WEST BENGAL STATE UNIVERSITY
B.Sc. Honours Part-I Examination, 2020

CHEMISTRY

PAPER-CEMA-II

CEMAT [12PA+12PB] (25 MARKS) + CEMAP [12PrA+12PrB] (25 MARKS)

Time Allotted: 1 Hour   Full Marks: 25

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

CEMAT-12PA

Answer any *one* question from the following

1. (a) Two gases of molar masses M1 and M2 show identical Maxwell's speed distribution curves at temperatures T1 and T2, respectively. Explain when such an observation will be valid. **2**

   (b) Starting from the van der Waals equation of state, find the reduced equation of state and comment on the utility of the reduced equation. **3**

   (c) A tube of internal diameter 4 mm is dipped into a liquid of surface tension 98 dynes/cm. Find the value of the capillary rise. **2**

   (d) Define mean free path of a gas molecule. Derive an expression for the mean free path of a gas molecule in terms of its diameter. How does it depend on temperature? **3**

   (e) Calculate the frequency of nitrogen-nitrogen collisions in 1 cc of air at 1 bar and 20°C. Assume that 80% of the molecules are nitrogen molecules. The collision cross section of nitrogen molecule is 4.5×10^{-19} m^2. **3**

2. (a) Consider an ideal gas at 25°C. If the pressure is doubled, what effect does it have on the mean free path of a gas molecule? **2**

   (b) The average speed of a gas at 25 °C is 300 m s^{-1}. Find the temperature at which the speed will be doubled. **2**

   (c) Starting from definition, find an expression for the Boyle temperature of a van der Waals gas. **4**

   (d) Show that surface tension and surface energy are numerically equal. **2**

   (e) Find the numerical value of compressibility factor (Z) of a gas that obeys the equation of state $P(V - nb) = nRT$. The pressure and temperature are such that $V/n = 10b$. **3**

CEMAT-12PB

Answer any *one* question from the following

3. (a) Classify the following into extensive and intensive properties: (i) osmotic pressure, (ii) pH of a solution, (iii) absorbance and (iv) specific conductance. | 2

(b) "Joule-Thomson experiment is an isenthalpic process." – Justify or criticize the statement. What is Joule Thomson coefficient? | 3

(c) State and explain the Kelvin-Planck or Clausius statement of the second law of thermodynamics. | 2

(d) Find an expression for the integrated rate law equation for a reaction of the type: $A + B \rightarrow$ product, in which the reaction is first-order with respect to each of the reactants. | 3

(e) At 30 °C the half-life for a reaction is found to be 5.5 h and it is independent of the initial concentration of reactant. Predict the order of the reaction, and calculate (i) the rate constant and (ii) the time required for 90% completion of the reaction. | 2

4. (a) One mole of an ideal gas at 1 atm and 300 K undergoes free expansion adiabatically to double its initial volume. Find the final temperature, ΔS of the surrounding. | 3

(b) What is entropy? Justify that it is related to unavailable work. | 2

(c) Show that for an ideal gas $(\delta C_p / \delta P)_T = 0$. | 2

(d) What is the main idea of steady-state concept? How and when does it mainly differ w.r.t. point of applicability from rate-determining step concept to explain reaction mechanism? | 3

(e) The stoichiometry of a reaction indicates the order of the reaction. Justify or contradict. | 2

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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