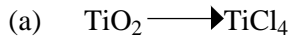


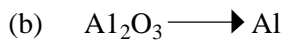
## 2.7 EXTRA QUESTIONS

1. Indicate how **each** of the following conversions can be carried out.



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.....

(2)



.....  
.....

(2)

(Total 4 marks)

2. Write an equation, or two half-equations, to show the essential reactions occurring during the extraction of the following from their oxides.

*Equation(s) for iron*.....

.....

*Equation(s) for aluminium*.....

.....

(3)

(Total 3 marks)

3. By giving the reagent(s), conditions and an equation, state how titanium is extracted from titanium(IV) chloride.

*Reagent(s)* .....

*Conditions* .....

*Equation* .....

(4)

(Total 4 marks)

4. (a) Iron is extracted from the oxide  $\text{Fe}_2\text{O}_3$  by reduction with carbon and carbon monoxide in a Blast Furnace.

(i) In the Blast Furnace, carbon monoxide is produced from carbon in a two-stage process. Write equations to show these two stages.

*Stage 1* .....

*Stage 2* .....

(ii) Write an equation for the reduction of  $\text{Fe}_2\text{O}_3$  by carbon and an equation for the reduction of  $\text{Fe}_2\text{O}_3$  by carbon monoxide.

*Equation for carbon* .....

*Equation for carbon monoxide* .....

(iii) Limestone is added to the Blast Furnace to remove impurities present in the iron ore. Identify the main impurity removed by limestone. Write an equation or equations to show how limestone acts to remove this impurity

*Impurity* .....

*Equation(s)* .....

.....

(7)

(b) Identify a gas which is released from the Blast Furnace which leads to environmental problems. State the environmental problem.

*Gas* .....

*Environmental problem* .....

(2)

(c) Identify another gas which leads to environmental problems when sulphide ores are used in the extraction of metals other than iron. State the environmental problem.

*Gas* .....

*Environmental problem* .....

(2)

(Total 11 marks)

5. Titanium is obtained by the reduction of titanium(IV) chloride.
- (a) Write an equation to show how  $\text{TiCl}_4$  is obtained from  $\text{TiO}_2$ .  
 ..... (2)
- (b) Outline the method employed to obtain titanium from  $\text{TiCl}_4$  by identifying a reducing agent, giving the conditions used and writing an equation for the reduction process.
- Reducing agent* .....  
*Conditions* .....  
 .....  
*Equation* ..... (4)
- (c) State why titanium cannot be extracted directly from the ore  $\text{TiO}_2$  using carbon.  
 ..... (1)
- (Total 7 marks)**

6. Aluminium and titanium are extracted from their purified oxides by different methods.
- (a) Discuss, with the aid of chemical equations, the method used for each metal. (10)
- (b) Explain why each method is chosen. (4)
- (c) Explain why aluminium is recycled although aluminium oxide is in plentiful supply. (3)
- (Total 17 marks)**

7. In this question, credit will be given for appropriate equations.
- (a) Describe the process by which titanium metal is extracted from titanium(IV) oxide. Explain why this extraction process causes titanium to be an expensive metal. (11)
- (b) Explain how the impurity silicon(IV) oxide is removed during the extraction of iron in the Blast Furnace. (4)
- (c) Describe how scrap iron is recycled. Discuss the social and environmental benefits of this recycling. (6)
- (Total 21 marks)**

8. (a) Iron is extracted in a Blast Furnace by a continuous reduction process. Identify **two** reducing agents present in the Blast Furnace. In each case, write an equation to show how the reducing agent reacts in the formation of iron.

*Reducing agent 1* .....

*Equation* .....

*Reducing agent 2* .....

*Equation* .....

(4)

- (b) Titanium is extracted from  $\text{TiO}_2$  using two separate batch processes. For each of these processes, write an equation for the reaction occurring.

*Equation 1* .....

*Equation 2* .....

(4)

- (c) Suggest in general terms how metals can be extracted from sulphide ores. Explain how pollution problems can arise from such extractions.

*Extraction* .....

.....

.....

*Pollution problems* .....

.....

.....

(4)

(Total 12 marks)

9. The extraction of metals involves redox reactions.

(a) In terms of electrons, state what happens in a redox reaction.

.....  
.....

(1)

(b) Titanium is extracted from titanium(IV) oxide in a two-step batch process.

(i) Write an equation for the first step in this process in which titanium(IV) oxide is converted into titanium(IV) chloride. Identify the oxidising and reducing agents in this step.

