KEY ANSWERS

UNIT-8

CHEMICAL EQUILIBRIUM

EVALUATE YOURSELF

1.

	Fe^{3+}	SCN^-	$[Fe(SCN)^{2+}$
Initial Concentration(M)	1×10^{-3} (10×10^{-4})	8×10^{-4}	–
Reacted	2×10^{-4}	2×10^{-4}	–
Equilibrium Concentration	8×10^{-4}	6×10^{-4}	2×10^{-4}

$$K_{eq} = \frac{[Fe(SCN)]^{2+}}{[Fe^{3+}][SCN^-]}$$

$$= \frac{2\times10^{-4}\ M}{8\times10^{-4}\ M \times 6\times10^{-4}\ M}$$

$$= 0.0416\times10^{4}$$

$$K_{eq} = 4.16\times10^{2}\ M^{-1}$$

2. $2\ NO(g) + O_2\ (g) \rightleftharpoons 2NO_2(g)$

	NO_2	O_2	NO_2
Initial Partial Pressure	1	1	–
Reacted	0.96	0.48	–
Equilibrium Partial Pressure	0.04	0.52	0.96

$$K_P = \frac{P^2_{NO_2}}{P^2_{NO}\ .\ Po_2}$$

$$= \frac{0.96\times0.96}{0.04\times0.04\times0.52}$$

$$= 11.07\times10^{2}\ (atm)^{-1}$$

3. $CO(g) + H_2O(g) \rightleftharpoons CO_2\ (g) + H_2(g)$

Given $K_P = 2.7$

$[CO] = 0.13$, $[H_2O] = 0.56$

$[CO_2] = 0.78$; $[H_2] = 0.28$

$V = 2L$

$K_P = K_C\ (RT)$

$2.7 = K_C\ (RT)^o$

$K_C = 2.7$

$$Q_C = \frac{[CO_2][H_2]}{[CO][H_2O]}$$

$$= \frac{\left(\frac{0.78}{2}\right)\left(\frac{0.28}{2}\right)}{\left(\frac{0.13}{2}\right)\left(\frac{0.56}{2}\right)}$$

$Q = 3$

$Q > K_C$, Hence the reaction proceed in the reverse direction.

4. $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

Given that $[PCl_5]_{initial} = 1$ mol; $V = 1\ dm^3$; $K_C = 2$

	PCl_5	PCl_3	Cl_2
Initial no. of moles	1	–	–
No. of moles	x	–	–
No. of moles at equilibrium	1–x	x	x
Equilibrium concentration	$\frac{1-x}{1}$	$\frac{x}{1}$	$\frac{x}{1}$

$$K_C = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$2 = \frac{x \times x}{(1-x)}$$

$2 - 2x = x^2$

$x^2 + 2x - 2 = 0$

solution for a quadratic equation $ax^2 + bx + c = 0$ are,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

a = 1 b = 2 c = –2

$$x = \frac{-2 \pm \sqrt{4 - 4 \times 1 \times -2}}{2 \times 1}$$

$$= \frac{-2 \pm \sqrt{12}}{2} = \frac{-2 \pm \sqrt{4 \times 3}}{2}$$

$$x = \frac{-2 \pm 2\sqrt{3}}{2}$$

$$= \frac{-2 + 2\sqrt{3}}{2}, \quad \frac{-2 - 2\sqrt{3}}{2}$$

$x = -1 + \sqrt{3}$; $-1 - \sqrt{3}$

Since X is +ve

$= -1 + 1.732$

$-1 - \sqrt{3}$ not possible

$= 0.732$

∴ Equilibrium concentration of

$$[PCl_5]_{eq} = \frac{1 - x}{1} = 1 - 0.732 = 0.268 \text{ M}$$

$$[PCl_3]_{eq} = \frac{x}{1} = \frac{0.732}{1} = 0.732$$

$$[Cl_2]_{eq} = \frac{x}{1} = \frac{0.732}{1} = 0.732$$

5. $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

$T_1 = 298$ K $\quad K_{P_1} = 0.15$

$T_2 = 100^o$ C = 100 + 273 = 373 K ;
$K_{P_2} = ?$

$$\log\left(\frac{K_2}{K_1}\right) = \frac{\Delta H^o}{2.303\,R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

$K_2 > K_1$ and $T_2 > T_1$

$$\log\left(\frac{K_{P_2}}{0.15}\right) = \frac{57.2 \text{ KJ mol}^{-1}}{2.303 \times 8.314 \text{ JK}^{-1} \text{ mol}^{-1}}\left[\frac{373 - 298}{373 \times 298}\right]$$

$$\log\left(\frac{K_{P_2}}{0.15}\right) = \frac{57.2 \times 10^{+3} \times 75}{2.303 \times 8.314 \times 373 \times 298}$$

$$\log\left(\frac{K_{P_2}}{0.15}\right) = 2.02$$

$$\frac{K_{P_2}}{0.15} = 104.7$$

$$K_{P_2} = 104.7 \times 0.15$$

$$K_{P_2} = 15.705$$

KEY FOR MCQs

1. $K_b = 0.8 \times 10^{-5}$

$K_f = 1.6 \times 10^{-4}$

$$K_{eq} = \frac{K_f}{K_b} = \frac{1.6 \times 10^{-4}}{0.8 \times 10^{-5}} = 20 \text{ (Option(a))}$$

2. $$K_1 = \frac{[A_3BC]^2}{[A_2]^3 [B_2][C]^2} \quad \ldots\ldots\ldots\ldots (1)$$

$$K_2 = \frac{[A_2]^{3/2} [B_2]^{1/2} [C]}{[A_3BC]}$$

$$\Rightarrow \quad K_2^2 = \frac{[A_2]^3 [B_2][C]^2}{[A_3BC]^2} \quad \ldots\ldots\ldots\ldots (2)$$

