

The Royal University of Bhutan
Paro College of Education
Spring Semester Examination - 2012

B.Ed(S) IV- Electrochemistry, Sulphur and its Compounds (CHE409)

Full mark: 100

Pass Mark: 50

Time: 3hrs

Instruction:

1. *Do not write for the first ten minutes. This time is to be spent in reading the questions.*
 2. *This question paper consists of 5 printed pages with two sections A & B. Section A is short answer type and Section B subjective type.*
 3. *All the questions from Section A are compulsory and Section B has choice (Answer any six questions from seven questions)*
 4. *You are allowed to use **fx82** or **fx100** scientific calculator only.*
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Section A (40 marks)

Instruction: Answer all the Questions.

Question 1

Each question carries four possible answers. Choose the most appropriate answer from the given options. **(10 X 2 = 20 marks)**

- a. Which of the following show higher degree of ionization?
i. CH_3COOH ii. HCl iii. $\text{C}_6\text{H}_5\text{COOH}$ iv. NaOH
A. i & ii
B. ii & iii
C. iii & iv
D. ii & iv
- b. If the oxidation potential of Silver is -0.799 V and Lithium is 3.045 V, the potential for the cell given below is;
$$\text{Ag} \mid \text{Ag}^+_{(1.0\text{ M})} \parallel \text{Li}^+_{(1.0\text{ M})} \mid \text{Li}$$

A. + 3.844 V
B. - 3.844 V
C. + 2.246 V
D. - 2.246 V
- c. If 18,000 coulombs of electricity is passed for 30 minutes, the current strength of electricity through an electrolyte is equal to;
A. 20 A.
B. 15 A.
C. 10 A.
D. 5 A.

- d. The following are the functions of a Salt Bridge **EXCEPT**, it;
 - A. completes the circuit.
 - B. prevents excess current.
 - C. balances the ionic mass.
 - D. prevents the physical contact of solutions.

- e. During the calculation of mole of a substance with regard to its molecular weight, the mole is.....proportional to its molecular weight.
 - A. indirectly
 - B. directly
 - C. inversely
 - D. not

- f. Temperature has impact on electrolysis, as temperature increases the ionic concentration in the solution;
 - A. decreases.
 - B. remains constant.
 - C. increases.
 - D. has no effect.

- g. $\text{H}_2\text{S}_2\text{O}_7$ can be called by various names, one of the following is not the chemical name of $\text{H}_2\text{S}_2\text{O}_7$;
 - A. Oleum.
 - B. Pyrosulphuric acid
 - C. Orthosulphuric acid
 - D. Parasulphuric acid.

- h. In pure water the concentration of;
 - A. H^+ is equal to OH^- ions.
 - B. H^+ is more than OH^- ions.
 - C. OH^- is more than H^+ ions.
 - D. H^+ is double of OH^- ions.

- i. Sulfuric acid referring to the glassy appearance of the hydrated sulfate salts is also known as;
 - A. White vitriol
 - B. Oil of vitriol
 - C. Blue vitriol
 - D. Green vitriol

- j. The expression " $W = Z \times c \times t$ " in Faraday's Law, Z is;
 - A. amount of charge.
 - B. electrochemical equivalent.
 - C. equivalent weight.
 - D. chemical equivalent.

Question 2

Define the following with an example each:

(1x5marks)

- Electrochemical equivalence.
- Acid anhydrides.
- Galvanic corrosion.
- Allotropy.
- Degree of freedom.

Question 3

State whether the following are TRUE or FALSE

(1x5 marks)

- The electrode with lower potential is taken as cathode and with higher potential as anode.
- Extraction of Sulphur by Sicilian process is less economical than Frasch process.
- Lower current strength for longer duration of time favour smooth metal coating during electroplating.
- Sulphur dioxide is prepared from SO_3 .
- Flow of electrons in the electrolytic process occurs from electrode of higher E to lower E.

Question 4

Differentiate the following with the area specified in the bracket for each question. Give appropriate example wherever possible:

(2 x 5 marks)

- Electrolysis of CuSO_4 Solution using Pt-electrodes and Cu-electrode. (**half cell reaction involved**)
- Electrode potential and Standard Electrode potential (**definition with condition**)
- Strong Electrolyte and Weak Electrolyte. (**degree of ionization with example**)
- Rhombic Sulphur and Monoclinic Sulphur (**With respect to their preparation**)
- Electrolytic cell and Electrochemical cell (**convention used on electrodes**)

Section B (6 x 10 = 60 marks)

Instruction: Answer any *SIX* Questions.

