PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

CHEMISTRY



EXAM QUESTION PACK

TOPIC 4: EXTRACTING METALS AND EQUILIBRIA: OBTAINING AND USING METALS (PAPER 1)

SCORE	PERCENTAGE
/98	%

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Q1.

Acid solutions contain hydrogen ions.

Aluminium reacts with dilute hydrochloric acid to form a solution containing aluminium ions, Al^{3+}.

Complete the balanced ionic equation for this reaction.

(2)

..... + ... H^+ → ..... Al^{3+} + ...

(Total for question = 2 marks)

(**Q19 1SC0/1CH, June 2018**)

Q2.

Zinc can be extracted from its ore by electrolysis or by heating the ore with carbon.

Give a reason for the method that is used.

(1)

.....

.....

(Total for question = 1 mark)

(**Q02d 1SC0/1CF, SAM 2016**)

Q3.

Most metals are extracted from ores found in the Earth's crust.

The method used to extract a metal from its ore is linked to the reactivity of the metal.

Part of the reactivity series is shown in Figure 14.

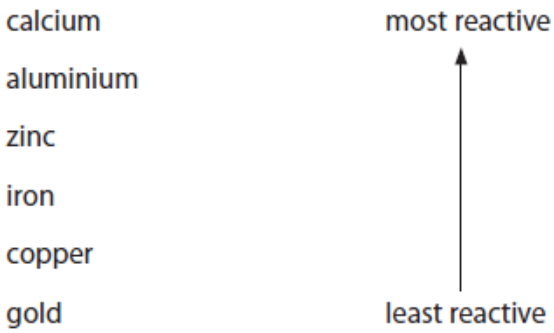


Figure 14

* Aluminium is extracted from its ore by electrolysis.
Iron is extracted from its ore by heating with carbon.
Both metals can also be obtained by recycling.

Explain the advantages of recycling aluminium and iron rather than extracting them from their ores.

(Total for question = 6 marks)

(**Q26 1SC0/1CF, June 2018**)

Q4.

(a) Drinks are often sold in cans.
These cans are made either of aluminium or of steel coated with tin.
The table gives information about these three metallic substances.

metal	cost of 1 kg / £	amount in Earth's crust / %
aluminium	1.31	8
steel (iron)	0.32	5
tin	12.6	0.0002

Use the table to give **two** reasons why it could be more important to recycle tin than to recycle aluminium or steel.

(2)

reason 1

.....

.....

reason 2

.....

.....

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

The reaction for the extraction of aluminium from its ore involves

(1)

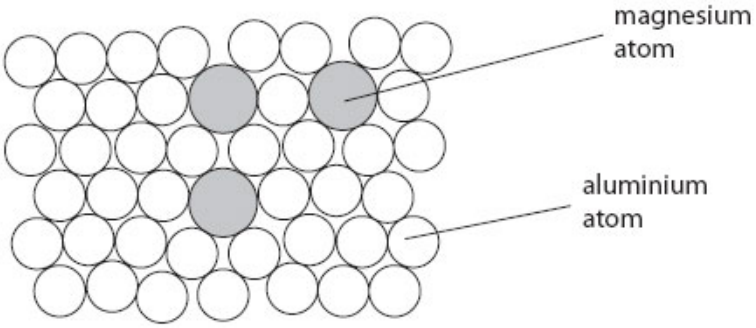
☒ **A** heating with carbon

☒ **B** thermal decomposition

☒ **C** reduction

☒ **D** neutralisation

(c) Magnalium is an alloy of aluminium and magnesium.
The diagram shows the structure of this alloy.



(i) Explain what you understand by the term **alloy.**

(2)

.....

.....

.....

(ii) Explain, in terms of their structures, why magnalium is stronger than pure aluminium.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question = 8 marks)

(**Q03 1SC0/1CH, June 2013**)

Q5.

An investigation was carried out on the reactivity of four metals, **D**, **E**, **F** and **G**.

Equal sized pieces of these metals were placed in excess dilute hydrochloric acid and left for three minutes.