Comparing (1) & (2)

$$K_2^2 = \frac{1}{K_1}$$

$\Rightarrow K_2 = K_1^{-1/2}$ (Option(b))

3. $T_1 = 25 + 273 = 298$ K

$T_2 = 700$ K

$$\log\left(\frac{K_2}{K_1}\right) = \frac{\Delta H^o}{2.303\,R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

In this case, $T_2 > T_1$ and $K_1 > K_2$

$$\Rightarrow \frac{2.303\,R \log\left(\frac{K_2}{K_1}\right)}{\left(\frac{T_2 - T_1}{T_1 T_2}\right)} = \Delta H^o$$

$$\Rightarrow \frac{-\text{ve}}{+\text{ve}} = \Delta H^o$$

ΔH^o is –ve ie., forward reaction is exothermic (option a)

4. Increase in temperature, favours the endothermic reaction,

Given that formation of NH_3 is exothermic ie., the reverse reaction is endothermic.

$\therefore$ increase in temperature, shift the equilibrium to left option (c)

5. $H_2O(l) + CO_2(g) \rightleftharpoons H_2CO_3\ (l)$

(1 mole) (0 mole)

increase in pressure, favours the forward reaction.

option (a)

6. option (a) : wrong statement

Correct statement is, for a system at equilibrium, $Q = K_{eq}$

7. $K_1 = \frac{[NO]^2}{[N_2][O_2]}\ K_2 = \frac{[NO]^2}{[NO]^2\,[O_2]}\ K = \frac{[N_2]^{1/2}\,[O_2]}{[NO_2]}$

$$\sqrt{K_1} = \frac{[NO]}{[N_2]^{1/2}\,[O_2]^{1/2}}\ \sqrt{K_2} = \frac{[NO_2]}{[NO]\,[O_2]^{1/2}}$$

$$\sqrt{K_1.K_2} = \frac{[NO_2]}{[N_2]^{1/2}\,[O_2]}$$

$$\therefore \quad K = \frac{1}{\sqrt{K_1K_2}}\ \text{(Option(a))}$$

8. $[A] = 1 \times 10^{-4}$ M ; $[B] = 2 \times 10^{-3}$ M
$[C] = 1.5 \times 10^{-4}$ M

$2A\ (g) \rightleftharpoons 2B(g) + C_2(g)$

$$K = \frac{[B]^2\,[C_2]}{[A]^2} = \frac{(2\times10^{-3})^2\ (1.5\times10^{-4})}{(1\times10^{-4})^2}$$

$$= 6.0\times10^{-2} = 0.06\ \text{(Option(a))}$$

$$K_C = \frac{[\text{Products}]}{[\text{Reactants}]}$$

$$3.2\times10^{-6} = \frac{[\text{Products}]}{[\text{Reactants}]}$$

$K_C < 10^{-3}$; indicates

that [Reactants] $\gg$ [Products]

option (b)is correct,largely towards reverse direction.

10. for the reaction,

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$;

$\Delta ng = 2 - 4 = -2$

$\therefore\ K_p = K_C\ (RT)^{-2}$

$\Rightarrow \frac{K_C}{K_P} = (RT)^2$ (Option(d))

11.

	AB	A	B
Initial no. of moles	100	-	-
No. of moles dissociated and formed	20	20	20
No. of moles at equilibrium	80	20	20

Total no. of moles at equilibrium = 80 + 20 + 20 = 120

$$K_P = \frac{P_A \cdot P_B}{P_{AB}} = \frac{\left(\frac{20}{120}\times P\right)\left(\frac{20}{120}\times P\right)}{\left(\frac{80}{120}\times P\right)} = \frac{P}{24}$$

$24K_p = P$ (option (a))

12. For reaction given in option (a), (b) & (c) $\Delta ng = 0$

For option (d) $\Delta ng = 2 - 1 = 1$

$\therefore\ K_p = K_C\ (RT)$

option (d)

13.

	PCl_5	PCl_3	Cl_2
Initial no. of moles	0.5	–	–
No. of moles dissociated	x	–	–
No. of moles at equilibrium	0.5 – x	x	x

Total no. of moles at equilibrium =0.5–x + x + x

= 0.5 + x

option (b)

14.

	$x \rightleftharpoons y + z$			$A \rightleftharpoons 2B$	
	x	y	z	A	B
Initial no. of moles	a	–	–	a	–
Number of moles dissociated	x	–	–	x	–
No. of moles at equilibrium	a – x	x	x	a – x	2x
Total no. of moles at equilibriant	a – x + x + x + a + x			a – x +2x a + x	

$$\frac{K_{P_1}}{K_{P_1}} = \frac{P_y P_z}{P_x} \times \frac{P_A}{P_B^2}$$

$$\frac{K_{P_1}}{K_{P_2}} = \left[\frac{\left(\frac{x}{a+x}\right)P_1\left(\frac{x}{a+x}\right)P_1}{\frac{(a-x)}{(a+x)} \times P_1}\right] \times \left[\frac{\frac{(a-x)}{(a+x)}P_2}{\frac{4x^2P_2^2}{(a+x)^2}}\right]$$

$$\frac{K_{P_1}}{K_{P_1}} = \frac{P_1}{4P_2}$$

Given that $\frac{K_{P_1}}{K_{P_2}} = \frac{9}{1}$

$$\therefore \frac{9}{1} = \frac{P_1}{4P_2} \Rightarrow \frac{P_1}{P_2} = \frac{36}{1}$$

option (a) is correct

15. $K_C = \frac{[Fe^{3+}][OH^-]^3}{[Fe(OH)_3(s)]}$

$$K_C = [Fe^{3+}] \times \frac{1}{64}[OH^-]^3$$

To maintain K_C as constant, concentration of Fe^{3+} will increase by 64 times.

