

## CHEMISTRY SOLUTIONS PAPER II

### Multiple Correct Answer Type

1. (A, D)

**Sol.** State function are internal energy and molar enthalpy.  
Work is path function whether it is reversible or Irreversible.

2. (B)

**Sol.**  $\Delta H_f^\circ (\text{Cl}_2, \text{g}) = 0$ , As  $\Delta H_f^\circ$  of elements in their standard state is taken to be zero.

3. (A, B, D)

**Sol.** In an isolated system, there is no exchange of energy or matter between the system and surrounding.  
For a spontaneous process in an isolated system, the change in entropy is positive, i.e.  $\Delta S > 0$ .  
Most of the spontaneous chemical reactions are exothermic. A number of endothermic reaction are spontaneous e.g melting of ice (an endothermic process) is a spontaneous reaction.  
The two factors which are responsible for the spontaneity of process are  
(i) tendency to acquire minimum energy  
(ii) tendency to acquire maximum randomness.

4. (A, C, D)

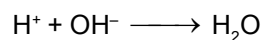
**Sol.**  $K_w$  changes with temperature.

5. (A, C)

**Sol.** As  $K_a$  of acid increases,  $K_b$  of its conjugate base decreases.

6. (A, D)

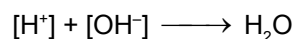
**Sol.** (A)  $[\text{H}^+] = 10^{-2}$  and  $[\text{OH}^-] = 10^{-2}$



This leads complete neutralisation

$$\text{pH} = 7 = \frac{2+12}{2}$$

(D)  $[\text{H}^+] = 10^{-5}$  and  $[\text{OH}^-] = 10^{-5}$



This leads complete neutralisation

$$\text{pH} = 7 = \frac{5+9}{2}$$

7. (A, B)

**Sol.** Total  $[\text{H}^+] = \sqrt{K_{a1}C_1 + K_{a2}C_2} = \sqrt{\left(3.6 \times 10^{-4} \times \frac{0.5}{500} \times 100\right) + \left(8 \times 10^{-4} \times \frac{0.1}{500} \times 400\right)}$

$$\therefore [\text{H}^+] = 10^{-2} \text{ M.}$$

$$\text{For } \text{HN}_3, \quad [\text{N}_3^-] = \frac{K_a[\text{HN}_3]}{[\text{H}^+]} = \frac{3.6 \times 10^{-4} \times 0.5}{0.01 \times 500} \times 100 = 3.6 \times 10^{-3} \text{ M.}$$

$$\text{For } \text{HOCN}, \quad [\text{OCN}^-] = \frac{K_a[\text{HOCN}]}{[\text{H}^+]} = \frac{8 \times 10^{-4} \times 0.1 \times 400}{0.01 \times 500} = 6.4 \times 10^{-3} \text{ M.}$$

8. (B, C, D)

**Sol.** From  $K_p = (P_{\text{NH}_3(\text{g})})^2 (P_{\text{CO}_2(\text{g})})$   
and since reaction is exothermic.

### Matrix - Match Type

1. (A) → (P, Q) ; (B) → (Q, R, S) ; (C) → (P) ; (D) → (R)

**Sol.** (A) This is combustion reaction as well as formation reaction of CO<sub>2</sub>.  
 (B) This is sublimation, atomization as well as formation reaction of C (g).  
 (C) This is combustion reaction of CO (g).  
 (D) This is atomization of CH<sub>4</sub> (g).

2. (A – R) ; (B – R) ; (C – Q) ; (D – P)

**Sol.** (A) Δn<sub>g</sub> is +ve so as P is increased, backward shifting will take place. Total pressure even after shifting will remain same.  
 (B) Δn<sub>g</sub> is –ve so as V is increased, backward shifting will take place. But P<sub>final</sub> < P<sub>initial</sub>.  
 (C) No change but P<sub>final</sub> < P<sub>initial</sub> as volume has increased.  
 (D) Forward shifting will take place and P<sub>final</sub> < P<sub>initial</sub>.

### Integer Type

1. (4)

**Sol.** Given that, ΔH<sub>vaps</sub> = 30 kJ/mol = 30 × 10<sup>3</sup> J/mol.  
 ΔS<sub>vaps</sub> = 75 J/mol.

We know that,  $\Delta S = \frac{\Delta H_{\text{vap}}}{T_{\text{B.P}}}$

$$\therefore \Delta H = T \Delta S \quad \Rightarrow \quad 30 \times 10^3 = T \times 75.$$

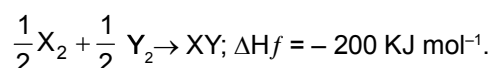
$$T = 400 \text{ K.}$$

2. (3)

**Sol.** ΔH = ΔU + Δn<sub>g</sub>RT ⇒ ΔH – ΔU = – 3RT

3. (8)

**Sol.** Let the bond dissociation energy of XY, X<sub>2</sub> and Y<sub>2</sub> be x, x and  $\frac{x}{2}$  KJ/mol respectively,



ΔH<sub>reaction</sub> = [(sum of bond dissociation energy of all reactants) – (sum of bond dissociation energy of product)]

$$= \left[ \frac{1}{2} \Delta H_{X_2} + \frac{1}{2} \Delta H_{Y_2} - \Delta H_{XY} \right] = \frac{x}{2} + \frac{0.5x}{2} - x = -200$$

$$\therefore x = \frac{200}{0.25} = 800 \text{ KJ mol}^{-1}.$$

4. (9)

**Sol.** W = – PΔV  
 = – 1 × 10<sup>5</sup> (1 × 10<sup>-2</sup> – 1 × 10<sup>-3</sup>)  
 = – 1 × 10<sup>5</sup> × 9 × 10<sup>-3</sup> = – 900 J = – 900 Litre-bar

5. (4)

**Sol.** 
$$C(s) + CO_2(g) \xrightleftharpoons[P-P/2]{P} 2CO(g)$$

$$\frac{3P}{2} = 12$$

$$K_p = \frac{P^2}{(P/2)} = 2P = 2 \times 8 = 16 \text{ atm.}$$

6. (6)

$$\text{Sol. } K_c = \frac{\left[\frac{C}{V}\right]^2}{\left[\frac{B}{V}\right]\left[\frac{A}{V}\right]^3} \Rightarrow 9 = \frac{\left[\frac{2}{V}\right]^2}{\left[\frac{2}{V}\right]\left[\frac{2}{V}\right]^3} \Rightarrow V = 6 \text{ L}$$

7. (3)

$$\text{Sol. } K_p = K_c (RT)^{\Delta n_g} = K_c (RT)$$

$$T = \frac{K_p}{K_c} \frac{1}{R} = \frac{1}{0.0821} = 12.18 \text{ K}$$

8. (4)

$$\text{Sol. } K_a = \frac{[H^+][A^-]}{[HA]} = \frac{[H^+]^2}{[HA]} (\because [H^+] = [A^-])$$

$$\text{and } K_b = \frac{[H^+][B^-]}{[HB]} = \frac{[H^+]^2}{[HB]} (\because [H^+] = [B^-])$$

$$\text{Also } H^+ \text{ are same } \therefore \frac{K_a}{K_b} = \frac{[HB]}{[HA]} = \frac{1}{4}$$

$$\frac{[HA]}{[HB]} = 4$$