

**ST-301003**

Seat No. _____

M. Sc. (Sem. I) Examination**February - 2021****MSC1C103 : Physical Chemistry****(New Course)**

Time : 2 Hours]

[Total Marks : 50

- Instructions :** (1) Answer only three (3) questions.
(2) Q. No. 9 is compulsory and carries 14 marks.
(3) Answer any two questions from questions No. 1 to 8. Each question carries 18 marks.

_____ **Necessary Constants :**

$N = 6.012 \times 10^{23} \text{ mole}^{-1}$, $K = 1.38 \times 10^{-16} \text{ ergs}$,
 $K^{-1} = 1.38 \times 10^{-23} \text{ JK}^{-1}$, $h = 6.626 \times 10^{-27} \text{ ergs.sec} = 6.626 \times 10^{-34} \text{ J.sec.}$,
 $C = 2.998 \times 10^{10} \text{ cm. sec}^{-1} = 2.998 \times 10^{10} \text{ m.sec}^{-1}$,
 $R = 8.314 \times 10^7 \text{ ergs K}^{-1} \text{ M}^{-1} = 8.314 \text{ JK}^{-1} \text{ M}^{-1} = 1.987 \text{ Cal.K}^{-1} \text{ M}^{-1}$,
 $F = 96500 \text{ C}$.

- 1 (a) State the third law of thermodynamics. Show how the absolute entropy of a substance can be determined with the help of this law. 18
(b) Determine fugacity using Vender Waal's equation.
- 2 (a) Heat of dissociation of calcium carbonate is 42500 cal. Find the dissociation pressure of calcium carbonate at 1000°K. Given that the chemical constant for carbon dioxide is 3.4. 18
$$\text{CaCO}_3(s) \rightleftharpoons \text{CaO}(s) + \text{CO}_2(g)$$

(b) What is fugacity of gas when its activity coefficient is 0.935 at 21 atm. pressure ?
- 3 (a) Discuss the Lindemann theory of unimolecular reactions. 18
(b) Write a note on explosion limits.
- 4 (a) Calculate frequency factor (A) for the decomposition of N_2O_5 at 25°C. The value entropy of activation (ΔS^*) is 4.354 cal. mole⁻¹. deg⁻¹. (e.u.) 18
(b) Calculate frequency factor (A) for the unimolecular decomposition of an organic substance at 285°C. The value entropy of activation (ΔS^*) is 13.15 cal. mol⁻¹.deg⁻¹. (e.u.)

- 5 (a) Derive an equation to calculate number of Schottky defects in solids. 18
 (b) Discuss defects in solids.
- 6 (a) Classify materials into conductors, semi-conductors and insulators. Explain on what basis this classification is made. 18
 (b) Discuss super conductivity.
- 7 (a) What is micelles ? Explain critical micellar concentration. 18
 (b) Discuss the BET and the Harkins and Jura method of determining the surface area of adsorbents.
- 8 (a) For a 1.0×10^{-10} M aqueous solution of n-butanoic acid $dr/dc = -0.080 \text{ Nm}^2 \text{ mole}^{-1}$. at 25°C using the Gibbs adsorption equation, determine the surface excess of the acid and also calculate the average surface area available to each molecule. 18
 (b) In the study of adsorption of Nitrogen on $\text{Fe-Al}_2\text{O}_3$ at 77°K the area occupied by molecular of Nitrogen is 16.2 \AA^2 . If the specific area of Al_2O_3 is $12.46 \text{ M}^{-2} \cdot \text{gm}^{-1}$. Calculate the value of V_m in BET equation.
- 9 Answer in brief : (each one mark) 14
 (1) Give the uses of Thermodynamics.
 (2) Define - Chemical potential.
 (3) Write the relation between Joule and erg.
 (4) Define - Entropy.
 (5) Give the uses of chemical kinetics.
 (6) Define - Chain reactions.
 (7) Define - Order of the reaction.
 (8) Define - Chain length.
 (9) Give the uses of semi conductor.
 (10) Define - Crystal.
 (11) Give the types of defects in solid.
 (12) What is Sorption ?
 (13) Give the uses of adsorption.
 (14) Define - Adsorbate.