option (d)

16. $K_p = 0.5$

$$Q = \frac{P_{PCl_3} \cdot P_{Cl_2}}{P_{PCl_5}}$$

$$Q = \frac{1 \times 1}{1}$$

$Q > K_p$ ∴ Reverse reaction is favoured ; i.e. more PCl5 will be produced. option (c)

17. V = 1L

$H_2 + I_2 \rightleftharpoons 2HI$

$[H_2]_{initial} = [I_2]_{initial} = a$

$[H_2]_{eq} = [I_2]_{eq} = (a - x)$

and $[HI]_{eq} = 2x$

$$K_C = \frac{[HI]^2}{[H_2][I_2]}$$

$$\therefore K_C = \frac{4x^2}{(a-x)^2}$$

Given that $K_C = \frac{K_f}{K_r} = 1$

$\therefore 4x^2 = (a - x)^2$

$4x^2 = a^2 + x^2 – 2ax$

$3x^2 + 2ax – a^2 = 0$

$x = –a$ & $x = \frac{a}{3}$

degree of dissociation = $\frac{a}{3} \times 100$

= 33.33 %

option (a)

18. $K_f = 2.5 \times 10^2$

$K_C = 50$ $K_r = ?$

$$K_C = \frac{K_f}{K_r}$$

$$50 = \frac{2.5 \times 10^2}{K_r}$$

$K_r = 5$ (Option (b))

19. correct statement : Physical processes occurs at the same rate at equilibrium

∴ option (c) is incorrect statement

20. $2SO_2 + O_2 \rightleftharpoons 2SO_3$

$$K_1 = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$$

dissociation of 1 mole of SO_3

$$SO_3 \rightleftharpoons SO_2 + \frac{1}{2}O_2$$

$$K_2 = \frac{[SO_2][O_2]^{1/2}}{[SO_3]} \quad \therefore K_2 = \frac{1}{\sqrt{K_1}}$$

option (c) is correct

21. option (b)

22. $A + B \rightleftharpoons C$

$$K_C = \frac{[C]}{[A][B]}$$

if [A] and [B] are doubled, [C] increases 4 times to maintain K_C as constant.

$\therefore$ equilibrium constant will remain the same – option (d)

23. on cooling, reverse reaction predominates and the solution is pink in colour.

$\therefore$ decrease in temperature, favours the reverse reaction ie reverse reaction is exothermic and for the forward reaction is endothermic ($\Delta H > 0$)

option (a)

24. $$K_1 = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

$$K_2 = \frac{[NO]^2}{[N_2][O_2]}$$

$$K_3 = \frac{[H_2O]}{[H_2][O_2]^{1/2}}$$

$$K = \frac{[NO]^2[H_2O]^3}{[NH_3]^2[O_2]^{5/2}}$$

$$K = \frac{(K_2)(K_3)^3}{(K_1)} = \frac{[NO]^2}{\cancel{[N_2]}[O_2]} \times \frac{[H_2O]^3}{\cancel{[H_2]^3}[O_2]^{3/2}} \frac{\cancel{[N_2]}\cancel{[H_2]^3}}{[NH_3]^2}$$

$$= \frac{[NO]^2[H_2O]^3}{[NH_3]^2[O_2]^{5/2}}$$

option (c)

25. Given that $K_p = 1.6$ atm

$V_1 = 20$ L $\quad V_2 = ?$

$T_1 = 400$ K $\quad T_2 = 400$ K

$K_p = P_{CO_2}$

$\therefore P_{CO_2} = 1.6$ atm

$P_1 = 0.4$ atm. $\quad P_2 = 1.6$ atm

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\therefore V_2 = \frac{P_1V_1}{T_1} \times \frac{T_2}{P_2} = \frac{0.4 \text{ atm} \times 20 \text{ L}}{\cancel{400 \text{ K}}} \times \frac{\cancel{400 \text{ K}}}{1.6 \text{ atm}}$$

$= 5$L (option b)

31. $$K_C = \frac{[AB]^2}{[A_2][B_2]}$$

A – green

B – blue

Given that 'V' is constant (closed system)

At equilibrium

$$K_C = \frac{\left(\frac{4}{V}\right)^2}{\left(\frac{2}{V}\right)\left(\frac{2}{V}\right)} = \frac{16}{4} = 4$$

$K_p = K_C (RT)^{\Delta n}$

$K_p = 4(RT)^o = 4$

At Stage 'x'

$$Q = \frac{\left(\frac{6}{V}\right)^2}{\left(\frac{2}{V}\right)\left(\frac{1}{V}\right)} = \frac{36}{2} = 18$$

$Q > K_C$ ie., reverse reaction is favoured

At Stage 'y'

$$Q = \frac{\left(\frac{3}{V}\right)^2}{\left(\frac{3}{V}\right)\left(\frac{3}{V}\right)} = \frac{9}{3 \times 3} = 1$$

$K_C > Q$ ie., forward reaction is favoured.

