BCHCT-133

ASSIGNMENT BOOKLET

Bachelor's Degree Programme
(BSCG/BSCM)

CHEMICAL ENERGETICS, EQUILIBRIA AND FUNCTIONAL ORGANIC CHEMISTRY I

Valid from 1st January, 2025 to 31st December, 2025

School of Sciences
Indira Gandhi National Open University
Maidan Garhi
New Delhi-110068
(2025)

Dear Student,

Please read the section on assignments in the Programme Guide for B. Sc. 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 it consists of two parts, Part A and B. It covers all blocks of the course. The total marks of all the parts are 100, of which 35% 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) Solve Part (A) and Part (B) of this assignment, and **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, 2025 to 31st December, 2025**. If you have failed in this assignment or fail to submit it by December, 2025, then you need to get the assignment for the year 2026, 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

CHEMICAL ENERGETICS, EQUILIBRIA AND FUNCTIONAL ORGANIC CHEMISTRY I

Core Course in Chemistry

Course Code: BCHCT-133
Assignment Code: BCHCT-133/TMA/2025
Maximum Marks: 100

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

PART A: CHEMICAL ENERGETICS AND EQUILIBRIA

1. (a) (i) Define chemical thermodynamics and outline its significance. (2)

   (ii) Explain the concept of thermodynamic reversibility with the help of a suitable example. (3)

   (b) (i) 223 J of heat was supplied to a thermodynamic system and its internal energy was found to decrease by 92 J. Calculate the amount of associated work and state whether the work was done by the system or done on the system? (2)

   (ii) Derive the relationship between the temperature and pressure for a reversible adiabatic process. (3)

2. (a) (i) 0.5 mole of an ideal gas is taken in a container at 298 K. Calculate the values of its heat capacities at constant pressure and at constant volume conditions. (2)

   (ii) 1 mole of an ideal gas is allowed to undergo isothermal reversible expansion at 25°C from a volume of 10 $dm^3$to 20 dm^3. Calculate the maximum amount of work done by the gas on the surroundings. (3)

   (b) (i) Derive the relationship between $\Delta_r U$ and $\Delta_r H$. (2)

   (ii) Describe the method for experimental determination of energy changes accompanying chemical reactions under constant volume conditions. (3)

3. (a) (i) State Hess' law of constant heat summation and give its significance (2)

   (ii) Using the bond enthalpy datafrom Table 3.2 of (Unit 3; p, 76), calculate the enthalpy of hydrogenation of 1–propene. (3)

   (b) (i) Give the mathematical expressions for the thermodynamic and statistical definitions of entropy. (2)

   (ii) Explain the effect of temperature on the enthalpy of a reaction and derive the Kirchhoff's equation. (3)

4. (a) (i) What is residual entropy? What kind of systems show residual entropy? (2)

   (ii) Explain the difference between enthalpy driven and entropy driven reactions. (3)

   (b) (i) Define equilibrium constant and write the expressions for concentration equilibrium constant for the following reaction (2)

$$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$$

(ii) For the following equilibrium reaction (3)

$$2SO_2(g)+O_2(g) \rightleftarrows 2SO_3(g)\ K_c=245(\text{at } 100\ K)$$

the equilibrium concentrations are $[SO_2]=0.204$,$[O_2]=0.0264$ and $[SO_3]=0.368$. Show that the equilibrium will shift towards the reactants side if the concentration of SO_2 is suddenly doubled.

5. (a) (i) Define degree of hydrolysis and derive its relationship with hydrolysis constant (2)

(ii) Explain the effect of addition of inert gas to a gaseous equilibrium reaction under the conditions of i) constant volume and ii) constant pressure. (3)

(b) (i) Calculate the pH of 0.1 M aqueous solution of sodium formate at 298 K. [Given: Ka (HCOOH) =1.7 X 10^{-4} at 298K (2)

(ii) Define solubility product constant and derive an expression for the solubility product constant for a sparingly soluble salt of M_2A_3 type having a solubility of S mol dm^{-3}. (3)

PART B: FUNCTIONAL GROUP ORGANIC CHEMISTRY-I

6. (a) Both 1, 3, 5-cycloheptatrienyl cation and 1,3,5-cycloheptatriene have 6 π elections , comments on the aromaticity of these compounds. (5)

(b) Discuss the role of Lewis acids in halogenations and alkylation reactions of benzene. Write the limitations of Freidel Crafts alkylation reaction. (5)

7. (a) Nitro group is *meta* directing, explain. (5)

(b) What would be the final products of the reaction of HI with diethyl ether and anisol? Write the mechanism of both the reactions. (5)

8. (a) What is aldol condensation? Write its mechanism. (5)

(b) Arrange the following in order of their increasing reactivity towards S_N2 substitution reactions: bromomethane, 1-bromo-propane, 2-bromopropane, 2-bormo-2-methyl propane. Justify your answer. (5)

9. (a) Write their representative reaction for the following reactions. (5)

(b) Sandmeyer reaction

(c) Reimer-Tiemann reaction

(d) Mannich reaction

(e) Willgerodt reaction

Knoevenagel reaction

10 (a) Write the mechanism of Pinacol-pinacolone reaction. (5)

(b) How you will introduce a formyl group into phenol ring. (5)