Figure 9 shows the observations of the reactions for metals **D**, **E** and **F**.

metal	observations with dilute hydrochloric acid
D	Bubbles formed quickly. After three minutes all the metal had reacted.
E	Bubbles formed very quickly. No metal remaining after three minutes.
F	A few bubbles were seen to form. The metal looked unchanged after three minutes.
G	

Figure 6

The order of reactivity for these metals is shown in Figure 10.



Figure 7

(i) Use the information in Figure 9 and Figure 10 to suggest the observations that would be made for metal **G**.

(2)

.....

.....

.....

.....

(ii) The dilute hydrochloric acid used in this reaction is a strong acid.

Explain the meaning of the terms **dilute** and **strong acid**.

(4)

dilute

.....

.....

.....

.....

strong acid

.....

.....

.....

.....

(Total for question = 6 marks)

(**QU06a 1SC0/1CH, June 2024**)

Q6.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

This question is about the extraction of metals.

(i) Small amounts of some metals are extracted using displacement reactions.

In one process, zinc dust is used to precipitate cadmium metal from a solution containing cadmium ions.

$$\underset{\text{cadmium ions}}{Cd^{2+}(aq)} + Zn(s) \rightarrow Cd(s) + \underset{\text{cadmium}}{Zn^{2+}(aq)}$$

Explain why this displacement reaction can be described as a **redox reaction**.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

(ii) The formula of the cadmium ion is Cd^{2+}.

The formula of the phosphate ion is PO_4^{3-}.

Which is the formula of cadmium phosphate?

(1)

☒ **A** $Cd_2(PO_4)_3$

☒ **B** Cd_3PO_{12}

☒ **C** $Cd_3(PO_4)_2$

☒ **D** $Cd_3P_2O_8$

(Total for question = 4 marks)

(**QU03b 1SC0/1CH, June 2024**)

Q7.

Figure 8 shows part of the reactivity series of metals.

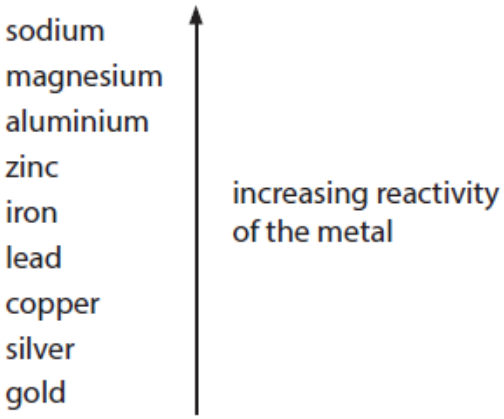


Figure 8

When copper oxide is heated with carbon, the products are copper and carbon dioxide.

(i) Write the word equation for this reaction.

(1)

.....

(ii) In this reaction, copper oxide loses oxygen.

State the type of reaction when copper oxide loses oxygen.

(1)

.....

(iii) In one reaction, 159.0 g of copper oxide was heated with excess carbon to produce 127.0 g of copper.

Use this information to calculate the mass of copper formed, in g, when 238.5 g of copper oxide is reacted with excess carbon.

(2)

.....

.....

mass of copper = ... g

(iv) State why this reaction with copper oxide uses excess carbon.

(1)

.....

.....

(Total for question = 5 marks)

(**QU04c 1SC0/1CF, June 2025**)

Q8.

The reactivity of copper, magnesium and zinc was investigated.
Each metal was placed separately in dilute hydrochloric acid.
The amount of effervescence was observed.

(i) The same mass of metal was used in each experiment.

Which piece of apparatus should be used to find the mass of metal used?

(1)

☒ **A** a balance

☒ **B** a pipette

☒ **C** a stopwatch

☒ **D** a thermometer

(ii) State **two** variables, apart from the mass of the metals, that should be controlled in this investigation.

(2)

1 .....

.....

2 .....

.....

(iii) Magnesium produces the most vigorous effervescence.

Copper does not produce any effervescence.

Give the reason why copper does not produce any effervescence.

(1)

.....

(iv) The magnesium reacts with dilute hydrochloric acid to form

magnesium chloride solution and hydrogen gas.

The equation for the reaction is

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(\text{.....}) + H_2(\text{.....})$$

Fill in the missing state symbols in the spaces provided.