37. $K_C = \dfrac{[NH_3]^4[O_2]^5}{[NO]^4[H_2O]^6}$

Chemical equation is,

$$4\,NO + 6H_2O \rightleftharpoons 4NH_3 + 5O_2$$

40. Given that $[PCl_5]_{initial} = \dfrac{1\,mole}{1\,dm^3}$

$[Cl_2]_{eq} = 0.6$ mole dm^{-3}

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$[PCl_3]_{eq} = 0.6$ mole dm^{-3}

$[PCl_5]_{eq} = 0.4$ mole dm^{-3}

$$\therefore K_C = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{0.6 \times 0.6}{0.4}$$

$K_C = 0.9$

41. for the reaction,

$SrCO_3\,(S) \rightleftharpoons SrO(S) + CO_2(S)$

$\Delta ng = 1 - 0 = 1$

$\therefore K_P = K_C\,(RT)$

$2.2 \times 10^{-4} = K_C\,(0.0821)\,(1002)$

$$K_C = \frac{2.2 \times 10^{-4}}{0.0821 \times 1002}$$

$$= 2.674 \times 10^{-6}$$

42. V = 3L

$$[HI]_{initial} = \frac{0.3\,mol}{3L} = 0.1\ M$$

$[HI]_{eq} = 0.05$ M

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

	HI(g)	$H_2(g)$	$I_2(g)$
Initial Concentration	0.1	–	–
Reacted	0.05	–	–
Equilibrium concentration	0.05	0.025	0.025

$$K_C = \frac{[H_2][I_2]}{[HI]^2}$$

$$= \frac{0.025 \times 0.025}{0.05 \times 0.05}$$

$K_C = 0.25$

$K_P = K_C\,(RT)^{\Delta ng}$

$\Delta ng = 2 - 2 = 0$

$K_P = 0.25\,(RT)^o$

$K_P = 0.25$

43. $CH_4(g) + 2H_2S(g) \rightleftharpoons CS_2(g) + 4H_2(g)$

$K_C = 4 \times 10^{-2}$ mol lit^{-2}

Volume = 500 ml = $^1/_2$ L

$$[CH_4]_{in} = \frac{1\,mol}{1/2\,L} = 2\ mol\ L^{-1} \qquad [CS_2]_{in} = \frac{1\,mol}{1/2\,L} = 2\ mol\ L^{-1}$$

$$[H_2S]_{in} = \frac{2\,mol}{1/2\,L} = 4\ mol\ L^{-1} \qquad [H_2] = \frac{2\,mol}{1/2\,L} = 4\ mol\ L^{-1}$$

$$Q = \frac{[CS_2][H_2]^4}{[CH_4][H_2S]^2}$$

$$\therefore Q = \frac{2 \times (4)^4}{(2) \times (4)^2} = 16$$

$Q > K_C$

$\therefore$ The reaction will proceed in the reverse direction to reach the equilibrium.

44. $K_C = 4 \times 10^{-2}$ for the reaction,

$H_2S(g) \rightleftharpoons H_2(g) + {}^1/_2\ S_2(g)$

$$K_C = \frac{[H_2][S_2]^{1/2}}{[H_2S]}$$

$$\Rightarrow 4 \times 10^{-2} = \frac{[H_2][S_2]^{1/2}}{[H_2S]}$$

For the reaction,

$2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$

$$K_C = \frac{[H_2]^2[S_2]}{[H_2S]^2} = \left(4\times10^{-2}\right)^2 = 16\times10^{-4}$$

For the reaction,

$$3H_2S(g) \rightleftharpoons 3H_2(g) + \tfrac{3}{2}\, S_2(g)$$

$$K_C = \frac{[H_2]^3\,[S_2]^{3/2}}{[H_2S]^3} = \left(4\times10^{-2}\right)^3 = 64\times10^{-6}$$

45. Given $m_{N_2} = 28$ g $\quad m_{H_2} = 6$g

V = 1 L

$$\left(n_{N_2}\right)_{initial} = \frac{28}{28} = 1 \text{ mol}$$

$$\left(n_{H_2}\right)_{initial} = \frac{6}{2} = 3 \text{ mol}$$

$N_2(g) + 3H_2(g) \rightleftharpoons 2\,NH_3(g)$

	$N_2(g)$	$H_2(g)$	$NH_3(g)$
Initial concentration	1	3	–
Reacted	0.5	1.5	–
Equilibrium concentration	0.5	1.5	1

$$[NH_3] = \left(\frac{17}{17}\right) = 1 \text{ mol} = 1 \text{ mol}$$

Weight of N_2 = (no. of moles of N_2) × molar mass of N_2

= 0.5 × 28 = 14 g

Weight of H_2 = (no. of moles of H_2) × molar mass of H_2

= 1.5 × 2 = 3 g

46. $2XY_2(g) \rightleftharpoons 2XY(g) + Y_2(g)$

	XY_2	XY	Y_2
Intial no. of moles	1	-	-
No. of moles dissociated	x	-	-
No. of moles at equilibrium	$(1 - x) \cong 1$	x	$x/2$

Total No. of moles = $1 - x + x + x/2$

$= 1 + x/2 \cong 1$

[$\because$ Given that $x << 1$; $1 - x \cong 1$ and $1 + x/2 \cong 1$]

$$K_P = \frac{(P_{XY})^2\,(P_{Y_2})}{(P_{XY_2})^2} = \frac{\left(\frac{x}{1}\times P\right)^2\left(\frac{x/2}{1}\times P\right)}{\left(\frac{1}{1}\times P\right)^2}$$

$$K_P = \frac{x^2 P^{\cancel{2}}\; x\; P}{2P^{\cancel{2}}}$$

$$\Rightarrow \boxed{2K_P = x^3P}$$

47. $A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$

	A_2	B_2	AB
Initial Concentration	1	1	-
No. of moles reacted	x	x	-
No. of moles at equilibrium	1 – x	1 – x	2x

