Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Chemical Equilibria, Le Chatelier's Principle And Kc

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Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

Sulfuric acid is made from SO_3 which can be manufactured in a series of stages from iron(II) disulfide (FeS_2), found in the mineral iron pyrites.

(a) In the first stage, FeS_2 is roasted in air to form iron(III) oxide and sulfur dioxide.

(i) Balance the following equation for this reaction.

.....FeS_2 + ...O_2 → .....Fe_2O_3 + ...SO_2

(1)

(ii) Deduce the oxidation state of sulfur in each of the following compounds.

SO_2 _____

FeS_2 _____

(2)

(b) In the second stage of the manufacture of sulfuric acid, sulfur dioxide reacts with oxygen. The equation for the equilibrium that is established is shown below.

$$SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g) \qquad \Delta H = -98 \text{ kJ mol}^{-1}$$

State and explain the effect of an increase in temperature on the equilibrium yield of SO_3

Effect of increase in temperature on yield _____

Explanation _____

_____

_____

(3)

(c) In the extraction of iron, carbon monoxide reacts with iron(III) oxide. Write an equation for this reaction and state the role of the carbon monoxide.

Equation _____

Role of the carbon monoxide _____

(2)

(Total 8 marks)

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Q2.

The method of extraction of zinc has changed as different ores containing the element have been discovered and as technology has improved.

Extraction process 1

In the earliest process, calamine (impure zinc carbonate) was heated with charcoal in earthenware pots. This two-stage process gave a low yield of zinc.

$$ZnCO_3(s) \rightarrow ZnO(s) + CO_2(g)$$

$$ZnO(s) + C(s) \rightarrow Zn(s) + CO(g)$$

Extraction process 2

Deposits of calamine were being used up and a new two-stage process was developed using zinc sulfide ores. All of the waste gases from this process were released into the atmosphere.

$$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$$

$$ZnO(s) + C(s) \rightarrow Zn(s) + CO(g)$$

Extraction process 3

The modern process uses the electrolysis of aqueous solutions of very pure zinc sulfate. The first step in this process is the same as the first step in Extraction process **2**. The second step uses sulfuric acid made from the SO_2 collected in the first step. The third step involves the electrolysis of zinc sulfate solution to form pure zinc.

$$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$$

$$ZnO(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2O(l)$$

$$ZnSO_4(aq) \xrightarrow{\text{electrolysis}} Zn(s)$$

(a) In the first stage of Extraction process **1** the following equilibrium is established when zinc carbonate is heated in a closed container.

$$ZnCO_3(s) \rightleftharpoons ZnO(s) + CO_2(g)$$

Use Le Chatelier's principle to suggest and explain the effect on the yield of zinc oxide of allowing the carbon dioxide to escape from the container.

_____

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_____

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(3)

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(b) State and explain **one** environmental reason why Extraction process **3** is an improvement over Extraction process **2**.

(3)

(c) Give **one** reason why Extraction process **3** is an expensive method of making zinc but one which is justified in terms of the product formed.

(2)

(d) Deduce the half-equation for the formation of zinc from zinc ions during the electrolysis of zinc sulfate solution and identify the electrode at which this reaction occurs.

(2)

(e) Identify **one** reaction from the three extraction processes that is **not** a redox reaction and state the type of reaction that it is. In terms of redox, state what happens to the carbon in Extraction process **2**.

(3)

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(f) Zinc and magnesium both react with steam in a similar way. Write an equation for the reaction of zinc with steam and name the products of this reaction.

_____

_____

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_____

(2)

(Total 15 marks)

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