Answer the following questions

Question-1: (10 marks)

(a) Predict the values of the universal gas constant (R) in three different units of energy? (**4mark**)

(b) Find the molecular formula of a compound whose composition in weight percentage is given as: carbon 27.273 % and oxygen 72.727 % by weight. If it is found that 278 cc. of this gas measured at 27 ^{o}C and 735 torr. Pressure weights 0.48 g. (**6mark**)

Question-2: (12marks)

(a) Derive the relationship between C_P and C_v for real and ideal gases? (**3mark**)

(b) Express the free-energy change in a process in terms of the changes that occur in the enthalpy and entropy of the system and study the effect of temperature on spontaneity? (**3mark**)

(c) Calculate the change in internal energy, (ΔE) and change in enthalpy (ΔH), when 28 g of methane gas (CH_4), are expanded from 5.00 liters to 15.00 liters by raising the temperature of the gas, at constant pressure of 4.92 atm.? (**Consider methane behaves as an ideal gas during this process and C_p varies with temperature**). For methane [$Cp = 5.3 +0.011T$ cal / (K. mole)] (6mark)

Question-3: (12marks)

(a) Explain the phenomena of osmosis? And what is meant by isotonic, hypotonic and hypertonic solutions? (**3mark**)

(b) The vapor pressure of ethanol (C_2H_5OH), and i- propanol (C_3H_7OH) at 35 ^{o} C are 100 mmHg and 37.6 mmHg. Respectively Assume ideal behavior and calculate the partial pressures of ethanol and propanol at 35 ^{o}C. over a solution of ethanol in propanol, in which the mole fraction of ethanol is 0.300. (**3mark**)

(c) What approximate osmotic pressure at 25 ^{o}C would be created across semipermeable membrane if water containing 0.01 M Na_2SO_4, 0.02 M $MgCl_2$, and 0.03 M $CaCl_2$ were placed on one side of the membrane and distilled water were on the other side? (**6mark**)

Question-4: (16 marks)

(a) Explain the main features of the phase diagram of water? Define the triple point of water on this diagram and apply the phase rule to interpret the triple point of water on its phase diagram. (**4mark**)

(b) Calculate the freezing point and boiling point of water at 101 atm. pressures, where the density of liquid water at 0 °C is given as 0.99 g/cm^3 and that for ice at 0 °C is 0.91 g/cm^3?(Given that ΔH_{Fus} =**1436.42 cal/mole** , $\Delta Hvap$= **9717.97 cal/mole**) (**6mark**)

(c) For the reaction: $Cu^{++} + Zn = Cu + Zn^{++}$

What is the concentration ratio between Zn^{++} and Cu^{++} which produce a potential of the cell containing (Zn^{++}/Zn) and(Cu^{++}/Cu) couples equal 0.8635, at a temperature of 25°C. (**6mark**)

$$Cu^{2+} // Cu = + 0.34 V \quad , \quad Zn^{2+} // Zn = - 0.76V$$

With My Best Regards and Good Luck

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