

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)**

- (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 equilibrium constant  $k_p$  for the reaction  $N_2O_4 \rightleftharpoons 2NO_2$  at  $25^\circ C$  is 0.14. Calculate standard free energy change  $\Delta G^\circ$  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 × 6 = 6

**Section A**

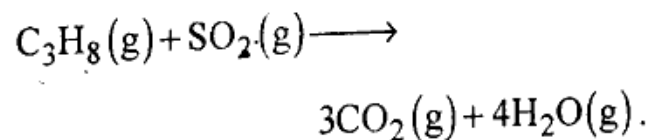
- (a) Derive an expression for the work done in the isothermal reversible expansion of a real gas. 3
- (b) Calculate the enthalpy change for the reaction  $H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$ .

Given that the Bond energies of H-H, Br-Br and H-Br are 435, 192 and 364 kJ mol<sup>-1</sup> 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<sup>-1</sup> mol<sup>-1</sup>. Find heat of reaction at 85°C. 2

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



Given that average bond enthalpies are :

C - C      347 kJ mol<sup>-1</sup>

C - H      414 kJ mol<sup>-1</sup>

C = O      741 kJ mol<sup>-1</sup>

O = O      498 kJ mol<sup>-1</sup>

O - H      464 kJ mol<sup>-1</sup>      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  $4.08 \cdot 10^{-4}$  at 2000 K and  $3.60 \cdot 10^{-3}$  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 contain 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 ?

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