Total no. of moles = $1 - x + 1 - x + 2x$

$= 2$

$$K_P = \frac{(P_{AB})^2}{(P_{A_2})(P_{B_2})} = \frac{\left(\frac{2x}{2}\times P\right)^2}{\left(\frac{(1-x)}{2}\times P\right)\left(\frac{1-x}{2}\times P\right)}$$

$$K_P = \frac{4x^2}{(1-x)^2}$$

Given that $K_P = 1; \frac{4x^2}{(1-x)^2} = 1$

$\Rightarrow 4x^2 = (1-x)^2$

$\Rightarrow 4x^2 = 1 + x^2 - 2x$

$3x^2 + 2x - 1 = 0$

$$x = \frac{-2 \pm \sqrt{4 - 4\times3\times-1}}{2(3)}$$

$$x = \frac{-2 \pm \sqrt{4+12}}{6}$$

$$= \frac{-2 \pm \sqrt{16}}{6}$$

$$= \frac{-2+4}{6} ; \frac{-2-4}{6}$$

$$= \frac{2}{6} ; \frac{-6}{6}$$

$x = 0.33 ; -1$ (not possible)

$\therefore [A_2]_{eq} = 1 - x = 1 - 0.33 = 0.67$

$[B_2]_{eq} = 1 - x = 1 - 0.33 = 0.67$

$[AB]_{eq} = 2x = 2 \times 0.33 = 0.66$

49. $K_{P_1} = 8.19 \times 10^2 \quad T_1 = 298\ K$

$K_{P_2} = 4.6 \times 10^{-1} \quad T_2 = 498\ K$

$$\log\left(\frac{K_{P_2}}{K_{P_1}}\right) = \frac{\Delta H^o}{2.303\ R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

$$\log\left(\frac{4.6 \times 10^{-1}}{8.19 \times 10^2}\right) = \frac{\Delta H^o}{2.303 \times 8.314}\left(\frac{498 - 298}{498 \times 298}\right)$$

$$\frac{-3.2505 \times 2.303 \times 8.314 \times 498 \times 298}{200} = \Delta H^o$$

$\Delta H^o = -46181\ J\ mol^{-1}$

$\Delta H^o = -46.18\ KJ\ mol^{-1}$

50. $P_{CO_2} = 1.017 \times 10^{-3}$ atm $T = 500^o\ C$

$K_P = P_{CO_2}$

$\therefore K_{P_1} = 1.017 \times 10^{-3} \quad T = 500 + 273 = 773\ K$

$K_{P_2} = ? \quad T = 600 + 273 = 873\ K$

$\Delta H^o = 181\ KJ\ mol^{-1}$

$$\log\left(\frac{K_{P_2}}{K_{P_1}}\right) = \frac{\Delta H^o}{2.303\ R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

$$\log\left(\frac{K_{P_2}}{1.017 \times 10^{-3}}\right) = \frac{181 \times 10^3}{2.303 \times 8.314}\left(\frac{873 - 773}{873 \times 773}\right)$$

$$\log\left(\frac{K_{P_2}}{1.017 \times 10^{-3}}\right) = \frac{181 \times 10^3 \times 100}{2.303 \times 8.314 \times 873 \times 773}$$

$$\frac{K_{P_2}}{1.017 \times 10^{-3}} = \text{anti log of } (1.40)$$

$$\frac{K_{P_2}}{1.017 \times 10^{-3}} = 25.12$$

$$\Rightarrow K_{P_2} = 25.12 \times 1.017 \times 10^{-3}$$

$$K_{P_2} = 25.54 \times 10^{-3}$$

Unit - 9

Evaluate yourself :

1) mass of KOH = 5.6 g

no. of moles = $\frac{5.6}{56}$ = 0.1 mol

i) Volume of the solution = 500 ml = 0.5 L

ii) Volume of the solution = 1 L

$$\text{molarity} = \frac{\text{number of moles of solute}}{\text{volume of solution (in L)}}$$

$$= \frac{0.1}{0.5} = 0.2\ M$$

ii) Volume of the solution = 1 L

$$\text{molarity} = \frac{0.1}{1} = 0.1M$$

2. mass of glucose = 2.82 g

no. of moles of glucose = $\frac{2.82}{180} = 0.016$

mass of water = 30 g

$$= \frac{30}{18} = 1.67$$

$$x_{H_2O} = \frac{1.67}{1.67 + 0.016} = \frac{1.67}{1.686} = 0.99$$

$$\therefore\ x_{H_2O} + x_{glucose} = 1$$

$$0.99 + x_{glucose} = 1$$

$$x_{glucose} = 1 - 0.99$$

$$= 0.01$$

3.10% $\frac{W}{V}$ means that 10g of solute in 100ml solution

$$\therefore \text{ amount of iodopovidone in } 1.5 \text{ ml} = \frac{10 \text{ g}}{100 \text{ ml}} \times 1.5 \text{ ml}$$

$$= 0.15 \text{ g}$$

4. $$\frac{\text{mass of dissolved solid}}{\text{mass of water}} \times 10^6$$

$$\frac{5 \times 10^{-3} \text{ g}}{1.05 \times 10^{3} \text{ g}} \times 10^6 = 4.76 \text{ ppm}$$

5. (a) mass of 1.5 moles of $CoCl_2$ = 1.5 × 129.9

= 194.85 g

194.85 g anhydrons cobalt chloride is dissolved in water and the solution is make up to one litre in a standard flask.

6. 6% $\frac{V}{V}$ aqeous solution contains 6g of methanol in 100 ml solution.

∴ To prepare 500 ml of 6% $\frac{V}{V}$ solution of methanol 30g methanol is taken in a 500 ml standard flask and required quantity of water is added to make up the solution to 500 ml.

