

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIRST SEMESTER EXAMINATION, DECEMBER 2017

FIRST YEAR [BATCH 2017-20]

CHEMISTRY (General)

Date : 15/12/2017

Time : 11 am – 1 pm

Paper : I

Full Marks : 50

(Use a separate Answer book for each group)

Group – A

UNIT-I

Answer **any one** of the following:

1 × 13

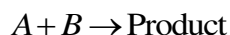
1. a) Applying Bohr's theory evaluate the expression of energy of the electron in the 3rd Bohr orbit. What is the implication of its negative sign? 2+1
b) An element (A = 235, Z = 92) emits one α and two β particles. What are the values of A and Z for the new element. 2
c) Distinguish between nuclear fission and nuclear fusion with examples. (One example for each). 2+2
d) What do you mean by half life of a radioactive element? It takes 356 minutes for the disintegration of 90% of ^{18}F atom. Calculate the half life of ^{18}F . 2+2
2. a) The ^{16}O isotope is chemically identical with the ^{18}O isotope why? 2
b) Define electron affinity of an atom. The first electron affinity of oxygen is positive, but the second electron affinity is negative. Explain. 1+2
c) Calculate the radius of Li^{2+} ions in the 3rd excited state. 2
d) Give the four values of quantum number that describes the electron in 3d orbitals. 2
e) What is meant by the term ionization energy? "Successive ionization potentials have progressively higher values" – justify. 2+2

UNIT-II

Answer **any one** of the following:

1 × 12

3. a) Consider a pseudo 1st order reaction $\text{CH}_3\text{COOEt} + \text{H}_2\text{O} \xrightarrow{\text{H}^+} \text{CH}_3\text{COOH} + \text{EtOH}$
The reaction seems to be a 3rd order reaction but actually, it is not. Why is it so? Also show that the reaction rate constant is doubled, if the acid concentration is doubled. 3
b) At 25°C, the equivalent conductance at infinite dilution of NaOH, NH_4Cl and NaCl are 248.1, 149.7 and 126.4 $\text{ohm}^{-1} \text{cm}^2$, respectively. Calculate the same at infinite dilution for NH_4OH , defining Kohtransch's law. 3
c) Explain – specific conductance of 0.1 (N) HCl > 0.1 (N) CH_3COOH . 1
d) Deduce the integrated rate equation of the following second order reaction where the initial concentrations of the two reactants are same. 3+2



Show that time for half decomposition of this type of second order reaction is dependent on the initial concentration of the reactant.

4. a) In the Arrhenius equation for a certain reaction the value of A (frequency factor) and E_a (activation energy) are $4 \times 10^{13} \text{ s}^{-1}$ and 98.6 kJ mole^{-1} respectively. If the reaction is first order then at what temperature will its half-life period be 10 min. 3
b) How equivalent conductance vary with concentration both for strong and weak electrolyte. 3

- c) Explain the followings: 2+2
- (i) In a set of two Parallel reactions, the one with greater rate constant will be faster than other.
- (ii) Kohlrausch's law is applicable at infinite dilution.
- d) Define steady state approximation and why is it important. 2

Group – B

UNIT-I

Answer **any one** of the following:

1 × 12

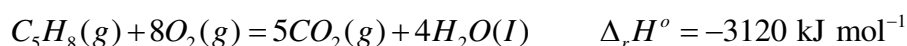
5. a) Define most probable velocity and root mean square velocity. 3
- b) With increasing temperature viscosity of liquid decreases whereas viscosity of gas increases – explain. 2
- c) Write the Maxwell's speed distribution equation and draw the distribution curve for a gas at two different temperatures. 2
- d) (i) Define the principle of equipartition of energy. (ii) Calculate the average energy of 1 mole of H₂ and He gas in terms of KT by applying the equipartition principle. 1+4
6. a) State the principle of corresponding state. Derive an expression interconnecting P_r, V_r and T_r for a van der Waals gas. 1+3
- b) If a glass capillary is dipped into water and mercury separately, what would you observe? Explain. 2
- c) Define surface tension and viscosity coefficient of a liquid and mention their SI unit. 2+1
- d) Explain the principle of measuring viscosity coefficient of a liquid by using Ostwald Viscometer. 3

UNIT-II

Answer **any one** of the following:

1 × 13

7. a) Deduce the expression for maximum work done when 'n' mole ideal gas expands reversibly and isothermally. 3
- b) What do you understand by the terms C_p and C_v . Derive their relationship for an ideal gas. 2+2
- c) Prove that for ideal gas in adiabatic reversible process $TV^{\gamma-1} = \text{constant}$. 3
- d) One mole of an ideal gas undergoes adiabatic free expansion from 1 liter to 10 liters. Calculate w and ΔU . 3
8. a) What do you mean by extensive property and intensive property? Identify the following as an extensive or intensive property: 2+2
- (i) temperature (ii) density (iii) enthalpy (iv) molar heat capacity
- b) 1.4 g of water vapour expand reversibly and adiabatically from an initial temperature of 27°C and volume of 1 lit to a final volume of 4 lit. Calculate the final pressure. ($\gamma = 1.3$) 3
- c) State and explain Hess's law of constant heat summation. 3
- d) Given the following heat of reaction at 25°C. 3



Calculate the $\Delta_r H^\circ$ for the heat of formation of $C_5H_8(g)$ [$5C(\text{graphite}) + 4H_2(g) = C_5H_8(g)$]

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