SD-179

Total No. of Pages : 3

Seat No.

M.Sc. (Part-I) (Semester-I) (CBCS) Examination, April-2019

CHEMISTRY

CH-103: Physical Chemistry - I (Paper - III)

Sub. Code : 71513

Day and Date : Tuesday, 09 - 04 - 2019 **Total Marks : 80**

Time : 11.00 a.m. to 2.00 p.m.

Instructions :

1) **Question No. 1 is compulsory.**
2) **Solve any two questions from each Section I and Section II**
3) **All questions carry equal marks.**
4) **Figures to the right indicates full marks.**
5) **Use of log-tables/non programmable scientific calculator is allowed.**
6) **Neat diagrams and sketches should be drawn wherever necessary.**

Q1) Answer the following: **[16]**

a) Complete the equation $(?/\delta V)_{?} = (\delta P/\delta T)_{v}$.

b) Define Chemical Potential in terms of free energy.

c) If total volume of a salt solution is expressed as V = 1001.6m where m is molality of the solution then what will be the partial molar volume of the salt in the solution?

d) $(\delta \mu_i/\delta P)_{T,N} = ?$

e) Define 'canonical' ensemble.

f) What is the vibrational contribution to the internal energy using equipartition principle for linear diatomic molecules?

g) Calculate the statistical weight factor for an atomic chlorine in two electronic states with spin $\frac{3}{2}$ and $\frac{1}{2}$.

h) What is value of translational partition function at absolute zero of temperature?

P.T.O.

i) Write the Freundlich adsorption isotherm related to concentration of adsorbate

j) A system with at least one dimension of the dispersed particles in the range of ___ nm is classed as a colloidal dispersion.

k) In a paint, dispersion medium and phase are____

l) At critical micelle concentration, the surface tension property of solution___

m) Metal sols are lyophobic colloids (True/False)

n) Give any two names of methods used for the determination of average molar mass of polymer.

o) Termination in chain polymerization occurs by ____ and ____way.

p) Initiation of the cationic polymerization occurs by Lewis acid. (True/False)

SECTION - I

Q2) a) Derive expressions for chemical potentials in terms of free energy, enthalpy, internal energy and work function. **[8]**

b) Derive equation for total vapour pressure for a mixture of two liquids in terms of vapour phase composition. **[8]**

Q3) a) In statistical mechanics, the entropy S of a system is set equal to k ln W, where k is the Boltzmann constant and W is the total number of microstates accessible to the system. Can you justify this equality? **[6]**

b) Discuss the use of partitions functions in studying chemical equilibria and kinetics of reactions. **[6]**

c) Deduce an equation for entropy of monoatomic gases using the translational partition function. **[4]**

Q4) a) What are colloids? Give the characteristics of lyophobic and lyophilic colloids. **[6]**

b) What are the characteristics of adsorption? Give the applications of adsorptions. **[6]**

c) What is critical micelle concentration (CMC)? Explain one of the method to obtain CMC. **[4]**

SECTION - II

Q5) a) Derive an expression for weight average and number average molar mass of the polymer. [6]

b) Write the names of various experimental techniques used to determine the average molar mass of polymer. Explain any one method in detail. [6]

c) If a 5% solution of a monomer A containing 10^{-4} mol/L of peroxide P is polymerized at 70°C, 40% of the original monomer charge is converted to polymer in 1 h. How long will it take to polymerize 90% of the original monomer charge in a solution containing (initially) 10% A and 10^{-2} mol/L of peroxide P? [4]

Q6) a) Give the expression for translational partition function and derive the Sackur-Tetrode equation. [6]

b) Define the molecular partition function and interpret the significance of its value. [6]

c) At what temperature will the vibrational partition function for I_2 will be greatest. 298 K or 1000 K? Given: Vibrational frequency for I_2 is 208 cm^{-1}. [4]

Q7) Answer any three of the following: [16]

a) Electronic partition function.

b) Gibbs-Duhem equation.

c) Optical properties of Colloids.

d) Micelles.

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M.Sc. (Part - I) (Semester - I) (CBCS) Examination, November - 2019

CHEMISTRY

Physical Chemistry - I (Paper - III)

Sub. Code : 71513

Day and Date : Tuesday, 19 - 11 - 2019 **Total Marks : 80**

Time : 11.00 a.m. to 02.00 p.m.

Instructions :
1) **Question one is compulsory.**
2) **Solve any two questions from section I and Section II.**
3) **All questions carry equal marks.**
4) **Figures to the right indicates marks.**
5) **Use of log-tables/non programmable scientific calculator is allowed.**
6) **Neat diagrams and sketches should be drawn wherever necessary.**

Q1) Answer the followings : **[16]**

a) Complete the equation $(\delta S/\delta P)_T = (?/\delta T)_?$.

b) Write the Duhem-Margules equation.

c) Write an expression for the total volume of a mixture of two liquids in terms of the partial molar volumes of both liquids.

d) Write an expression for effect of temperature on chemical potential.

e) Write an expression for the partition function of a linear molecule treated as rigid rotator.

f) What are the relative populations of states of two level system when the temperature is infinite.

g) Give relationship between constant volume heat capacity and partition function.

h) Give an equation describing Sterling's approximation.

i) The surface tension of water decreases after addition of surfactant. (True/ False).

j) A system with at least one dimension of the dispersed particles in the range of ---- nm is classed as a colloidal dispersion.