*Equation* .....

*Oxidising agent* .....

*Reducing agent* .....

(ii) Write an equation for the second step in this process in which titanium(IV) chloride is converted into titanium metal. State two important conditions for this step and in each case explain why the conditions are necessary.

*Equation* .....

*Condition 1* .....

*Explanation* .....

.....

*Condition 2* .....

*Explanation* .....

.....

(10)

(c) Give the major reason why recycling aluminium is economically viable.

.....

(1)

(Total 12 marks)

10. Metal reactivity and required purity are important considerations when choosing the method of extracting a metal. Each of the following is a reduction process used in the industrial extraction of one or more metals from its ore.

- Method 1     high temperature reaction between an oxide and carbon
- Method 2     electrolysis of a molten compound
- Method 3     displacement from a compound using a more reactive metal

- (i) For each method of extraction, identify **one** metal which is extracted using this process and write an equation for the reaction in which the metal is formed.
- (ii) Give **two** reasons why Method 3 is a very expensive extraction process.
- (iii) When beryllium oxide is heated with carbon to a very high temperature, beryllium carbide,  $\text{Be}_2\text{C}$ , is formed. This carbide reacts with water to form beryllium hydroxide and methane. Write an equation for the reaction of beryllium carbide with water.

(Total 10 marks)

11. (a) Explain, with the aid of equations, how the silicon-containing impurity in iron ore is removed in the Blast Furnace.

(5)

- (b) Describe how aluminium is manufactured from purified bauxite. Illustrate your answer by writing equations. State the major economic benefit arising from the recycling of aluminium. What is the major problem associated with this recycling process?

(7)

(Total 12 marks)

12. (a) When iron(III) oxide is reduced in the Blast Furnace, both carbon and carbon monoxide act as reducing agents.

- (i) Write an equation to illustrate how carbon monoxide is formed in the Blast Furnace.

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- (ii) Write an equation to illustrate how carbon monoxide reduces iron (III) oxide.

.....

- (iii) Suggest in terms of collisions why, in the Blast Furnace, carbon monoxide reacts more rapidly with iron (III) oxide than does carbon.

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.....

(4)

(b) State why carbon is not used to reduce the oxide of titanium to the metal.

.....

(1)

(c) Give **two** reasons why titanium is a more expensive metal than iron.

*Reason 1* .....

*Reason 2* .....

(2)

(Total 7 marks)

**13.** Reducing agents are used in the extraction of metals.

(a) In terms of electrons, state the function of a reducing agent.

.....

(1)

(b) Identify a reducing agent used in the extraction of iron. Write an equation for the redox reaction in which iron is formed from iron(III) oxide using this reducing agent.

*Reducing agent* .....

*Equation* .....

(2)

(c) Identify a reducing agent used to obtain titanium metal from titanium(IV) chloride. In addition to a high temperature, state a condition that is used for this reaction and explain why this condition is necessary.

*Reducing agent* .....

*Condition* .....

*Explanation* .....

.....

(3)

(d) (i) State **two** essential conditions used for the electrolytic extraction of aluminium from aluminium oxide.

*Condition 1* .....

*Condition 2* .....

(ii) Write an equation to illustrate how aluminium is formed from aluminium ions in this process.

.....

(3)

(Total 9 marks)

14. In this question, where appropriate, illustrate your answer with equations.

Explain how iron is produced in the Blast Furnace from an iron ore that does not contain sulphur impurities. In your answer, state the source of the energy for this process and mention any environmental problems that may arise from the operation of the Blast Furnace.

Explain why limestone is added to the Blast Furnace.

(Total 10 marks)

15. Iron is extracted from iron(III) oxide in a continuous process, whereas titanium is extracted from titanium(IV) oxide in a batch process.

(a) Suggest why a high-temperature batch process is less energy-efficient than a high-temperature continuous process.

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.....

(2)

(b) Write an overall equation for the reduction of iron(III) oxide in the Blast Furnace.

.....

(2)

(c) Write two equations to show how titanium is extracted from titanium(IV) oxide in a two-stage process.

*Equation for stage 1* .....

*Equation for stage 2*.....

(4)

(d) Give the major reason, other than its production in a batch process, why titanium is a more expensive metal than aluminium.

.....  
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(1)

(e) Give the major reason why aluminium is more expensive to extract than iron.

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(1)

(Total 10 marks)