6. $C_1V_1 = C_2V_2$

6 M (V_1) = 0.25 M × 500 ml

$$V_1 = \frac{0.25 \times 500}{6}$$

V_1 = 20.83 mL

7. Total pressure = 1 atm

$$P_{N_2} = \left(\frac{80}{100}\right) \times \text{ total pressure } = \frac{80}{100} \times 1 \text{ atm} = 0.8 \text{ atm}$$

$$P_{O_2} = \left(\frac{20}{100}\right) \times 1 = 0.2 \text{ atm}$$

Accordingg to Henry's Law

$$P_{solute} = K_H\, x_{solute \text{ in solution}}$$

$$\therefore P_{N_2} = (K_H)_{Nitrogen} \times \text{mole fraction of } N_2 \text{ in solution}$$

$$\frac{0.8}{8.5 \times 10^4} = x_{N_2}$$

$$x_{N_2} = 9.4 \times 10^{-6}$$

Similarly,

$$x_{O_2} = \frac{0.2}{4.6 \times 10^4}$$

$$= 4.3 \times 10^{-6}$$

9. $P^o_{\text{pure benzene}} = 50.71$ mm Hg

$P^o_{naphthalene} = 32.06$ mm Hg

Number of moles of benzene = $\frac{39}{78}$ = 0.5 mol

Number of moles of napthalene = $\frac{128}{128}$ = 1 mol

mole fraction of benzene = $\frac{0.5}{1.5}$ = 0.33

mole fraction of napthalene = 1 – 0.33 = 0.67

Partial vapour pressure of benzene

= $P^o_{benzene}$ × mole fraction of benzene

= 50.71 × 0.33

= 16.73 mm Hg

Partial vapour pressure of napthalene

= 32.06 × 0.67

= 21.48 mm Hg

Mole fraction of benzene in vapour phase = $\frac{16.73}{16.73 + 21.48} = \frac{16.73}{38.21} = 0.44$

Mole fraction of napthalene in vapour phase = 1 – 0.44 = 0.56

10. P_A^o = 10 torr , $P_{solution}$ = 9 torr

W_A = 20 g W_B = 1 g

M_A = 200 g mol^{-1} M_B = ?

$$\frac{\Delta P}{P_A^o} = \frac{W_B \times M_A}{M_B \times W_A}$$

$$\frac{10-9}{10} = \frac{1 \times 200}{M_B \times 20}$$

$$M_B = \frac{200}{20} \times 10 = 100 \text{ g mol}^{-1}$$

11. W_2 = 2.56 g

W_1 = 100 g

T = 319.692 K

K_b = 2.42 K Kg mol^{-1}

ΔT_b = (319.692 – 319.450) K

= 0.242 K

$$M_2 = \frac{K_b \times W_2 \times 100}{\Delta T_b \times W_1}$$

$$= \frac{2.42 \times 2.56 \times 1000}{0.242 \times 100}$$

$$M_2 = 256 \text{ g mol}^{-1}$$

Molecular mass of sulphur in solution
= 256 g mol^{-1}

atomic mass of one mole of sulphur atom = 32

No. of atoms in a molecule of sulphur

$$= \frac{256}{32} = 8$$

Hence molecular formula of sulphur is S_8.

12. W_2 = 2g W_1 = 75 g

ΔT_f = 0.2 K K_f = 5.12 K Kg mol^{-1}

M_2 = ?

$$M_2 = \frac{K_f \times W_2 \times 1000}{\Delta T_f \times W_1} = \frac{5.12 \times 2 \times 1000}{0.2 \times 75}$$

$$= 682.66 \text{ g mol}^{-1}$$

13.Osmotic pressure of urea solution (π_1)=CRT

$$= \frac{W_2}{M_2 V} RT$$

$$= \frac{6}{60 \times 1} \times RT$$

Osmotic pressure of glucose solution

$$(\pi_2) = \frac{W_2}{180 \times 1} \times RT$$

For isotonic solution,

$\pi_1 = \pi_2$

$$\frac{6}{60} RT = \frac{W_2}{180} RT$$

$$\Rightarrow W_2 = \frac{6}{60} \times 180$$

$$W_2 = 18 \text{ g}$$

14. $$i = \frac{\text{Observed property}}{\text{Theoritical property (calculated)}}$$

Given ΔT_f = 0.680 K

m = 0.2 m

ΔT_f (observed) = 0.680 K

ΔT_f (calculated) = K_f . m

= 1.86 K Kg mol^{-1} × 0.2 mol Kg^{-1}

= 0.372 K

$$i = \frac{(\Delta T_f) \text{ Observed}}{(\Delta T_f) \text{ Calculated}} = \frac{0.680 \text{ K}}{0.372 \text{ K}} = 1.82$$

MCQ

1. molality $$= \frac{\text{number of moles of solute}}{\text{weight of solvent (in kg)}}$$

$$= \frac{\left(\frac{1.8}{180}\right)}{0.25} = \frac{0.01}{0.25} = 0.04 \text{ M}$$

option (d) is correct.

2. option (d) is correct. Molality and mole fraction are independent of temperature.

3. $M_1 \times V_1 = M_2 \times V_2$ [$\because$ 0.1 M $Al(OH)_3$ gives 3 × 0.1 = 0.3 M OH^- ions]

$0.3 \times V_1 = 0.1 \times 21$

$$V_1 = \frac{0.1 \times 21}{0.3} = 7 \text{ ml}$$

option (b)

4. $P_{N_2} = 0.76$ atm

$K_H = 7.6 \times 10^4$

x = ?

