

**M.Sc. CHEMISTRY**  
**Second Semester (Repeat)**  
**PHYSICAL CHEMISTRY-II**  
**(MSC – 203)**

**Duration: 3Hrs.**

**Full Marks: 70**

Part-A (Objective) =20

Part-B (Descriptive) =50

**(PART-B: Descriptive)**

**Duration: 2 hrs. 40 mins.**

**Marks: 50**

**Answer any four from Question no. 2 to 8**  
**Question no. 1 is compulsory.**

1. Calculate the packing efficiency of cubic closest packing. Show that the critical radius ratio for tetrahedral coordination is 0.225. (5+5=10)
2. Discuss the Michaelis-Menten mechanism and kinetics of enzyme catalysed reactions. How would you determine Michaelis constant  $K_m$ ? (8+2=10)
3. Briefly mention the important postulates of conventional activated complex theory (cACT) and derive the rate constant of a gaseous bimolecular reaction in terms of thermodynamic formulations (cACT). (10)
4. i. Define phenomenological law. Prove that the direct phenomenological coefficients have always positive values for processes occurring simultaneously in the same system.  
ii. Derive an expression for the rate of entropy production arising from heat interaction between two systems. (5+5=10)
5. Define canonical, grand canonical and microcanonical ensembles. Derive an expression for the molecular vibrational partition function of an ideal diatomic gas. (5+5=10)

6. What is meant by the terms *partition function*? Derive an expression for the equilibrium constant of an ideal gaseous mixture in terms of the partition functions of the reactants and the products. (2+8=10)
7. Derive the BET equation for multilayer adsorption stating important assumptions. (10)
8. What is the origin of charge on colloidal particles? What is meant by electrical double layer? Briefly discuss the factors that can affect the CMC in aqueous media. (2+3+5=10)

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M.Sc. CHEMISTRY  
Second Semester (Repeat)  
PHYSICAL CHEMISTRY-II  
(MSC – 203)

Duration: 20 minutes

Marks – 20

(PART A - Objective Type)

I. Choose the correct answer:

1×20=20

- i) The radius ratio in an ionic crystal lies between 0.732 and 1.0, the structure is:  
(a) Triangular  
(b) Tetrahedral  
(c) Octahedral  
(d) Cubic
- ii) The *F-centre* in alkali halides is defined as:  
(a) Hole trapped by a pair of anions  
(b) Electron trapped at anion vacancy  
(c) Two adjacent F-centre  
(d) Three adjacent F-centre
- iii) The Miller indices of crystal planes which cut through the crystal axes at (2a, -3b, -3c) is:  
(a) (322)  
(b)  $\bar{3}33$   
(c)  $(\bar{3}\bar{2}\bar{2})$   
(d) (223)
- iv) Maximum packing efficiency is not possible in which arrangement (configurations)?  
(a) BCC  
(b) FCC  
(c) HCP  
(d) CCP
- v) The “grain boundary” defect in solids is a:  
(a) Point defect  
(b) Line defect  
(c) Plane defect  
(d) None above
- vi) The crystal defects (zero-dimensional) due to the aliovalent impurity in ionic solids cause:  
(a) Decrease in density  
(b) Increase in density  
(c) No change in density  
(d) Deviate the charge neutrality

vii) The Miller indices (*hkl*) of a crystal plane can be obtained from:

- (a) The intercepts of the plane on crystal axes.  
(b) The reciprocal of the intercepts (as fractions).  
(c) The smallest three integers obtained from the fractions.  
(d) All the above steps.

viii) What happens in a steady state?

- (a) Product is being formed faster than reactants are consumed.  
(b) Heat is evolved.  
(c) The concentration of an intermediate is constant.  
(d) The reaction terminates.

ix) Based on the collision theory, the atoms at the top of the potential energy “hill” are called:

- (a) Peak of the hill  
(b) Activation energy  
(c) Transition state  
(d) Saddle point

x) In absolute reaction rate theory, the activated complex:

- (a) Maintains equilibrium with reactants.  
(b) Behaves like normal molecule except the number of degrees of freedom.  
(c) Has fourth translation degree of freedom.  
(d) Obeys all above characteristics.

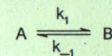
xi) Langmuir isotherms holds at low pressure but fails at:

- (a) High pressure  
(b) Low temperature  
(c) Intermediate pressure  
(d) Sub-zero temperatures

xii) The presence of the double layer in colloids accounts for:

- (a) Kinetic properties  
(b) Electrical properties  
(c) Optical properties  
(d) Stability of colloids

xiii) The relaxation time ( $\tau$ ) for the following reaction is:



- (a)  $\frac{1}{k_1 + k_{-1}}$   
(b)  $\frac{1}{k_1 - k_{-1}}$   
(c)  $k_1 + k_{-1}$   
(d)  $k_1 - k_{-1}$