(2)

(Total for question = 6 marks)

(**Q03a 1SC0/1CF, June 2019**)

Q9.

Answer the question with a cross in the box you think is correct (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

This question is about metals and their reactions with acids.

Three equal sized pieces of the metals **E**, **F**, **G** and **H** are put into separate test tubes containing equal volumes of dilute sulfuric acid.

The results in Figure 6 show the test tubes after half a minute.

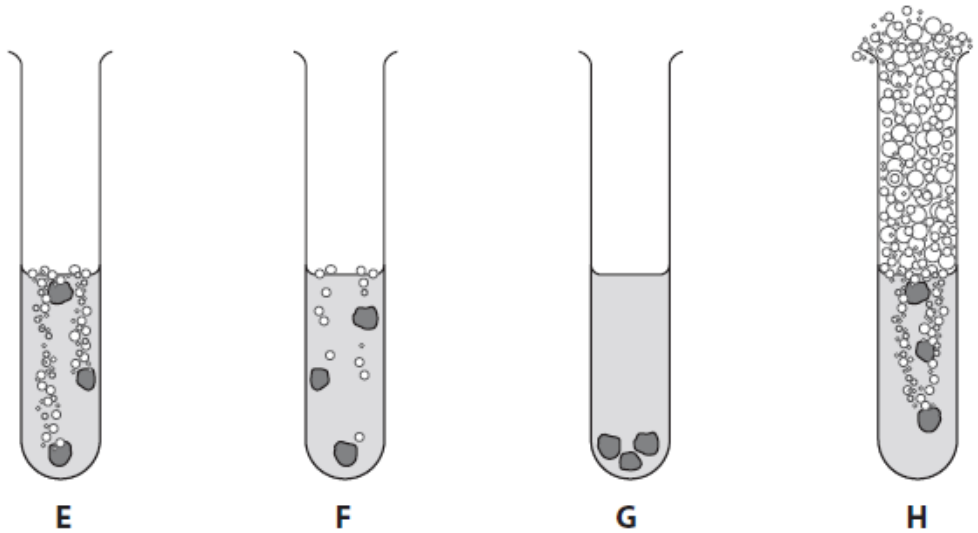


Figure 6

(i) Arrange the metals **E**, **F**, **G** and **H** in order of reactivity.

(2)

metal	
	most reactive
	least reactive

(ii) The bubbles that form are hydrogen.

Which row of the table shows the test and result that confirm the gas is hydrogen?

(1)

		test	result
☒	**A**	put a glowing splint into the gas	the splint relights
☒	**B**	put a lighted splint into the gas	the gas ignites with a squeaky pop
☒	**C**	test the gas with damp litmus paper	the litmus paper turns pink
☒	**D**	test the gas with damp litmus paper	the litmus paper turns white

(Total for question = 3 marks)

(QU03b 1SC0/1CF, June 2025)

Q10.

An ore of iron is mostly iron oxide, Fe_2O_3.
Iron can be extracted from this iron oxide by heating it with carbon.

Balance this equation for the reaction that takes place.

(1)

$$2Fe_2O_3 + \ldots\ldots C \rightarrow \ldots\ldots Fe + \ldots\ldots CO_2$$

(Total for question = 1 mark)

(**Q04c 1SC0/1CF, Nov 2020**)

Q11.

One way to extract metals from land contaminated with metal compounds is phytoextraction.
When plants grow they absorb metal ions through their roots.
The plants are harvested, dried and burned forming an ash.
The ash contains metal compounds.

Plants were grown in a piece of ground contaminated with nickel compounds.

(i) 1 kg of the ash from these plants contained 142.0 g of nickel compounds.

Calculate the percentage by mass of nickel compounds in the ash.

(3)

.....

.....

.....

.....

percentage by mass = ...

(ii) Nickel is extracted from nickel compounds.

State an advantage of extracting nickel by phytoextraction rather than from its ore.

(1)

.....

.....

.....

(Total for question = 4 marks)

(**Q03a 1SC0/1CH, June 2019**)

Q12.

Most copper ores are described as low grade.
This means that the percentage of copper in the ore is very small.

5000 kg of one copper ore was found to contain 42.5 kg of copper.

Calculate the percentage of copper in this ore.

