to 99.9999% pure copper by electrolysis.

Use values from the graph to explain why copper is purified to 99.9999%.

---

---

---

---

(2)

- (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Read the information in the box.

### **Copper extraction**

World demand for copper for the year 2011 was about 20 million tonnes.

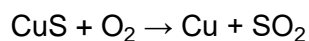
World reserves of copper are estimated to be 700 million tonnes.

Most of the copper used is obtained from copper ores, which are mined.

The copper ore chalcopyrite is heated in a furnace to produce copper sulfide, CuS

The furnace is heated by burning fossil fuels.

Air is then blown through the hot copper sulfide, to produce copper and sulfur dioxide.





A scientist made the statement: 'Copper should be recycled'.

Use the information in the box and your own knowledge and understanding to justify the scientist's statement.

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

Extra space

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

- (c) Phytomining is used to obtain copper from land that contains very low percentages of copper compounds.

Describe how copper compounds are obtained by phytomining.

---

---

---

---

---

---

---

---

(3)

(Total 11 marks)

4.

Where copper ore has been mined there are areas of land that contain very low percentages of copper compounds.

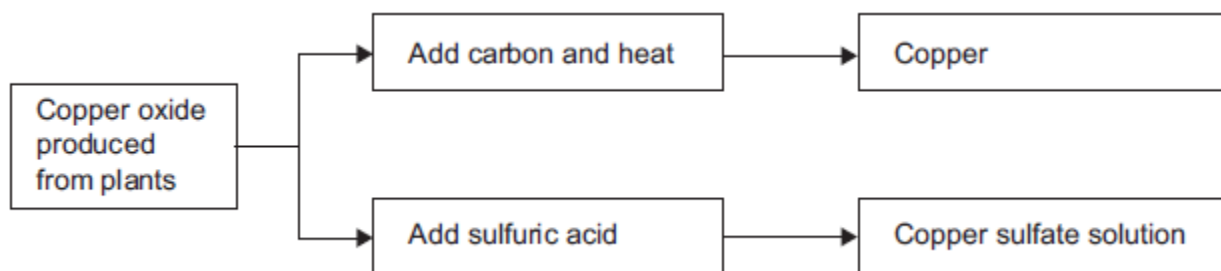
One way to extract the copper is to grow plants on the land.

The plants absorb copper compounds through their roots.

The plants are burned to produce copper oxide.

The copper oxide produced from plants can be reacted to produce copper or copper sulfate solution, as shown in **Figure 1**.

Figure 1



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

- (i) Copper ores contain enough copper to make extraction of the metal

carbon neutral.  
economical.  
reversible.

(1)

(ii) Using plants to extract metals is called

photosynthesis.  
phytomining.  
polymerisation.

(1)

(iii) Copper oxide reacts with carbon to produce copper and

carbon dioxide.  
oxygen.  
sulfur dioxide.

(1)

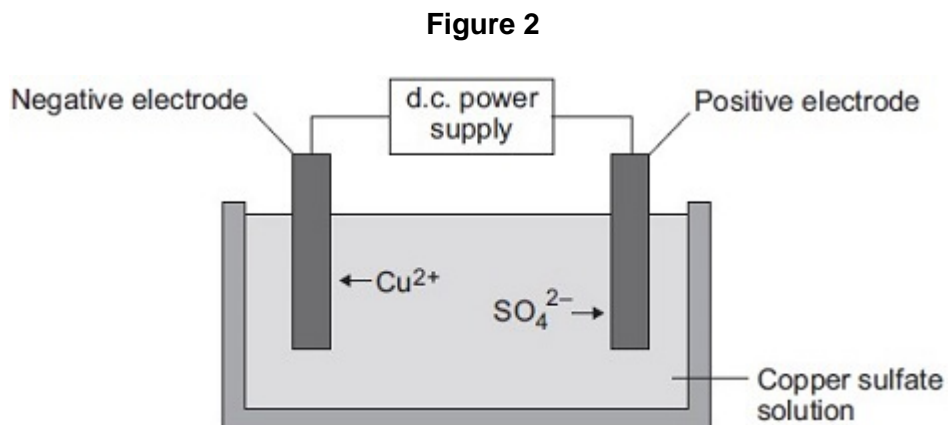
(b) Copper is produced from copper sulfate solution by displacement using iron or by electrolysis.

(i) Complete the word equation.

copper sulfate + iron  $\longrightarrow$  \_\_\_\_\_ + \_\_\_\_\_

(2)

(ii) **Figure 2** shows the electrolysis of copper sulfate solution.



Why do copper ions go to the negative electrode?

