

GCSE Chemistry (9 – 1)

Extracting Metals

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/4
2	/10
3	/6
4	/10
5	/9
6	/13
7	/6
8	/8
Total	/66
%	
Grade	

Information

- The maximum mark for this paper is 66 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. The vast majority of metals exist not as shiny, ready to use elements, but as compounds within in the Earth's crust. Extracting these for our use is hugely important to the world's economy.

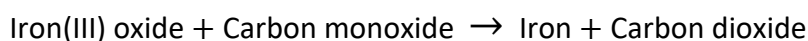
Circle the letter of the correct answer for each of the following questions.

- a) Which of the following metals is most easily extracted from its ore?

A	B	C	D
Copper	Aluminium	Calcium	Iron

(1 mark)

- b) Iron is extracted from iron(III) oxide in a blast furnace. The main reaction is shown in the word equation:



What type of reaction has the iron(III) oxide undergone?

A	B	C	D
Oxidation	Reduction	Neutralisation	Precipitation

(1 mark)

- c) Which row in the table correctly links the metal to its main extraction method?

	Metal	Method of Extraction
A	Aluminium	Reduction with carbon
B	Iron	Electrolysis
C	Gold	Found native (uncombined)
D	Sodium	Heating its ore in air

(1 mark)

- d) Aluminium is a reactive metal extracted by the electrolysis of molten aluminium oxide. Why is electrolysis used for aluminium instead of reduction with carbon?

- A** Aluminium is more reactive than carbon.
- B** Carbon is more reactive than aluminium.
- C** Electrolysis is a cheaper process.
- D** Aluminium oxide is an ionic compound.

(1 mark)

(Total for Question 1 is 4 marks)

2. The table below shows some observations about the reactivity of metals with dilute hydrochloric acid.

Metal	Observations
Iron	A few bubbles are produced but very slowly
Copper	No bubbles are formed.
Calcium	Many bubbles are produced very quickly. Some spitting is seen.
Magnesium	Many bubbles produced quickly but no spitting is seen.

- a) Based on the information above. Place these metals in order of their reactivity.

Least reactive Most reactive

..... (2 marks)

- b) A student observes that when iron is added to dilute acid, it produces bubbles slowly. When magnesium is added to the same acid, it fizzes vigorously.

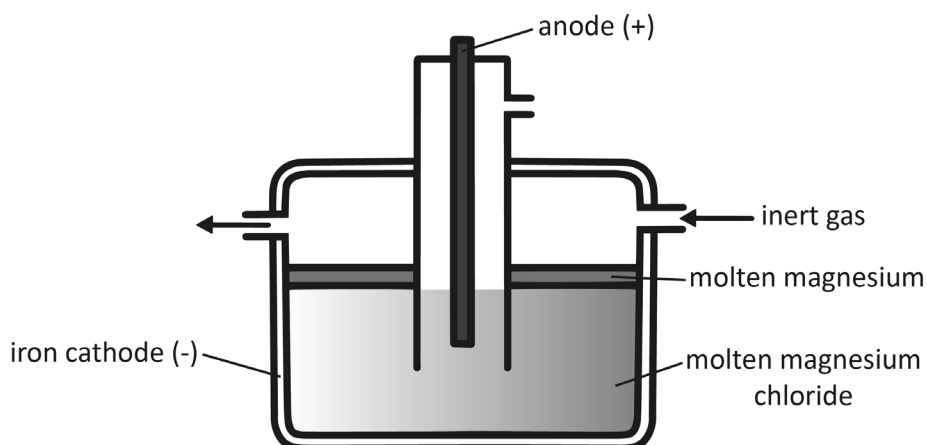
Zinc is between iron and magnesium in the reactivity series.

Predict the observation when zinc is added to the acid and explain your reasoning.

[illegible]

(2 marks)

Magnesium is extracted from its ore by the electrolysis of **molten** magnesium chloride. The figure below shows the set up for this extraction.



- c) Explain why the extraction is carried out **molten** magnesium chloride rather than **solid** magnesium chloride.

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(3 marks)

- d) Explain why magnesium has to be extracted by electrolysis rather than by heating its oxide with carbon.

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(2 marks)

- e) Suggest why an inert gas is blown over the surface of the molten magnesium.

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(1 mark)

(Total for Question 2 is 10 marks)

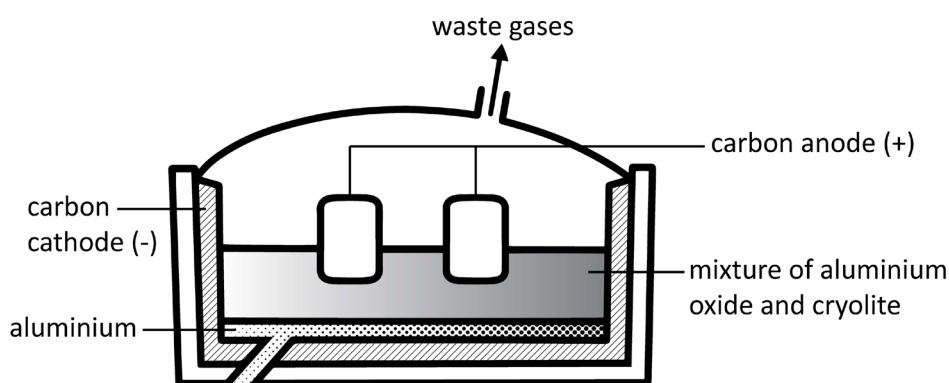
3. Aluminium is a very useful metal for the manufacture of products.