(2)

.....

.....

.....

percentage of copper in ore = ...

(Total for question = 2 marks)

(**Q04d 1SC0/1CF, Nov 2020**)

Q13.

Figure 8 shows part of the reactivity series of metals.

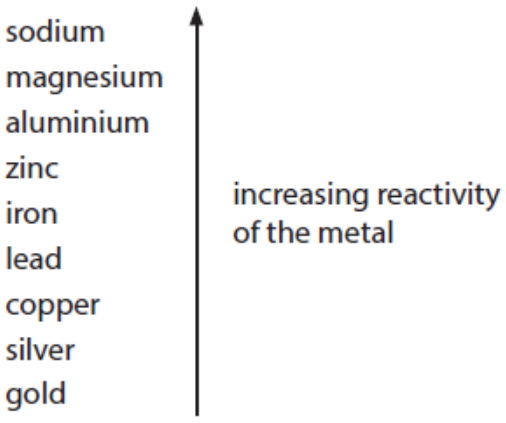


Figure 8

25 000 kg of an ore of iron was found to contain 10 050 kg of iron.

Calculate the percentage of iron in this ore of iron.

$$\text{percentage of metal} = \frac{\text{mass of metal}}{\text{mass of metal ore}} \times 100$$

(2)

.....

.....

percentage of iron in ore = ...

(Total for question = 2 marks)

(**QU04b 1SC0/1CF, June 2025**)

Q14.

Malachite, $Cu_2CO_3(OH)_2$, is a mineral containing copper.

Copper can be extracted from copper oxide by heating the copper oxide with carbon.

A student investigated two methods to extract the maximum mass of copper from copper oxide.

Figure 2 shows the two methods.

method 1	method 2
step 1 place one spatula measure of copper oxide into a beaker	**step 1** place one spatula measure of copper oxide into a glass test tube
step 2 mix the copper oxide thoroughly with carbon powder	**step 2** carefully add carbon powder on top of the copper oxide
step 3 place the mixture into a metal crucible and heat the mixture with a roaring Bunsen flame	**step 3** heat the two layers with a roaring Bunsen flame

Figure 2

Comment on the strengths and weaknesses of these two methods.

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(Total for question = 3 marks)

(**QU04b 1SC0/1CH, June 2025**)

Q15.

Unreactive metals are found as uncombined metals in the Earth's crust.

When iron oxide is heated with carbon, iron is produced.

(i) Complete the word equation for the reaction.

(2)

iron oxide + carbon → ..... +
.....

(ii) What happens to the iron oxide during this reaction?

(1)

☒ **A** the iron oxide burns

☒ **B** the iron oxide is neutralised

☒ **C** the iron oxide is oxidised

☒ **D** the iron oxide is reduced

(Total for question = 3 marks)

(**Q02b 1SC0/1CF, SAM 2016**)

Q16.

The order of reactivity of copper, magnesium and zinc can be determined by the displacement reactions between these metals and solutions of their salts.

You are provided with

- samples of the three metals
- solutions of copper sulfate, magnesium sulfate and zinc sulfate.

Describe the experiments that can be done to determine the order of reactivity of these metals by displacement reactions.

(3)

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.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

(**Q05a 1SC0/1CH, Nov 2021**)

Q17.

This question is about the extraction of metals.

Lead is low in the reactivity series.

Describe how to obtain a sample of lead from some lead oxide in the laboratory.

(2)

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.....

.....

.....

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.....

(Total for question = 2 marks)

(**QU03d 1SC0/1CH, June 2024**)

Q18.

Pieces of zinc react with copper sulfate solution.
Zinc sulfate solution is colourless.

$$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$$

Describe what you would **see** when an excess of zinc is added to copper sulfate solution and the mixture left until the reaction is complete.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

(**Q05a 1SC0/1CH, June 2019**)

Q19.

Devise a simple method to obtain a sample of copper from copper oxide in the laboratory.

(2)

.....

.....

.....

.....

.....

.....

(Total for question = 2 marks)

(**QU04d 1SC0/1CH, June 2022**)

Q20.

Pieces of zinc react with copper sulfate solution.
Zinc sulfate solution is colourless.

$$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$$

This reaction is described as a redox reaction.

