

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)

CLASS: IMSC  
BRANCH: CHEMISTRY

SEMESTER : II  
SESSION : SP/19

SUBJECT: CH107 PHYSICAL CHEMISTRY II: CHEMICAL THERMODYNAMICS & ITS APPLICATIONS

TIME: 3.00 Hrs.

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) Define the heat capacities at constant pressure ( $C_p$ ) and at constant volume ( $C_v$ ) for a gas. Prove that for n mole of an ideal gas  $C_p - C_v = nR$  [5]
- Q.1(b) 0.5 mole of an ideal mono-atomic gas initially at 5 atm. pressure and 0 °C is allowed to expand against a constant pressure of 0.5 atm. conditions are such that the final volume is 10 times the initial volume; the final gas pressure equals the external pressure. Calculate Q, W,  $\Delta U$  and  $\Delta H$ . [5]
- Q.2(a) For the reaction  $X_2O_4 (l) \longrightarrow 2XO_2 (g)$  at 298 K, given the values,  $\Delta U = 9 \text{ kJmol}^{-1}$  and  $\Delta S = 84 \text{ JK}^{-1}\text{mol}^{-1}$ , calculate the value of  $\Delta G$ . [5]
- Q.2(b) An ideal monoatomic gas undergoes a reversible process by which its volume and temperature are each doubled. Calculate change in entropy  $\Delta S$ . [5]
- Q.3(a) Show that mixing of gases is a spontaneous process and entropy increases. [5]
- Q.3(b) Calculate the entropy change accompanying the mixing of 1 mole of a substance A with 1 mole of another substance B, the process being carried out at T=0. [5]
- Q.4(a) Explain the effect of temperature and pressure on equilibrium constant  $K_p$ . [5]
- Q.4(b) What is LeChatelier principle? Apply the LeChatelier principle, to predict the effect of pressure and addition of inert gas on the gas phase equilibria  
(a)  $H_2 (g) + I_2 (g) \longrightarrow 2HI (g)$  [5]  
(b)  $COCl_2 (g) \longrightarrow CO (g) + Cl_2 (g)$
- Q.5(a) What is Raoult's law? Derive the corresponding equation for Raoult's law. [5]
- Q.5(b) 0.1 molal aqueous solution of a weak electrolyte ionizing into two ions freezes at -0.208 °C. Calculate the degree of dissociation. [ $K_f = 1.86$ ] [5]

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