The position of aluminium in the reactivity series of metals is shown in the table below.

Magnesium	More reactive ↓ Less reactive
Aluminium	
Zinc	
Copper	

Aluminium is extracted by the electrolysis.

The figure below shows the extraction of aluminium.



a) Identify the main aluminium ore.

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(1 mark)

b) Why is molten cryolite added to the electrolyte?

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(2 marks)

c) Oxygen is produced at the positive electrode (anode).
Name another gas which is given off at this electrode.

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(1 mark)

d) At the negative electrode (cathode), aluminium ions (Al^{3+}) are reduced to form molten aluminium (Al).
Write the **balanced** half-equation for this reaction.

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(2 marks)

(Total for Question 3 is 6 marks)

4. This question is about iron.

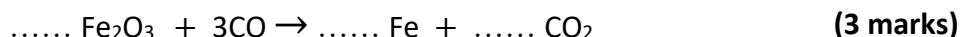
a. Identify the main ore of iron.

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(1 mark)

b. Iron ore is reduced to iron in a blast furnace.

The unbalanced chemical equation for the reaction is shown below.

Balance the equation for this reaction.



c. Which substance, in the equation above acted as the reducing agent.

Give a reason for your answer.

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(2 marks)

Iron is a transition metal. Sodium is a Group 1 metal.

d. Give **two** differences between the properties of iron and sodium.

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(2 marks)

e. Nickel is extracted from nickel oxide by reduction with carbon.

Explain why carbon can be used to extract nickel from nickel oxide.

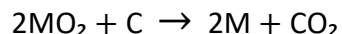
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(2 marks)

(Total for Question 4 is 10 marks)

5. This question is about the extraction of metals.

An unknown metal, M, is extracted from its oxide by reduction with carbon.

The equation for the reaction is:



The sum of the relative formula masses (M_r) of the reactants ($2\text{MO}_2 + \text{C}$) is 186.

- a. Calculate the relative atomic mass (A_r) of M.

Relative atomic masses (A_r): C = 12, O = 16.

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(3 marks)

- b. Identify the unknown metal **M**.

To identify M you should use:

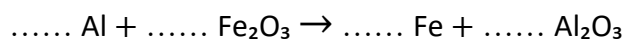
- your answer from part (a)
- the periodic table.

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(2 marks)

The Thermite reaction is sometimes used to produce small amounts of molten iron.

The unbalanced equation for the reaction between aluminium and iron(III) oxide is:



- c. Balance the equation and use it to calculate the percentage atom economy for extracting iron (Fe) in this reaction.

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Atom economy = ... %

(4 marks)

(Total for Question 5 is 9 marks)

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- This image shows a full page of a document template designed for handwriting practice. It features approximately 28 evenly spaced, horizontal grey lines extending across the entire width of the page. The background is plain white, providing a clear guide for letter height and placement. There are no margins, text, or other markings present.

Page | 7

- b. Cars are generally made of steel.

When a car reaches the end of its useful life, the car body which is mostly steel can be recycled, reused or sent to a landfill.

Describe **three** reasons why the steel from a car's body should be recycled and not reused or sent to landfill.

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(3 marks)

Titanium, Ti is a strong, corrosion-resistant metal used in high-performance alloys.

It is extracted from its main ore, titanium dioxide, TiO_2 . A manufacturer needs to choose the best method to produce a sample of high-purity titanium.

The table below shows information about **three** possible reduction methods.

Method	Reactant	Relative cost of reactant	Products
A	Carbon	Low	Titanium solid Carbon monoxide gas Titanium carbide solid
B	Hydrogen	High	Titanium solid Water vapour
C	Copper	Low	No reaction

- c. Evaluate the three methods and justify which one the manufacturer should choose to produce high-purity titanium.

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(4 marks)

(Total for Question 6 is 13 marks)

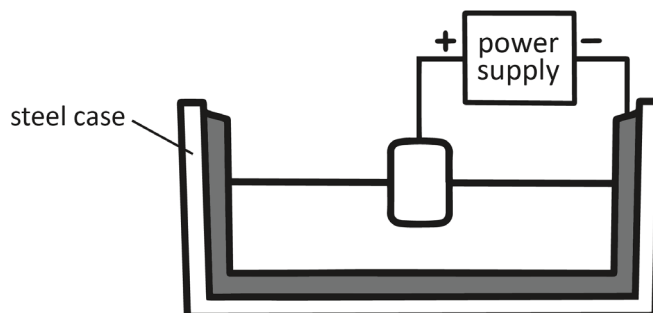
8. Aluminium is extracted by electrolysis of its purified ore.

a. Name the main **ore** of aluminium.

.....

(1 mark)

b. The figure below shows a simplified version of the apparatus used for the extraction of aluminium.



i. Label the cathode in figure above.

ii. The electrolyte contains molten aluminium oxide.

State the product formed at **each** electrode during electrolysis.

Positive electrode:

Negative electrode:

(2 marks)

c. State **two** physical properties that explain why aluminium is used in overhead electrical cables.

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(2 marks)

d. Aluminium oxide has the formula Al_2O_3 .

Calculate the percentage by mass of aluminium in aluminium oxide.

Percentage = ...

(2 marks)

(Total for Question 8 is 8 marks)