Explain, in terms of electrons, which particles have been oxidised and which particles have been reduced in this reaction.

(4)

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

(**Q05b 1SC0/1CH, June 2019**)

Q21.

In one stage of the extraction of lead from its ore, lead oxide is heated strongly with carbon.

The equation for the reaction is

$$2PbO + C \rightarrow 2Pb + CO_2$$

Explain, using this equation, which substance has been oxidised in this reaction.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

(**Q04e 1SC0/1CF, Nov 2020**)

Q22.

Metals can be extracted from ores found in the Earth's crust.

Explain why aluminium cannot be extracted from its ore by heating with carbon but can be extracted by electrolysis.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

(**Q05b 1SC0/1CH, Nov 2021**)

Q23.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(i) One step in the extraction of titanium metal involves the displacement reaction between titanium chloride, $TiCl_4$, and magnesium.

$$TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$$

This equation can be simplified as

$$Ti^{4+} + 2Mg \rightarrow Ti + 2Mg^{2+}$$

Explain why this displacement reaction can be described as a redox reaction.

(3)

.....

.....

.....

.....

.....

.....

(ii) The formula of the sulfate ion is SO_4^{2-}.

Which of the following is the formula of titanium sulfate containing the Ti^{4+} ion?

(1)

☒ **A** $TiSO_4$

☒ **B** Ti_2SO_4

☒ **C** $Ti(SO_4)_2$

☒ **D** $Ti_2S_2O_8$

(Total for question = 4 marks)

(**QU04b 1SC0/1CH, June 2022**)

Q24.

The method used to extract a metal from its ore depends on the position of the metal in the reactivity series.

Aluminium is extracted from its ore by electrolysis.

Explain why this method is used to extract aluminium from its ore.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

(**QU04a 1SC0/1CH, June 2022**)

Q25.

Most metals are extracted from ores found in the Earth's crust.

The method used to extract a metal from its ore is linked to the reactivity of the metal.

Part of the reactivity series is shown in Figure 14.

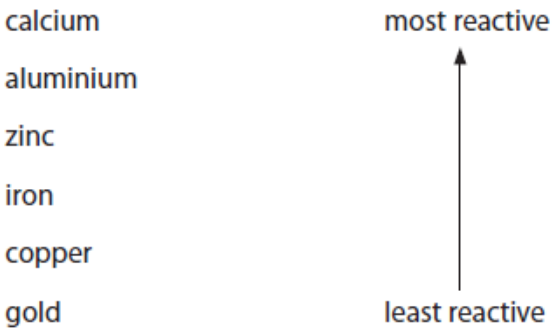


Figure 14

Iron ore contains iron oxide.

Iron is extracted from iron oxide by heating the oxide with carbon.

$$\text{iron oxide} + \text{carbon} \rightarrow \text{iron} + \text{carbon dioxide}$$

(i) In this reaction

(1)

☒ **A** carbon is reduced

☒ **B** iron oxide is neutralised

☒ **C** iron oxide is reduced

☒ **D** iron is oxidised

(ii) The formula of the iron oxide is Fe_2O_3.

Calculate the maximum mass of iron that can be obtained from 240 tonnes of iron oxide, Fe_2O_3.

(relative atomic masses: O = 16, Fe = 56)

(3)

.....

.....

.....

.....

.....

.....

mass of iron = ... tonnes

(Total for question = 4 marks)

(**Q23 1SC0/1CF, June 2018**)

Q26.

Most metals are extracted from ores found in the Earth's crust.

The method used to extract a metal from its ore is linked to the reactivity of the metal.

Part of the reactivity series is shown in Figure 14.

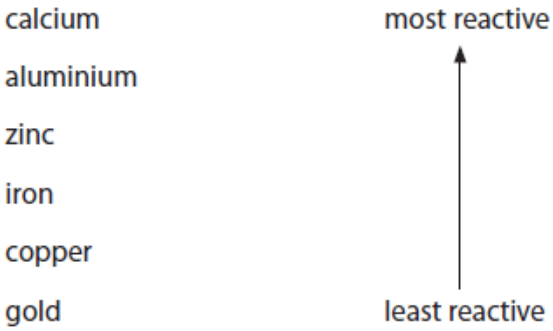


Figure 14

Aluminium cannot be extracted by heating its oxide with carbon.
Aluminium has to be extracted from its oxide by electrolysis.

