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. Drive 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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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) $\bar{2}33$
(c) $(3\bar{2}\bar{2})$
(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 (τ) for the following reaction is:

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

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

xiv) Which one of the following statements is not true concerning enzyme catalysed reactions?
(a) Enzymes require optimum temperature.
(b) Enzymes become zwitter ionic at optimum Ph.
(c) Enzymes increase activation energy.
(d) Enzymes are highly specific in nature.

xv) An example of a relaxation method of measuring rates is:
(a) Spectroscopic monitoring of product concentration
(b) Stopped flow technique
(c) Temperature jump experiments
(d) Measurement of spectral line widths

xvi) In which technique, a short pulse of electromagnetic radiation is used to initiate the reactions?
(a) Pulse radiolysis
(b) Flash photolysis
(c) Stopped-flow method
(d) Temperature jump method

xvii) In which statistics, the particles are considered distinguishable?
(a) Maxwell-Boltzmann
(b) Bose-Einstein
(c) Fermi-Dirac
(d) All above

xviii) Adsorption takes place with:
(a) Decrease in enthalpy of the system.
(b) Increase in enthalpy of the system.
(c) No change in enthalpy of the system.
(d) First increase and then decrease in enthalpy of the system.

xix) Laplace equation is given by:
(a) $p_{in} + p_{out} = \frac{2\gamma}{r}$
(b) $p_{in} - p_{out} = \frac{2\gamma}{r}$
(c) $p_{out} + p_{in} = \frac{2\gamma}{r}$
(d) $p_{in} + p_{out} = -\frac{2\gamma}{r}$

xx) The flux generated by the gradient of chemical potential is:
(a) Heat flow
(b) Charge flow
(c) Mass flow
(d) All of these

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University of Science and Technology, Meghalaya

Date Stamp:_____

SESSION: 2016-17

COURSE_____**PAPER Code:**_____

NAME OF THE PAPER:_____

SEMESTER_____

Instructions to Candidates

1. This answer booklet has 4 pages. Please check before writing whether it is complete or in good condition.
2. Do not write your name anywhere in the answer booklet.
3. Write legibly on both sides of the paper
4. You may use some space for any rough notes or calculation on the answer booklet if you need. These rough notes, calculations must be scored out before submitting the answer booklet.
5. Do not bring any book or loose paper in the examination hall.
6. Do not tear any page from the answer booklet.
7. Do not write anything on the question paper or blotting paper or any pieces of paper while you are in the examination hall.
8. Any act of indiscipline or misbehavior in the examination hall will result in your expulsion.
9. No examinee is allowed to leave the examination hall until 30 minutes lapse after the commencement of the examination.
10. Additional answer sheet will be supplied after the main answer booklet is completed.

For Objective Type Questions

Page No.	Marks
Total	

For Descriptive Type Questions

Question No.	Marks
Total	
Grand Total	

Session: 2016-17

Course_____

Roll No._____

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