---

---

(1)

(c) Suggest **two** reasons why copper should **not** be disposed of in landfill sites.

---

---

---

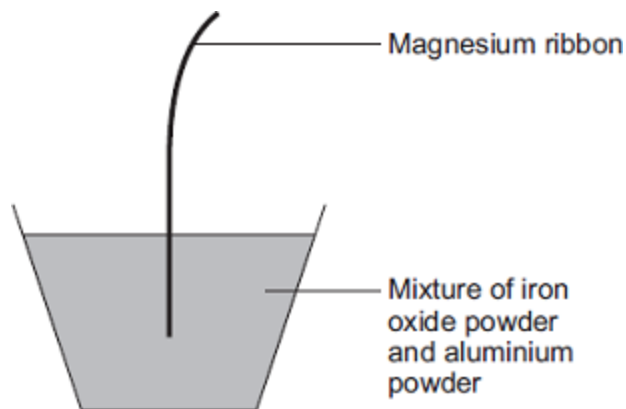
---

(2)

(Total 8 marks)

5.

The diagram shows one way of producing iron.



Iron oxide reacts with aluminium to produce iron.

The symbol equation for the reaction is:



(a) (i) Complete the word equation for this reaction.

iron oxide + aluminium  $\longrightarrow$  iron + \_\_\_\_\_

(1)

(ii) The magnesium ribbon is lit to start the reaction.

Why does the burning magnesium ribbon start the reaction?

---

---

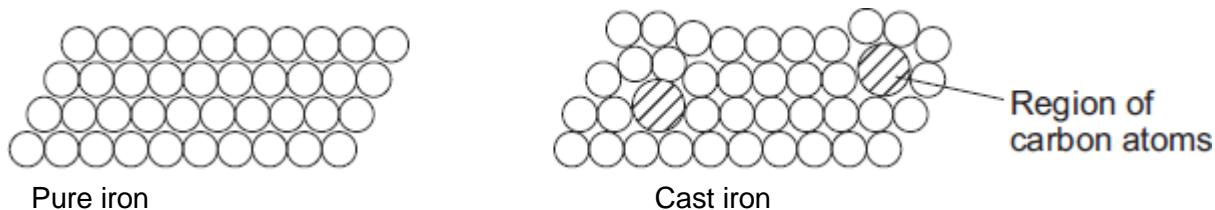
(1)

(b) In industry, iron is produced in the blast furnace when iron oxide is heated with carbon.

The iron from the blast furnace is called cast iron.

Cast iron contains carbon.

The diagrams show the structure of pure iron and cast iron.



Use the diagrams to help you answer the questions.

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

Pure iron is an element because pure iron

contains only one sort of atom.  
is magnetic.  
is a metal.

(1)

- (ii) Suggest why cast iron is harder than pure iron.

---



---



---



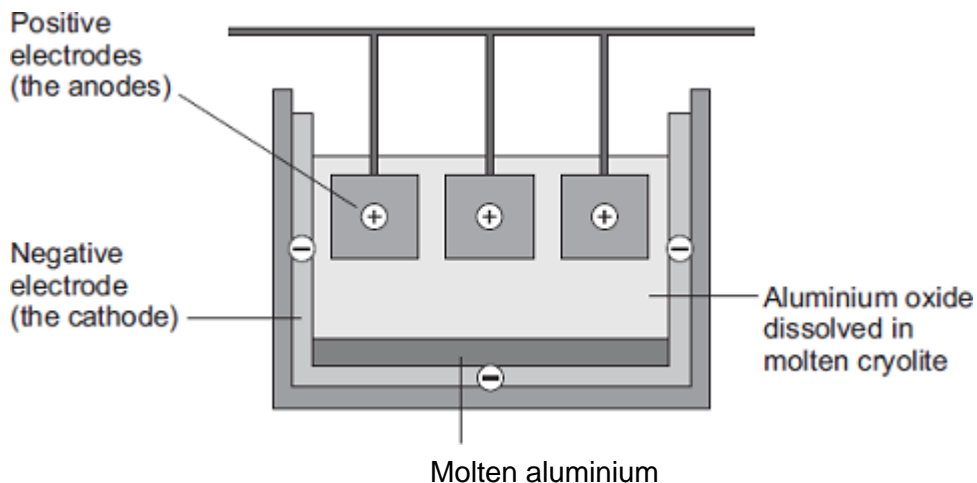
---



---

(2)

- (c) Aluminium is extracted by electrolysis using the ionic compound aluminium oxide.



(i) Aluminium **cannot** be extracted by heating aluminium oxide with carbon.

Suggest why.