Explain why.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

(**Q24 1SC0/1CF, June 2018**)

Q27.

Most metals are extracted from ores found in the Earth's crust.

The method used to extract a metal from its ore is linked to the reactivity of the metal.

Part of the reactivity series is shown in Figure 2.

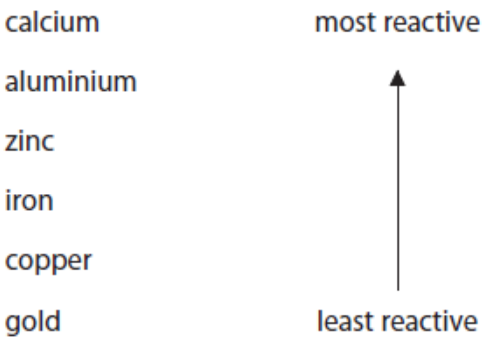


Figure 2

Aluminium cannot be extracted by heating its oxide with carbon.
Aluminium has to be extracted from its oxide by electrolysis.

Explain why.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

(**Q05 1SC0/1CH, June 2018**)

Q28.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The reaction for the extraction of aluminium from its ore involves

(1)

☒ **A** heating with carbon

☒ **B** thermal decomposition

☒ **C** reduction

☒ **D** neutralisation

(**Q09 1SC0/1CH, June 2013**)

Q29.

Most metals are extracted from ores found in the Earth's crust.

The method used to extract a metal from its ore is linked to the reactivity of the metal.

Part of the reactivity series is shown in Figure 2.

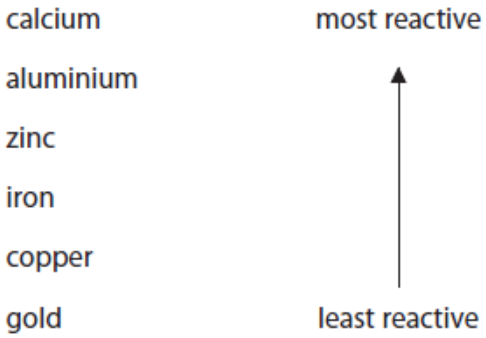


Figure 2

Iron ore contains iron oxide.

Iron is extracted from iron oxide by heating the oxide with carbon.

$$\text{iron oxide} + \text{carbon} \rightarrow \text{iron} + \text{carbon dioxide}$$

(i) In this reaction

(1)

☒ **A** carbon is reduced

☒ **B** iron oxide is neutralised

☒ **C** iron oxide is reduced

☒ **D** iron is oxidised

(ii) The formula of the iron oxide is Fe_2O_3.

Calculate the maximum mass of iron that can be obtained from 240 tonnes of iron oxide, Fe_2O_3.

(relative atomic masses: O = 16, Fe = 56)

(3)

.....

.....

.....

.....

.....

.....

mass of iron = ... tonnes

(Total for question = 4 marks)

(**Q04 1SC0/1CH, June 2018**)

Q30.

Iron is extracted from iron oxide, Fe_2O_3.

In the extraction process the iron oxide is heated with carbon to form iron and carbon dioxide.

Write the balanced equation for this reaction.

(3)

.....

(**Q04 5CH1H/01, June 2015**)

Q31.

(a) Iron can be extracted from a naturally occurring substance called haematite.

State the name given to the naturally occurring substances from which metals are extracted.

(1)

.....

(b) In the extraction of iron, iron oxide is heated with carbon to form iron.
A gas is also formed.

Write the word equation for this reaction.

(2)

.....

.....

(**Q04 1SC0/1CF, June 2015**)

Q32.

The list shows some metals in order of reactivity.

most reactive	sodium
	aluminium
	zinc
	iron
	copper
least reactive	gold

(a) Aluminium and iron are extracted by reduction of their oxides.

State what is meant by reduction.

(1)

.....

.....

(b) Electrolysis and heating with carbon are two methods of reduction.

Explain why aluminium needs to be extracted from its ore by electrolysis, rather than by heating with carbon.