$P_{N_2} = K_H \cdot x$

$0.76 = 7.6 \times 10^4 \times x$

$\therefore x = \frac{0.76}{7.6 \times 10^4} = 1 \times 10^{-5}$ (option d)

5. $K_H = 8 \times 10_4$

$\left(x_{N_2}\right)_{\text{in air}} = 0.5$

Total pressure = 4 atm

pressure Partial pressure of nitrogen
= mole fraction × total pressure
$0.5 \times 4 = 2$

$\left(P_{N_2}\right) = K_H \times$ mole fraction of N_2 in solution

$$2 = 8 \times 10^4 \times \frac{\text{number of moles of nitrogen}}{\text{Total number of moles}}$$

$$\frac{10 + \text{number of moles } N_2}{\text{number of moles } N_2} = \frac{8 \times 10^4}{2}$$

$$\frac{10}{\text{number of moles } N_2} + 1 = 4 \times 10^4$$

$$\frac{10}{\text{number of moles } N_2} = 40000 - 1$$

$$\therefore \text{number of moles } N_2 = \frac{10}{39999}$$

$= 2.5 \times 10^{-4}$ (option d)

6 for an ideal solution,

$\Delta S_{mix} \neq 0$; Hence $\Delta G_{mix} \neq 0$

$\therefore$ incorrect is $\Delta G_{mix} = 0$ (option d)

7. Carbon dioxide ; most stable gas and has lowest value of Henrys Law constant.

8. $P_{total} = P_1 + P_2$

$= P_1x_1 + P_2x_2$ $\quad x_1 + x_2 = 1$

$= P_1 (1 - x_2) + P_2x_2$ $\quad x_1 = 1 - x_2$

$= P_1 - P_1x_2 + P_2x_2$

$= P_1 - x_2 (P_1 - P_2)$

option (c)

9. $\pi = CRT$

$\pi = \frac{n}{V} RT$

$\pi V = nRT$ option (b)

10. Ethanol and water

option (d)

11. Given, $(K_H)_A = x$

$(K_H)_B = y$

$\frac{x_A}{x_B} = 0.2$

$\left(\frac{x_B}{x_A}\right)_{\text{in solution}} = ?$

$P_A = x\,(x_A)_{\text{in solution}} - (1)$

$P_B = y\,(x_B)_{\text{in solution}} - (2)$

$$\left(\frac{x_B}{x_A}\right)_{\text{in solution}} = \frac{P_B}{P_A} \times \frac{x}{y}$$

$$= \frac{x_B}{x_A} \times \frac{x}{y}$$

$$= \frac{1}{0.2} \times \frac{x}{y} = \frac{5x}{y}$$ (option d)

12. $\frac{\Delta P}{P^o} = \frac{n_2}{n_1}$

$W_2 = 6.5$ g

$W_1 = 100$ g

$K_b = 0.52$

$\frac{\Delta P}{P^o} = \frac{W_2M_1}{M_2W_1}$

$\frac{760 - 732}{760} = \frac{6.5 \times 18}{M_2 \times 100}$

$\therefore M_2 = 31.75$

$\Delta T_b = K_b \cdot m$

$$= \frac{0.52 \times 6.5 \times 1000}{31.75 \times 100} = 1.06$$

$T_b - 100 = 1.06$

$T_b = 100 + 1.06$

$= 101.06 \approx 101^o$ C

13. $\frac{\Delta P}{P^o} = x_2$ (mole fraction of the solute)

option (b)

14. option (d) 0.1×3 ion $[Ba^{2+}, 2NO_3^-]$

0.1×3 ion $[2\ Na^+, SO_4^-]$

15. $(\pi_1)_{\text{non electrolyte}} = (\pi_2)_{\text{glucose}}$

$C_1RT = C_2RT$

$\frac{W_1}{M_1} = \frac{W_2}{M_2}$ $\qquad CH_2O$

$12 + 2 + 16 = 30$

$\frac{6}{n(30)} = 0.025$

$\therefore n = \frac{6}{0.025 \times 30} = 8$

$\therefore$ molecular formula = $C_8H_{16}O_8$ (option b)

16. $K_H = 4 \times 10^4$ atm

$\left(P_{O_2}\right)_{air} = 0.4$ atm

$\left(x_{O_2}\right)_{\text{in solution}} = ?$

$\left(P_{O_2}\right)_{air} = K_H \left(x_{O_2}\right)_{\text{in solution}}$

$0.4 = 4 \times 10^4 \left(x_{O_2}\right)_{\text{in solution}}$

$\Rightarrow \left(x_{O_2}\right)_{\text{in solution}} = \frac{0.4}{4 \times 10^4} = 1 \times 10^{-5}$ (Option c)

17. Normality of H_2SO_4 = (no. of replacable H^+) $\times$ M

$= 2 \times 1.25$

$= 2.5$ N

18. ΔH_{mix} is negative and show negative deviation from Raoults law.

option (d)

19. $\frac{\Delta P}{P^o} = x_{sugar}$

$3.5 \times 10^{-3} = x_{sugar}$

$x_{Sugar} + x_{H_2O} = 1$

$\therefore x_{H_2O} = 1 - 0.0035 = 0.9965$ (Option d)

20. $\frac{\Delta P}{P^o} = x_2$

$\frac{100 - 90}{100} = \frac{n_2}{n_2 + n_1}$

$\Rightarrow \frac{n_2 + n_1}{n_2} = \frac{100}{10}$ $\qquad \left[n_1 = \frac{92}{92} = 1\right]$

