MCH-013

ASSIGNMENT BOOKLET

M.Sc. in Chemistry Programme
(MSCCHEM)

GENERAL PHYSICAL CHEMISTRY

Valid from 1st January, 2024 to 31st December, 2024

School of Sciences
Indira Gandhi National Open University
Maidan Garhi
New Delhi-110068
(2024)

Dear Student,

Please read the section on assignments in the Programme Guide for M.Sc. in Chemistry that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, which would consist of one tutor-marked assignment for this course. The assignment is in this booklet, and covers all blocks of the course. The total marks of all the parts are 100, of which 40% are needed to pass it.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO.: ……

NAME: ……

ADDRESS: ……

……

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COURSE CODE: ……

COURSE TITLE: ……

ASSIGNMENT NO.: ……

STUDY CENTRE: …… DATE: ……..

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3) Leave 4 cm margin on the left, top and bottom of your answer sheet.

4) Your answers should be precise.

5) Submit the complete assignment answer sheets within the due date.

6) The assignment answer sheets are to be submitted to your Study Centre within the due date. Answer sheets received after the due date shall not be accepted.

   We strongly suggest that you retain a copy of your answer sheets.

7) This assignment is valid from 1st January, 2024 to 31st December, 2024. If you have failed in this assignment or fail to submit it by December, 2024, then you need to get the assignment for the year 2025, and submit it as per the instructions given in the Programme Guide.

8) You cannot fill the examination form for this course until you have submitted this assignment.

We wish you good luck.

ASSIGNMENT

General Physical Chemistry

Course Code: MCH-013

Assignment Code: MCH-013/TMA/2024

Maximum Marks: 100

Note: Attempt all questions. The marks for each question are indicated against it.

1. Answer **any five** of the following in brief. **(2x5)**
   (a) The entropy change is not a good criterion for spontaneity of a thermodynamic process. Comment.
   (b) Derive the relation between Gibbs energy and Helmholtz energy.
   (c) Differentiate between molar and partial molar properties.
   (d) Give Stirling's approximation and outline its significance
   (e) How can the diamagnetic and paramagnetic substances be distinguished using magnetic susceptibilities?
   (f) Outline the limitations of collision theory.

2. (a) (i) An isothermal and isobaric process is accompanied by changes in enthalpy and entropy as 52 kJ mol^{-1} and 165 JK^{-1} mol^{-1}, respectively. Predict whether the process be spontaneous at 400K.
   (ii) If the enthalpy and entropy changes are not affected by the change in temperature calculate the temperature at which the system will attain equilibrium **(3+2)**
   (b) Define the term 'chemical potential' and discuss the effect of temperature on chemical potential. **(2+3)**

3. (a) Explain the difference between permutation and configuration. Calculate the number of permutations and configurations possible while selecting three days out of seven days in a week. **(3+2)**
   (b) Define molecular partition functions. Derive an expression for the translational partition function for motion along x- direction in a system. **(2+3)**

4. (a) The X-ray power diffraction angles from the molybdenum crystal are observed at 20.26°, 29.30°, 36.82°, 43.82°, 50.70°, 58.80°, 66.30°. Determine the type of cubic crystal formed by molybdenum? **(5)**
   (b) Explain crystal symmetry elements, Screw Axis and Glide Plane using suitable illustrations. **(5)**

5. (a) Describe the basic premise of transition state theory of reaction rates and derive an expression by using this theory for the rate constant for the elementary reaction **(5)**

$$X + Y \rightarrow \text{Products}$$

(b) Discuss Lindemann-Christiansen mechanism for unimolecular reactions and derive an expression for the rate equation for the unimolecular reaction as per Lindemann-Christiansen mechanism. (**5)**

6. Answer **any five** of the following in brief. **2 x 5**

(a) Discuss the role of solvent in reactions in solution phase.

(b) Define fast reactions and give different strategies used for studying fast reactions.

(c) Define enzyme inhibition and state it's different types.

(d) Define ionic strength and calculate the same for an aqueous solution of 0.1 M $MgCl_2$.

(e) Differentiate between true and potential electrolytes.

(f) Differentiate between the phenomenon of Osmosis and Dialysis.

(g) State Fick's second law of diffusion and give its significance.

7. (a) Describe the encounter pair description of reaction in solution and derive the expression for the rate of a reaction in solution in terms of this description. (**2+3)**

(b) In a Temperature-jump experiment the relaxation time of an equilibrium reaction of the type

$$A \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} B$$

is found to be 5 μs. in a separate experiment, the equilibrium constant for the reaction is found to be 5 x 10^{-4}, calculate the values of rate constants for the forward and backward reactions. **(5)**

8. (a) Define homogeneous catalytic reactions and derive the expression for the initial reaction rate of a homogeneous catalytic reaction. (**2+3)**

(b) Give the Michaelis–Menten mechanism of enzyme catalysed reactions and derive an expression for the rate of enzymatic reaction using this mechanism. (**2+3)**

9. (a) Define mean ionic mobility and formulate the relations between mean ionic molality ($m_{\pm}$) and m for the following electrolytes: **(2+3)**

Li_2SO_4, $MgCl_2$ and Na_3PO_4

(b) Explain the principle for the experimental determination of mean ionic activity by emf measurement. **(5)**

10. (a) Define coefficient of viscosity and derive the relationship between the coefficient of viscosity and mean free path. **(2+3)**

(b) Define ionic mobility and derive the relationship between the ionic mobility and molar conductivity. **(2+3)**