

4 SEM TDC CHM M 1

2023

(May/June)

CHEMISTRY

(Major)

Course : 401

(**Physical Chemistry**)

Full Marks : 48

Pass Marks : 14

Time : 2 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct option : 1×4=4

(a) What is the necessary condition for a reaction to be spontaneous at all temperatures?

(i) ΔS should be negative and ΔH should be positive

(ii) ΔS should be positive and ΔH should be negative

(iii) ΔS and ΔH should be positive

(iv) ΔS and ΔH should be negative

(2)

(b) Which of the following laws states that, "when a system is at absolute zero temperature, its entropy is equal to zero"?

(i) Zeroth law of thermodynamics

(ii) First law of thermodynamics

(iii) Second law of thermodynamics

(iv) Third law of thermodynamics

(c) Hydrogen electrode which is the reference electrode can be used as which of the following?

(i) Anode only

(ii) Cathode only

(iii) Anode or cathode

(iv) Salt bridge

(d) A type of battery which can be charged, discharged into a load and then recharged many times is called

(i) rechargeable battery

(ii) secondary battery

(iii) primary battery

(iv) Both (i) and (ii)

(3)

2. Answer the following questions : $2 \times 6 = 12$

(a) State and explain Nernst heat theorem.

(b) Write the relationship between molar conductance and specific conductance. Write their SI units.

(c) Write a short note on Debye-Falkenhagen effect.

(d) Write the differences between electrolytic cell and galvanic cell.

(e) What do you mean by anomalous transference number?

(f) The specific conductivity of 0.01 N solution of KCl at 298-K is $0.0014114 \text{ S cm}^{-1}$. If the resistance of the solution is 725Ω , then find the cell constant.

3. Answer any two of the following questions : $4 \times 2 = 8$

(a) Derive an expression for the entropy change for isothermal mixing of ideal gases.

(b) Discuss the criteria for spontaneity of a reaction in the light of Gibbs-Helmholtz equation.

(c) Discuss how the absolute entropy of a pure substance can be determined using the third law of thermodynamics.

(4)

4. Answer any *three* of the following questions :
4×3=12

(a) The molar conductances at infinite dilution of HCl, NaCl and NaZ (sodium crotonate) are 4.25×10^{-2} , 1.25×10^{-2} and $8.0 \times 10^{-3} \text{ S m}^2 \text{ mol}^{-1}$ respectively. Calculate the molar conductance of crotonic acid (HZ) at infinite dilution. The specific conductance of a 0.001 M aqueous solution of crotonic acid (HZ) at 25 °C is $3.8 \times 10^{-3} \text{ S m}^{-1}$. Find the degree of dissociation of crotonic acid at 25 °C. 3+1=4

(b) What is transport number? State the Hittorf's rule. How is this rule related to transport number of an ion? 1+1+2=4

(c) Write short notes on any *two* of the following : 2×2=4

(i) Asymmetric effect

(ii) Wien effect

(iii) Walden's rules

(d) Write the principle of conductometric titration. Mention the advantages of conductometric titrations. 2+2=4

(5)

5. Answer any *two* of the following questions :
6×2=12

(a) What are concentration cells? Derive an expression for the e.m.f. of a concentration cell without transference. 2+4=6

(b) Describe how the pH of a solution can be determined with the help of glass electrode. 6

(c) (i) Deduce the Nernst equation for cell potential. 3

(ii) Calculate the e.m.f. of the following cell. Given that the standard potentials of Ag/Ag⁺ and Zn/Zn²⁺ half cells are +0.80 V and -0.76 V respectively : 3


