

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2021

Course: Physical Chemistry III

Program: BSc (H) Chemistry

Course Code: CHEM 2003

Semester: III

Duration: 03 hrs.

Max. Marks: 100

Instructions: Read the instructions given below carefully:

1. All questions are compulsory.
2. Internal choice is given in question 4 of Section B and question 2 of section C.

SECTION A

S. No.		Marks	CO
Q 1	Calculate the emf of a Daniel cell at 25 °C, when the concentration of ZnSO ₄ and CuSO ₄ are 0.001 M and 0.1 M respectively. The standard potential of cell is 1.2 volts.	4	CO1
Q 2	Calculate how long a hydrogen atom will remain on the surface of a solid at 298 K if its desorption activation energy is 15 kJ mol ⁻¹ . Assume that $\tau_0 = 10^{-13}$ s.	4	CO1
Q 3	Suggest the possible maximum number of phases that can co-exist in the following systems: a) Lead and silver alloy system. b) Potassium iodide-water system	4	CO1
Q 4	Differentiate between: a) Galvanic cell and Electrolytic cell b) Electrode potential and cell e.m.f.	4	CO2
Q 5	A particular mass of charcoal absorbs a large volume of ammonia than of hydrogen at a given temperature. Explain.	4	CO2

SECTION B

Q 1	State the phase rule. Explain the various terms used in it. Discuss the derivation of the phase rule from thermodynamic considerations.	10	CO1
Q 2	The specific volumes of ice and water at 0 °C are 1.0907 cm ³ and 1.0001 cm ³ , respectively. What would be the change in melting point of ice per atm increase of pressure? Heat of fusion of ice = 79.8 cal g ⁻¹ .	10	CO1
Q 3	Discuss BET theory of multilayer adsorption. Write the BET equation and explain the terms involved in this equation.	10	CO2

<p>Q 4</p>	<p>A cell uses Zn^{2+} / Zn and Ag^+ / Ag electrodes. Write the cell representation, half-cell reactions and net cell reaction. Calculate the EMF of the cell. Given $E^0 Zn^{2+} / Zn = -0.76 V$ and $E^0 Ag^+ / Ag = 0.8V$.</p> <p style="text-align: center;">OR</p> <p>Describe a typical galvanic cell and show how the chemical energy is converted to electrical energy. What is the relation between free energy and EMF of a cell?</p>	<p>10</p>	<p>CO3</p>
<p>SECTION-C</p>			
<p>Q 1</p>	<p>(a) Define the term: ionic mobility. Derive the relation between ionic mobility and molar ionic conductance. How is ionic mobility determined experimentally?</p> <p>(b) Discuss in details the various applications of adsorption in industry and in everyday life.</p>	<p>10+10</p>	<p>CO2</p>
<p>Q 2</p>	<p>(a) Discuss the salient features of phase diagram of Sulphur system. Why can four phases of heterogeneous system not exist at equilibrium?</p> <p style="text-align: center;">OR</p> <p>What do you understand about Electrochemical series? Describe briefly the various uses to which the series can be put. Explain why Zn reacts with H_2SO_4 to give H_2 gas but Ag does not react.</p> <p>(b) The vapour pressure of water at $95^\circ C$ is found to be 634 mm. What would be the vapour pressure at a temperature of $100^\circ C$? The heat of vapourisation in this range of temperature may be taken as $40593 J mol^{-1}$.</p> <p style="text-align: center;">OR</p> <p>Calculate the number of components, number of phases and degree of freedom of the following system:</p> <p>(i) A liquid at critical temperature</p> <p>(ii) A binary azeotrope</p>	<p>10+10</p>	<p>CO3</p>