Question 5

(5 + 2 + 3 marks)

- a. The three electrolytic solution of dil: H_2SO_4 , CuSO_4 and ZnSO_4 are arranged in series and electrolytic process is carried out. If 2 g of H_2 is produced by the current in the first cell, calculate
- The equivalent weight of Zn.
 - The weight of Cu deposited in the second cell.
 - The weight of Zn deposited in the third cell.
 - The volume of H_2 evolved in the first cell.
- iv. How are these three cells arranged?
(Given $\text{Zn} = 65.4$ $\text{Cu} = 63.4$)
- b. State at least two uses of SO_2 gas.
- c. Explain briefly the method of extraction of sulphur by Sicilian process.

Question 6

(4 + 3 + 3 marks)

- a. Explain briefly the bleaching action of SO_2 . Compare and contrast between the bleaching action of SO_2 and Cl_2 .
- b. With the help of a diagram, explain the laboratory preparation of SO_2 ?
How is the gas collected? Give reasons.
- c. The E°_{cell} of the electrochemical cell is 0.76 V, calculate the standard oxidation electrode potential of Zn/Zn^{2+} when Zn electrode is dipped in 1 M ZnSO_4 solution and it is combined with Standard Hydrogen Electrode to form the complete cell.
What would be the standard reduction electrode potential of anode used above?

Question 7

(4 + 2 + 4 marks)

- a. Construct Daniell Cell. Explain briefly with the half cell (cathodic and anodic reactions) and its overall representation.
- b. What is the potential for the cell? The reduction potential for the following electrodes are ($E_{\text{Cu}} = 0.34\text{V}$ and $E_{\text{Li}} = -3.05\text{V}$)
 $\text{Cu} \mid \text{Cu}^{2+}_{(1.0\text{M})} \parallel \text{Li}^{+}_{(1.0\text{M})} \mid \text{Li}$
- c. Explain Leclanche Cell or dry cell with the help of a diagram and also explain the functioning of it.

Question 8

(4 + 2 + 2 + 2 marks)

- Determine the EMF or standard reduction potential of the Zn electrode immersed in 0.1M ZnSO₄ solution at 25 °C. ($E^{\circ}_{\text{red/elec}}$ for Zn electrode is -0.76 V)
- What is the relationship between Electric Work and Gibb's Free Energy?
- State the relationship between Electrochemical constant/equivalent (Z) and Chemical Equivalent (E).
- One Faraday = 96,500 coulomb. How is this figure obtained?

Question 9

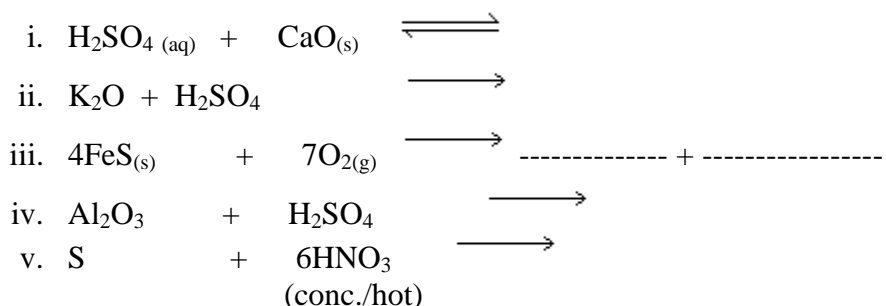
(4 + 3 + 3 marks)

- Illustrate with the help of diagram, the working of Standard Hydrogen Electrode (SHE). Why platinum is used as an electrode in SHE?
- State the factors that affect electrolytic process. Discuss any two factors.
- Explain the action of SO₃ with basic oxide, water and an alkali.

Question 10

(5 + 5 marks)

- Describe the industrial preparation of H₂SO₄ by Contact process.
- Complete and balance the following chemical equations:

**Question 11**

((3 x 2) + 4)

- Give reason for the following:
 - Electrometallurgy is applicable for the extraction of metals like Al, Na, K etc.
 - The anode in the voltaic cell has negative conventional sign.
 - Electrolyte has to be in its aqueous or fused state during electrolysis.
- Explain different phases of Sulphur with the help of Phase Diagram.