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CHE-503

Physical Chemistry

M.Sc. CHEMISTRY (MSCCH-12/13/16/17)

First Year, Examination-2019

Time: 3 Hours **Max. Marks : 80**

Note: This paper is of Eighty (80) marks divided into three (03) sections A, B and C. Attempt the questions contained in these sections according to the detailed instructions given therein.

Section –A

(Long-answer-type questions

Note: Section 'A' contains four (4) long-answer-type questions of Nineteen (19) marks each. Learners are required to answer any two (2) questions only. (2x19=38)

1. (a) Derive an expression for the wave function of a free particle. Is the wave function normalized ? If not normalize it. (12)

   (b) Why the zero point energy of a particle in a box cannot be zero:- (7)

2. (a) Derive the integrated equation for a 2^{nd} order reaction, when the initial concentration of all the reactants are same. (11)

   (b) Describe in detail the collision theory of unimolecular reactions. (8)

3. (a) Derive Gibbs – Helmholtz relation, and the clausius – Clapeyson equation from the 1^{st} law of thermodynamics. (10)

   (b) Discuss the physical concept of entropy. Show that the entropy of the universe in increasing. (9)

4. (a) Derive the Debye equation connecting $\gamma_{\pm}$ with ionic strength. (10)

(b) State and explain Faradey's law of electrolysis. Derive the relation F = Noe. (9)

Section – B

(Short-answer-type questions)

Note : Section 'B' contains eight (08) short-answer type questions of eight (08) marks each. Learners are required to answer any Four (04) questions only. (4x8=32)

Q1. Find the adjoint of operators $\frac{d^2}{dx^2}$ and $(\hat{x} + i\hat{p}_x)$. (8)

Q2. Prove that every Hermitian operator is normal. (8)

Q3. What is meant by a reaction being 1^{st}, 2^{nd} and zero order? What are prado unimolecular reaction.

Q4. What is quenching of fluorescence ? Deduce the expression for quantum yield. (8)

Q5 Deduce Lambert's – Beer's law and show its application in chemistry. (8)

Q6 What is the change in internal energy when an ideal gas expands isothermally. (8)

Q7 What is the significance of enthalpy of a system. (8)

Q8. Discuss a method for determining ionic mobility. (8)

Section –C

(Objective- type questions)

Note : Section 'C' contains (10) objective-type questions of one (01) mark each. All the questions of this sections are compulsory. (10x1=10)

Q1. Expression for Mayer's formula. (1)

(a) $Cv = (\partial U/\partial T)v$

(b) $Cp = (\partial U/\partial T)p$

(c) $Cp - Cv = RT$

(d) $Cp - Cv = R$

Q2. All natural process are irreversible. This is a direct consequence of : (1)

(a) 1st law of thermodynamics

(b) 2nd law of thermodynamics

(c) 3rd law of thermodynamic

(d) Gibbs paradox

Q3. The boyle temperature of a gas is : (1)

(a) a/bR

(b) a/27 b^2

(c) 8a/27Rb

(d) 8a/27b

4. A reversible heat engine can have 100% efficiency if the temperature of sink is (1)

(a) less than that of source

(b) equal to that of source

(c) 0 °C

(d) 0 °K

5. t1/2 value for 1st order reaction (1)

(a) loge 2

(b) 0.693/a

(c) log e2/ k_1

(d) $\log_{e10}$ 2/K_1

Q6. In Arhenius equation $k = A\, e^{-Ea/RT}$, 'A' stands for (1)

(a) Rate constant

(b) Pre exponential factor

(c) Exponential factor

(d) Activation energy

Q7. In a chemical reaction, a catalyst changes the : (1)

(a) Potential energy of the products

(b) Potential energy of the reactants

(c) Heat of reaction

(d) Activation energy

Q8. Entropy change (ΔS) is reversible cell is given by (1)

(a) -nFE

(b) nf $(\partial E/\partial T)p$

(c) 0

(d) -nFE + nFT $(\partial E/\partial T)p$

Q9. Unit of Ionic Conductivity is (1)

(a) $cm^2v^{-1}s^{-1}$

(b) cm^{-1}

(c) Unit less

(d) $ohm^{-1}\ cm^{-1}$

Q10. Operators used in quantum mechanics must be (1)

(a) real

(b) imaginary

(c) Hermitian

(d) anti – Hermitian

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