P.T.O.

k) In a paint, dispersion medium and phase are -----

l) At critical micelle concentration, the property of surface tension of solution -----

m) Metal sols are lyophobic colloids (True/ False)

n) What is number average molar mass of the polymer for the number fraction of 0.1 and molar mass of 9.1 kg/mol

o) Complete the rate expression of the radical chain polymerization-ln (l-P) = ?

p) Define critical micelle concentration of surfactant.

SECTION - I

Q2) a) Derive any two Maxwell relations. **[8]**

b) Derive equation for total vapour pressure for a mixture of two liquids in terms of vapour phase composition. **[8]**

Q3) a) Define a partition function and give its significance. Derive the relationships between partition functions and thermodynamic potentials. **[8]**

b) Define the molecular partition function and interpret the significance of its value. **[4]**

c) Deduce an equation for entropy of monoatomic gases using the translational partition function. **[4]**

Q4) a) Explain the types of adsorption isotherm with their significance. **[6]**

b) Explain the conductmetric method of determining the critical micelle concentration. **[6]**

c) Calculate the surface area if TiO_2 in terms of m^2/g by BET (point B) method. Assume the cross sectional area of N2 molecule is 16.2 A^2. From the plot of adsorption isotherm B point corresponds to monolayer volume is 40 mL. **[4]**

(Given R = 0.082 N 6.023 × 10^{23} To = 273K)

SECTION - II

Q5) a) Derive the rate expression for the acid catalyzed polyesterification process. **[6]**

b) Write the names of various experimental techniques used to determine the average molar mass of polymer. Explain any one method in detail. **[6]**

c) For a new monomer 50% conversion is obtained in 500 min when polymerized in homogeneous solution with a thermal initiator. Predict the time for 50% conversion in another run at the same temperature but with Four-fold initial initiator concentration. **[4]**

Q6) a) Derive expressions for chemical potentials in terms of free energy, enthalpy, internal energy and work function. **[8]**

b) Why the electronic partition function is generally equal to the degeneracy of the ground electronic state? **[4]**

c) Evaluate the rotational partition function for I_2 at 100 K. Given: Rotational constant (B) for I_2 is 0.0374 cm^{-1}. **[4]**

Q7) Answer any three of the following : **[16]**

a) Gibbs-Duhem equation and its significance.

b) Equilibrium constant and partition function.

c) Freundlich Adsorption isotherm.

d) Average molar mass of polymers.

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Seat No.

M.Sc. (Part-I) (Semester - I) (CBCS) Examination, November - 2019
CHEMISTRY/APPLIED CHEMISTRY/INDUSTRIAL CHEMISTRY
Physical Chemistry-I (Paper-III)
Sub. Code : 74579

Day and Date :Tuesday, 19-11-2019 **Total Marks :80**

Time : 11.00 a.m.to 02.00 p.m.

Instructions :

1) **Attempt in any five questions**
2) **Question one is compulsory.**
3) **Answers to the sub questions of question one should be written in the space provided and it is to be returned to the Supervisor after30 minutes from the start of the examination.**
4) **Attempt any two questions from Section I and any two from Section II.**
5) **All questions carry equal marks. Figures to right indicate marks.**
6) **Neat and labelled diagrams should be drawn.**
7) **Use of calculator and logtable is allowed.**

(Some useful constants : $h = 6.626\times10^{-34}$Js,$k = 1.381\times10^{-23}$ Jk^{-1})

Q1) Compulsory (one mark each.) **[16]**

a) $(\delta\mu/\delta T)_p$ = ?

b) Identify the missing factor $(\delta S / \delta V)_T = (?/\delta T)$ v

c) Write the Duhem Margules Equation for a two component liquid mixture

d) Express the total vapour pressure of liquid mixture containing liquids A and B in terms vapour pressures of pure A and B

e) For canonical ensemble the total number of particles or systems will not be constant. True or false.

f) write the expression for general partition function.

g) Complete the equation $E = kT^2$ (?/?)

h) Write the Sackur-Tetrode equation

i) The degree of polymerization of a sample of polyethylene is 10.What will be its molecular weight?

P.T.O.

j) Write the correlating equation of number average molar mass ($\overline{M}_n$) and degree of polymerization.

k) Write the mechanism of cationic polymerization.

l) What is an initiator?

m) The adsorption is an endothermic process. True or false.

n) Simultaneous adsorption and absorption is known as_____

o) Sodium stearate is used as a surfactant in soap. True of false.

p) What is an interfacial energy?

