

CHEMISTRY SOLUTIONS PAPER - I

Single Correct Answer Type

1. (B)

Sol. $\Delta G = \Delta H - T\Delta S$

For spontaneous reaction ΔG must be negative

At equilibrium temperature $\Delta G = 0$

to maintain the negative value of ΔG

T should be greater than T_e .

2. (A)

Sol. $C + 2H_2 \rightarrow CH_4$; $\Delta H^\circ = -74.8 \text{ kJ mol}^{-1}$

In order to calculate average energy for C – H bond formation we should know the following data.

$C(\text{graphite}) \rightarrow C(\text{g})$; $\Delta H_f^\circ =$ enthalpy of sublimation of carbon

$H_2(\text{g}) \rightarrow 2H(\text{g})$; ΔH° bond dissociation energy of H_2 .

3. (C)

Sol. $\Delta H = \Delta U + \Delta(PV)$

$\Rightarrow \Delta H = 30 + (P_2V_2 - P_1V_1) = 30 + (4 \times 5 - 2 \times 3) = 30 + 14 = 44 \text{ L atm.}$

4. (C)

Sol. In a reversible process, the driving and the opposite forces are nearly equal, hence the system and the surroundings always remain in equilibrium with each other.

5. (C)

Sol. High temperature will favour backward reaction as reaction is exothermic. While on increasing pressure reaction will shift in direction higher density.

6. (A)

Sol. From thermodynamics.

7. (B)

Sol. For constant volume, reaction quotient (Q) will remain constant.

For constant pressure, reaction quotient (Q) will remain constant when $\Delta n_g = 0$.

8. (D)

Sol. It is definition of Levelling effect,

Multiple Correct Answer Type

9. (B, C, D)

Sol. Conceptual

10. (B, C, D)

Sol. $H_2O(\ell, 1\text{bar}, 373\text{K}) \longrightarrow H_2O(\text{g}, 1\text{bar}, 373\text{K})$

$\Delta S > 0$; $\Delta H > 0$; $\Delta G = 0$

11. (A, C, D)

Sol. According to Le Chatelier's Principle exothermic reactions are favored at low temp.

12. (B, C, D)

Sol. In (A) the ratio of number of moles of reactants to products is same i.e., 2 : 2, hence change in volume will not alter the number of moles.

13. (C, D)

Sol. Addition of solids have no effect on equilibrium and temperature favours endothermic direction while increasing pressure will shift equilibrium in backward direction as Δn_g is +ve.

14. (A, B, C, D)

Sol. $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

(A) For changing pressure volume has to be changed, though number of moles of HI(g) do not get changed but its concentration will get changed.

(B) Temperature change will change K_p and hence concentration.

(C) Volume change will change concentration, not the number of moles.

(D) Catalyst does not change equilibrium concentrations.

15. (B, C)

Sol. On the basis of ostwald dilution law, number of H^+ ions will increase but increase in volume will be more. Therefore, $[H^+]$ decreases, pH increases.

16. (C)

Sol. $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

$$\begin{array}{ccc} \text{C} & & \text{O} \quad \text{O} \\ C(1-\alpha) & c\alpha & c\alpha = K_a \end{array} \quad \text{so pH} = \text{p}K_a$$

$$K_a = \frac{(c\alpha) \cdot (c\alpha)}{c(1-\alpha)} = \frac{K_a \cdot K_a}{c(1-\alpha)}$$

$$\text{so } c(1-\alpha) = K_a \Rightarrow c - c\alpha = K_a$$

$$\text{so } c = K_a + K_a = 2K_a \quad \text{Then } \alpha = \frac{K_a}{2K_a} = \frac{1}{2}$$

Paragraph Type

17. (A)

Sol. $\Delta H_{\text{ionisation}} = \Delta H_{\text{neutralisation}} - \Delta H^\circ (H + OH^- \longrightarrow H_2O)$
 $= -49.86 - (-55.84) \text{ kJ/mole}$
 $= 5.98 \text{ kJ/mole}$

18. (B)

Sol. $\Delta H^\circ = 2 \times (-55.84) \text{ kJ/mole} = -111.68 \text{ kJ}$

19. (B)

Sol. For max. rise in temp.; max. neutralization of H^+ and OH^- required.

If we take equal volume, all H^+ (5 m-mole) will react with all OH^- (5 m-mole).

20. (B)

Sol. Slope = $\frac{-\Delta H^\circ}{2.3R} = -\frac{230}{2.3 \times 2} = -50$

21. (B)

Sol. Using equation, $\log K = -\frac{\Delta H^\circ}{2.3RT} + \frac{\Delta S^\circ}{2.3R}$

22. (B)

Sol. Using equation, $\log \frac{K_2}{K_1} = \frac{\Delta H^\circ}{2.30R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$