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M. Sc. Chemistry, I Semester
End-term Examination 2023

Paper Name: Physical Chemistry I
Time: 3 hours

Paper Code: MCHCC101
Maximum Marks: 60

Note: This paper has 3 sections A, B, and C, Attempt all the three sections

Section A: Answer *all* the questions; **Section B:** Answer *any 2* out of 4; **Section C:** Answer *all* the questions, each question has an *internal choice*

Abbreviations Used

CLO- Course Learning Outcome, PLO- Program learning Outcome, BTL- Bloom Taxonomy Level: BT level 1-Remember; BT level 2-Understand; BT level 3-Apply; BT level 4-Analyse; BT level 5-Evaluate, BT level 6-Create

Q.No

SECTION A

BTL CLO PLO

Attempt all questions

(10*1.5= 15 Marks)

A 1. Discuss about the criteria for feasibility of a process.	2	1	1
A 2. Describe the variation of chemical potential with pressure.	4	1	2
A 3. Calculate the entropy change when 10^{-2} m^3 of an ideal gas ($C_P = 2.5R$) at 27°C and $1.01 \times 10^5 \text{ Nm}^{-2}$ pressure, are heated at constant pressure to 127°C .	5	2	3
A 4. Discuss the relation between symmetry factor and overpotential.	3	5	2
A 5. Explain the significance of half wave.	1	5	3
A 6. Briefly discuss about the Ilkovic equation.	4	5	2
A 7. Write the Hamiltonian for the He and Li atoms.	4	1	1
A 8. Differentiate between normalized and orthogonal functions.	6	4	1
A 9. Discuss the important industrial applications of the nanocatalysts.	2	3	2
A 10. What do you understand from the electrokinetic phenomenon?	3	1	1

SECTION B

Attempt any two out of four

(2*10=20 Marks)

B 1. Briefly discuss about the Debye-Huckel theory for electrolytic solutions.	2	1	1
B 2. Establish the relation of the Butler Volmer equation for the non-equilibrium drift-current density across the metal-solution interface and discuss various cases of Tafel plots.	4	5	3
B 3. Derive the solution for particle in an infinite one-dimensional box, with potential energy zero inside the box. Normalize the wavefunctions.	4	1	2
B 4. Derive the kinetic expression for Langmuir absorption isotherm. Also discuss the properties and modifications of BET.	2,4	3	3

SECTION C

Attempt *all* questions, each question has an Internal choice

(5*5=25 Marks)

C 1. Differentiate between fugacity and activity, and how they are related to chemical potential.?

1 1 1

OR

Discuss briefly the applications of the phase rule of three component systems.

1 1 1

C 2. The molar entropy of an ideal gas ($C_p = 20.9 \text{ J K}^{-1}$) at 298 K is $146.0 \text{ J K}^{-1} \text{ mol}^{-1}$. Find its value at 500 K.

5 4 2

OR

Discuss the method to determine the partial molar quantities.

5 4 2

C 3. Give a detailed account of the thermodynamics of polarizable interface.

3 2 2

OR

Derive the expression for the Nernst Planck equation.

3 2 2

C 4. Explain the construction, working, and principle of the hydrogen-oxygen fuel cell.

2 1 2

OR

Differentiate between electrocardiography and electrodialysis.

2 1 2

C 5. Discuss briefly the Young-Laplace equation.

3 1 1

OR

Briefly explain the catalytic activity of surfaces.

3 1 1