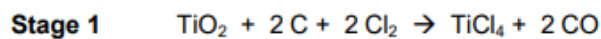
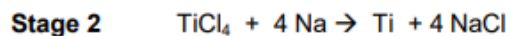


(Extraction of metals (carbon and electrolysis))

Q1 a). (2018)

Titanium is a transition metal.

Titanium is extracted from titanium dioxide in a two stage industrial process.

Suggest **one** hazard associated with **Stage 1**.**[1 mark]**

Q1. b). (2018)

Water must be kept away from the reaction in **Stage 2**.Give **one** reason why it would be hazardous if water came into contact with sodium.**[1 mark]**

Q1. c). (2018)

Suggest why the reaction in **Stage 2** is carried out in an atmosphere of argon and **not** in air.**[2 marks]**

Q1. d). (2018)

Titanium chloride is a liquid at room temperature.

Explain why you would **not** expect titanium chloride to be a liquid at room temperature.

[3 marks]

Q1. e). (2018)

In **Stage 2**, sodium displaces titanium from titanium chloride.

Sodium atoms are oxidised to sodium ions in this reaction.

Why is this an oxidation reaction?

[1 mark]

Q1. f). (2018)

Complete the half equation for the oxidation reaction.

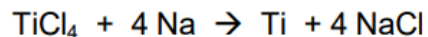
[1 mark]



Q1. g). (2018)

In **Stage 2**, 40 kg of titanium chloride was added to 20 kg of sodium.

The equation for the reaction is:



Relative atomic masses (A_r): Na = 23 Cl = 35.5 Ti = 48

Explain why titanium chloride is the limiting reactant.

You **must** show your working.

[4 marks]

Q1. h). (2018)

For a **Stage 2** reaction the percentage yield was 92.3%

The theoretical maximum mass of titanium produced in this batch was 13.5 kg.

Calculate the actual mass of titanium produced.

[2 marks]

Mass of titanium = _____ kg

Q2. (2019)

This question is about electrolysis.

Aluminium is produced by electrolysing a molten mixture of aluminium oxide and cryolite.

Explain why a mixture is used as the electrolyte instead of using only aluminium oxide.

[2 marks]

Q3. (2019)

Explain why the positive electrode must be continually replaced.

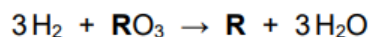
[3 marks]

Q4. a). (2021)

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:



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

[2 marks]

Relative atomic mass (A_r) of **R** = _____

Q4. b). (2021)

Identify element **R**.

You should use:

- your answer to **question 4. a).**
- the periodic table.

[1 mark]

Identity of **R** = _____

Q5. (2021)

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.

Table 2 shows information about three possible methods to extract tungsten from tungsten oxide.

Table 2

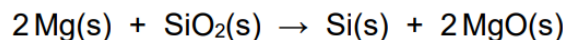
Method	Reactant	Relative cost of reactant	Products
1	Carbon	Low	Tungsten solid Carbon dioxide gas Tungsten carbide solid
2	Hydrogen	High	Tungsten solid Water vapour
3	Iron	Low	Tungsten solid Iron oxide solid

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

[4 marks]

Magnesium also reduces silicon dioxide.

The equation for the reaction is:



Give **one** reason why the products are difficult to separate if magnesium is used to reduce silicon dioxide.

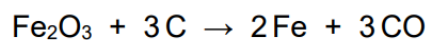
[1 mark]

Q7. (2023)

This question is about displacement reactions.

Iron is extracted from iron oxide by a displacement reaction with carbon.

The equation for the reaction is:



Which substance in the equation is reduced?

Give **one** reason for your answer.

Answer in terms of oxygen.

[2 marks]

Substance reduced _____

Reason _____

Explain what happens to the pH of an acid as the acid is diluted with water.

[2 marks]