SECTION-I

Q2) a) Derive any two Maxwell relations. **[8]**

b) Derive Duhem-Margules equation. **[8]**

Q3) a) Evaluate the value of arbitrary constant b used in Boltzmann Distribution. **[8]**

b) A dilute system at thermodynamic equilibrium consists of 50 independent particles. Each particle has three energy levels of energy 0, ε and 2ε, with degeneracies of 300, 600 and 1200 respectively. The system is at constant temperature T = ε/k where k is Boltzmann constant.
Calculate the i) Molecular partition function for the system ii) Number of particles in each and iii) The entropy of the system using Boltzmann relation. **[8]**

Q4) a) Obtain an expression for rotational partitional function for a diatomic molecule. **[6]**

b) Derive the rate expression of a condensation polymerization of polyester formation. **[6]**

c) Explain the use of photoelectron spectroscopy for study of surface properties of materials. **[4]**

SECTION-II

Q5) a) Draw and explain the significance of different types of adsorption isotherms with suitable examples. [6]

b) What is critical micelle concentration? How it can be determined conductometrically? [6]

c) Calculate the surface area of a catalyst in terms of m^2/g by BET method assuming that the area of nitrogen molecule is equal to 16.2Å^2.The volume of monolayer of gas is found to be 35 mL by BETmethod at 273 K and 1 atm. [4]

Q6) a) Enlist methods of determining average molecular weight of polymers. Explain briefly any one method with neat labeled diagram. [6]

b) Explain Flory-Huggins theory for estimating the thermodynamic parameter entropy of a polymer solution. [6]

c) Explain the mode of termination in chain polymerization. [4]

Q7) Write notes on any three. [16]

a) Excess functions.

b) Stirling's approximation.

c) Glass transition temperature of a polymer.

d) Factors affecting CMC

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M.Sc. (Part - I) (Semester - I) Examination, October - 2017
CHEMISTRY/APPLIED CHEMISTRY (CBCS) (Paper - III)
Physical Chemistry - I
Sub. Code : 59823/59805

Day and Date : Friday, 27 - 10 - 2017 **Total Marks : 80**

Time : 10.30 a.m. to 01.30 p.m.

Instructions:

1) **Attempt in all five questions.**
2) **Question one is compulsory.**
3) **Attempt any two questions from Section I and any two from Section II.**
4) **All questions carry equal marks. Figures to right indicate marks.**
5) **Neat and labelled diagrams should be drawn.**
6) **Use of calculator and logtable is allowed.**

Q1) Compulsory (One mark each). **[16]**

a) Write a relationship between volume of a component with its chemical potential.

b) Maxwell relations are not applicable to open systems. True or False

c) Write Gibbs-Duhem equation

d) Free energy of mixing, ΔG_{mixing}, is given by the equation

e) An ensemble is a small collection of identical macroscopic systems which are allowed to interact. True or False.

f) Write the expression for vibrational partition function of a molecule

g) Express work function, A, in terms of molar partition function

h) Identify the missing term R (In $[e^{5/2}V / Lh^3]$) $(2\pi mkT)^{3/2}$=?

i) Write the expression for V_{max} of an enzyme catalysed reaction in terms of enzyme concentration and k_3.

j) From the double reciprocal plot of an enzyme catalysed reaction slope / intercept = ?

k) Define activators of an enzyme.

l) What is peptide linkage?

m) Complete the equation x/m = KP?

P.T.O.

n) Identify the missing term $[x/ V(?)] = [1/ V_m C] + [x(C - 1) / V_m C]$

o) What happens to the surface tension of water after the addition of a surfactant?

p) The adsorption process involves increase in entropy. True or False.

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SECTION - I

Q2) a) Derive expressions for chemical potentials in terms of enthalpy and internal energy. [8]

b) Mixtures of liquid X and liquid Y behave ideally at 25°C. The vapour pressure of pure A is 127.2 mm of Hg and that of pure B is 60.7mm of Hg. Determine the weight compositions of vapour in equilibrium with a liquid mixture containing equal weights of both the liquids. (Molecular weights of liquid X and Y are 32 and 46 gm mol^{-1} respectively) [8]

Q3) a) Derive Maxwell-Boltzmann distribution law (Given $e^{\alpha} = N/ \sum g_i e^{-\varepsilon j/kT}$ and $\beta = 1/ kT$) [8]

b) Obtain an expression for translational partition function for a monoatomic gas. [8]

Q4) a) Explain various factors affecting enzyme activity. [6]

b) Derive Michealis-Menten equation for an enzyme catalysed reaction. [6]

c) Describe classification of proteins. [4]

SECTION II

Q5) a) Derive Gibbs adsorption isotherm for adsorption from solution. [6]

b) Describe gravimetric method of determining surface area of a solid catalyst. [6]

c) Explain the basic principle involved in ESCA. [4]

Q6) a) Describe volumetric method of determining surface area of a solid catalyst. [6]

b) Give a brief account of classification of amino acids. [6]

c) Explain the lock and key hypothesis in an enzyme catalysed reaction. [4]

Phy oct 17

Q7) Write Notes on any three. [16]

a) Translational partition function of monoatomic gas.

b) Duhem- Margules equation

c) Physical chemistry of cell membrane

d) Number average and mass average molecular weights of biopolymers

e) Applications of adsorption in industry

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