Roll No. .....

(01/22-II)

5193

B. Sc. EXAMINATION

(Third Semester)

CHEMISTRY

CH-202

Physical Chemistry

Time : Three Hours *Maximum Marks : 26*

Note : Question No. 1 is compulsory. Attempt *four* questions from Section A and Section B, selecting *two* questions from each Section.

(Compulsory Question)

1. (a) Why is zinc used in Parke's Process for desilverisation of lead ?

   (b) Under what condition k_p, k_c, k_a and k_x are all equal ?

(c) Which of the properties remain constant when equilibrium is attained ?

(d) The value of equlibirium constant k_p for the reaction $N_2O_4 \rightleftharpoons 2NO_2$ at 25°C is 0.14. Calculate standard free energy change ΔG° for the reaction.

(e) Under what condition an extensive property may become an intensive property ? Give an example.

(f) What is change in internal energy when an ideal gas expands isothermally ?

$1 \times 6 = 6$

Section A

2. (a) Derive an expression for the work done in the isothermal reversible expansion of a real gas. 3

(b) Calculate the enthalpy change for the reaction $H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$.

Given that the Bond energies of H-H Br-Br and H-Br are 435, 192 and 364 kJ mol^{-1} respectively. 2

3. (a) Derive expression for molar heat capacities C_p and C_v in terms of internal analysis change and enthalpy change and hence show $C_p - C_v = R$ for one mole of an ideal gas. 3

(b) Given that the heat of reaction of burning of Rhombic sulphur (S_R) in oxygen at 25°C to produce SO_2 gas is –296.9 kJ/mol. The heat capacities at constant pressure for S_R = 23.7, O_2 = 29.2 and SO_2 = 79.5 Jk^{-1} mol^{-1}. Find heat of reaction at 85°C. 2

4. (a) Propane has the structure $H_3C\text{-}CH_2\text{-}CH_3$. Calculate the change in enthalpy for the following reaction :

$$C_3H_8(g) + SO_2(g) \longrightarrow 3CO_2(g) + 4H_2O(g).$$

Given that average bond enthalpies are :

C – C	347 kJ mol^{-1}
C – H	414 kJ mol^{-1}
C = O	741 kJ mol^{-1}
O = O	498 kJ mol^{-1}
O – H	464 kJ mol^{-1}

3

(b) How is final temperature of irreversible adiabatic expansion of an ideal gas measured ? 2

Section B

5. (a) Calculate the enthalpy change for the reaction $N_2 + O_2 \rightleftharpoons 2NO$. Given that the equilibrium constant for this reaction is 4.08×10^{-4} at 2000 K and 3.60×10^{-3} at 2500 K. 3

(b) Starting from Clapeyron equation, how is Clausius-Clapeyron equation obtained ? Express it in integrated form. 2

6. Apply Le-Chatelier principle to predict suitable conditions for getting maximum yield of the product in each of the following cases :

(i) Manufacturing of Ammonia by Haber's Process

(ii) Manufacturing of Nitric Oxide by Birkland-Eyde process for manufacturing of Nitric acid.

(iii) Manufacturing of Hydrogen by Bosch process. 5

7. (a) 0.83 g succinic acid was shaken up with 100 ml each of water and ether. The water layer was found to contains 0.70 g of succinic acid the rest having passed on into ether layer. Calculate the quantity of succinic acid, which can be extracted from 1000 ml of ether solution containing 1 g of the acid, using 100 ml of water in one lot and in two equal fractions. 3

(b) A solute undergoes association in a solvent according to the equation $nX \longrightarrow X_n$. How can you determine the value of n by applying distribution law ? 2