(2)

.....

.....

.....

.....

.....

(**Q03 5CH1H/01, June 2015**)

Q33.

Phytoextraction is an alternative biological method that can be used to extract metals from very low-grade ores.

Give **one** disadvantage of phytoextraction as a method of extraction of metals.

(1)

.....

.....

(Total for question = 1 mark)

(**QU04c 1SC0/1CH, June 2022**)

Q34.

Figure 2 gives information about aluminium and tin.

metal	cost of 1 kg / £	amount in Earth's crust / %
aluminium	1.31	8
tin	12.60	0.0002

Figure 2

Give **two** reasons why it could be more important to recycle tin than to recycle aluminium. Use the information in Figure 2.

(2)

Reason 1

.....

.....

Reason 2

.....

.....

(Total for question = 2 marks)

(**Q02e 1SC0/1CF, SAM 2016**)

Q35.

Aluminium is extracted from aluminium oxide by electrolysis.
Aluminium oxide is made up of ions.

(i) The formula of aluminium oxide is Al_2O_3.

Give the number of ions in the formula Al_2O_3.

(1)

.....

(ii) Complete the balanced equation for the overall reaction by putting numbers in the spaces.

(2)

$$2Al_2O_3 \rightarrow \text{.....} Al + \text{.....} O_2$$

(Total for question = 3 marks)

(**Q04c 1SC0/1CF, June 2019**)

Q36.

Give **two** advantages of recycling metals rather than extracting metals from their ores.

(2)

1 .....

.....

2 .....

.....

(Total for question = 2 marks)

(**Q04b 1SC0/1CF, Nov 2020**)

Q37.

Part of the reactivity series is shown in Figure 8.

most reactive	magnesium
	aluminium
	iron
least reactive	silver

Figure 8

Iron is extracted from its ore by heating with carbon.
Aluminium is extracted from its ore using a different method.

(i) Give the name of the method used to extract aluminium.

(1)

.....

(ii) Explain why aluminium is extracted by a different method rather than heating the ore with carbon.

(2)

.....

.....

.....

.....

(Total for question = 3 marks)

(**Q03c 1SC0/1CH, SAM 2016**)

Q38.

Unreactive metals are found as uncombined metals in the Earth's crust.

Which of the following metals is found uncombined in the Earth's crust?

(1)

☒ **A** aluminium

☒ **B** gold

☒ **C** sodium

☒ **D** zinc

(Total for question = 1 mark)

(**Q02a 1SC0/1CF, SAM 2016**)

Q39.

Answer the question with a cross in the box you think is correct (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

Figure 8 shows part of the reactivity series of metals.

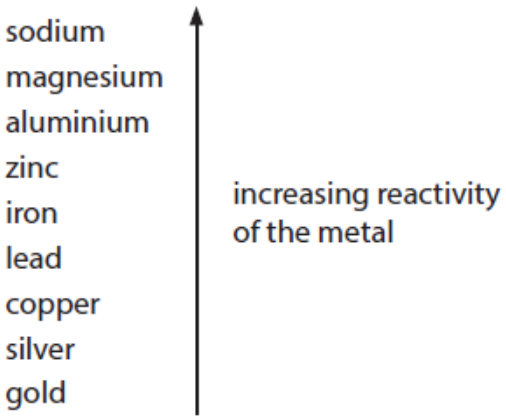


Figure 8

The method used to extract a metal from its ore is related to the metal's position in the reactivity series.

(i) Which metal is found in the Earth's crust as an uncombined element?

(1)

☒ **A** aluminium

☒ **B** gold

☒ **C** lead

☒ **D** sodium

(ii) Name **one** metal in Figure 8 that is normally extracted by electrolysis.

(1)

.....

(Total for question = 2 marks)

(**QU04a 1SC0/1CF, June 2025**)

Q40.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Metals are extracted from substances naturally occurring in the Earth's crust.

Which of these metals is usually found uncombined in the Earth's crust?

(1)

☒ **A** calcium

☒ **B** gold

☒ **C** iron

☒ **D** magnesium

(Total for question = 1 mark)

(**Q04a 1SC0/1CF, June 2019**)