---

---

(1)

(ii) Why is aluminium oxide dissolved in molten cryolite?

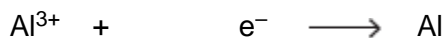
---

---

(1)

(iii) Aluminium metal is produced at the negative electrode (cathode).

Complete the half equation for the process.



(1)

(iv) Use the half equation to state why  $\text{Al}^{3+}$  ions are reduced.

---

---

(1)

(v) Explain why the positive electrodes (anodes) burn away.

Use your knowledge of the products of electrolysis to help you.

---

---

---

---

---

---

---

---

---

---

---

---

(4)

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

(a) Reacting iron oxide with carbon produces iron.

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

The reaction to produce iron from iron oxide is

- decomposition.
- oxidation.
- reduction.

(1)

(b) Aluminium cannot be produced by reacting aluminium oxide with carbon.

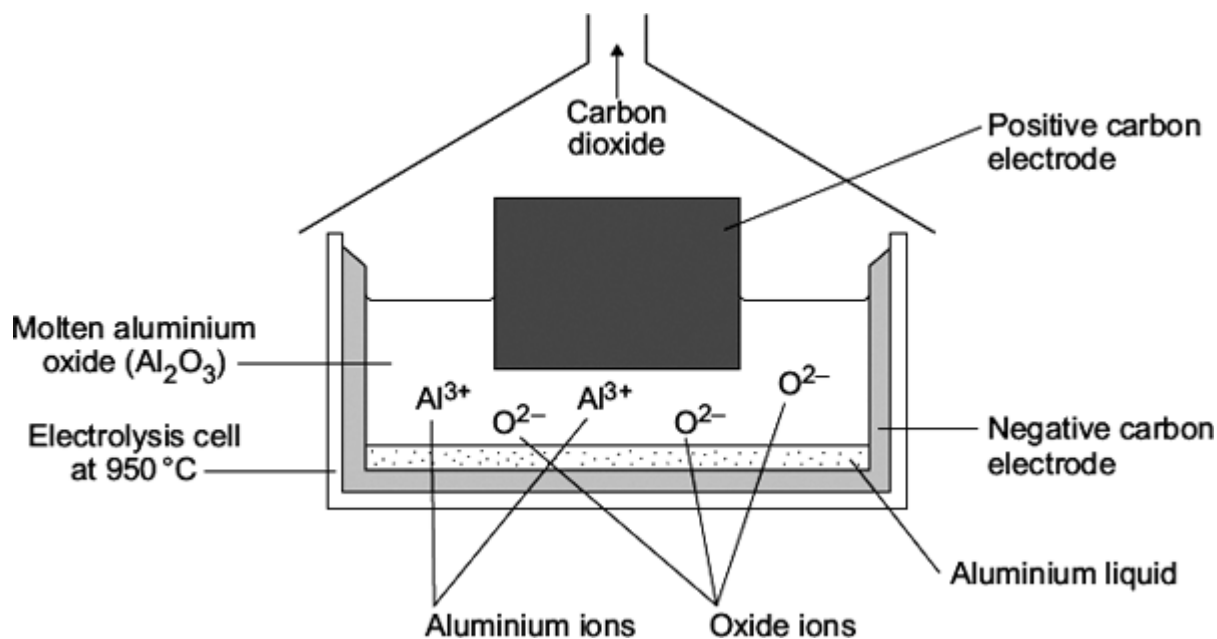
Why does aluminium oxide **not** react with carbon?

Tick ( ✓ ) the correct answer.

Answer	Tick ( ✓ )
aluminium is less reactive than carbon	
carbon is less reactive than aluminium	
oxygen is more reactive than carbon	

(1)

(c) Aluminium can be produced by electrolysis.



Why do the aluminium ions collect at the negative electrode?

---



---



---



---

(2)

(d) Some statements about aluminium are given below.

Tick (✓) **two** statements that are correct reasons why aluminium is used to make cans.

Statement	Tick (✓)
aluminium conducts electricity	
aluminium is not a transition metal	
aluminium has a low density	
aluminium is resistant to corrosion	

(2)



(e) Recycling aluminium cans uses less fossil fuels than producing aluminium from its ore.

Tick (✓) **one** advantage and tick (✓) **one** disadvantage of recycling aluminium to make aluminium cans.

<b>Statement</b>	<b>Advantage Tick (✓)</b>	<b>Disadvantage Tick (✓)</b>
aluminium is the most common metal in the Earth's crust		
less carbon dioxide is produced		
more aluminium ore needs to be mined		
used aluminium cans have to be collected and transported		

**(2)**  
**(Total 8 marks)**