$1 + \frac{1}{n_2} = 10$

$\frac{1}{n_2} = 9$

$\Rightarrow n_2 = \frac{1}{9}$

$\Rightarrow \frac{W_2}{M_2} = \frac{1}{9}$

$\Rightarrow W_2 = \frac{M_2}{9}$

$W_2 = \frac{80}{9} = 8.89$ g

21. $\pi = CRT$

$y = x\ (m)$

$m = RT$

$310\ R = RT$

$\therefore T = 310$ K

$= 37^o$ C

option (c)

22. $\pi = CRT$

$\pi = \frac{W}{M \times V} \times RT$

$\therefore M = \frac{WRT}{\pi V}$

$= \frac{1.26 \times 0.083 \times 300}{2.52 \times 10^{-3} \times 0.2}$

$= 62.22$ Kg mol^{-1}

23. $Ba(OH)_2$ dissociates to form

Ba^{2+} and $2OH^-$ ion

$$\alpha = \frac{(i-1)}{(n-1)}$$

$$i = \alpha (n-1) + 1$$

$\therefore$ n = i = 3 (for $Ba(OH)_2$, $\alpha = 1$)

24. 10% $\frac{W}{W}$ aqueous NaOH solution means that 10 g of sodium hydroxide in 100g solution

$$\text{molality} = \frac{\text{no. of moles of solute}}{\text{weight of solvent (in kg)}}$$

$$= \frac{\left(\frac{10}{40}\right)}{0.1} = \frac{0.25}{0.1} = 2.5\ M$$

25. $\alpha = \frac{(1-i)n}{(n-1)}$ (or) $\frac{n(i-1)}{(1-n)}$

option (c) is correct

26. Elevation of boiling point is more in the case of Na_3PO_4 (no. of ions 4 ; 3 Na^+, PO_4^{3-})

27. $\Delta T_f = i \times K_f \times m$

$$i = \frac{\Delta T_f \times M_2 \times W_1}{K_f \times W_2 \times 1000}$$

$$= \frac{3.64 \times 142 \times 45}{1.86 \times 5 \times 1000}$$

$i = 2.5$

$K_f = 1.86$

$W_2 = 5g$

$W_1 = 45\ g$

$\Delta T_f = 3.64$

$M_2 = 142$

28. Equimolal aqueous solution of KCl also shows 2° C depression in freezing point.

option (a) is correct.

29. i = 0.54

$$\alpha = \frac{(1-i)\,n}{(n-1)}$$

$$= \frac{(1-0.54)\,2}{(2-1)}$$

$$= 0.46 \times 2$$

$\alpha = 0.92$

30. a) both assertion and reason are correct and reason is the correct explanation of assertion.

40.

Given

Molarity = 12 M HCl

density of the solution = 1.2 g L^{-1}

In 12M HCl solution, there are 12 moles of HCl in 1 litre of the solution.

$$\text{molality} = \frac{\text{no.of moles of solute.}}{\text{mass of solvent (in kg)}}$$

calculate mass of water (solvent)

mass of 1 litre HCl solution

= density × volume

= 1.2 gmL^{-1} × 1000 mL

= 1200 g

mass of Hcl = no. of moles of HCl × molar mass of HCl

= 12 mol × 36.5g mol^{-1}

= 438 g

mass of water = mass of HCl solution – mass of HCl

mass of water = 1200 – 438 = 762 g

$$\text{molality} = \frac{12}{0.762}$$

$= 15.75m$

41. C = 0.25 M

T = 370.28 K

$(\pi)_{glucose}$ = CRT

$(\pi) = 0.25 molL^{-1} \times 0.082 L\ atm\ K^{-1} mol^{-1} \times 370.28 K$

= 7.59 atm

42.

$$\text{molality} = \frac{\text{no. of moles of solute}}{\text{mass of solvent (in kg)}}$$

$$\text{no. of moles of glycine} = \frac{\text{mass of glycine}}{\text{molar mass of glycine}}$$

$$= \frac{7.5}{75} = 0.1$$

$$\text{molality} = \frac{0.1}{0.5\ Kg}$$

$= 0.2m$

43. $\Delta T_f = K_f . m$

ie $\Delta T_f \alpha m$

$$m_{CH_3-OH} = \frac{\left(\frac{10}{32}\right)}{0.1} = 3.125m$$

$$m_{C_2H_5-OH} = \frac{\left(\frac{20}{46}\right)}{0.2} = 2.174m$$

$\therefore$ depression in freezing point is more in methanol solution and it will have lower freezing point.

44. In 10^{-4}M K_2SO_4 solution, there are 10^{-4} moles of potassium sulphate.

K_2SO_4 molecule contains 3 ions ($2K^+$ and $1So_4^{2-}$)

1 mole of K_2SO_4 contains $3 \times 6.023 \times 10^{23}$ ions

10^{-4} mole of K_2SO_4 contains $3 \times 6.023 \times 10^{23} \times 10^{-4}$ ions

$= 18.069 \times 10^{19}$

45. $(k_H)_{bonzene} = 4.2 \times 10^{-5}$ mm Hg

Solubility of methane = ?

P = 750mm Hg P = 840 mm Hg

According to Henrys Law,

$P = K_H . x_{\text{in solution}}$.

750mm Hg = 4.2×10^{-5} mm Hg . $x_{\text{in solution}}$

$$\Rightarrow x_{\text{in solution}} = \frac{750}{4.2 \times 10^{-5}}$$

i.e, solubility = 178.5×10^5

similarly at P = 840 mm Hg

$$\text{solubility} = \frac{840}{4.2 \times 10^{-5}}$$

$$= 200 \times 10^{-5}$$

46. $\Delta T_f = 0.093^oC = 0.093K$

m = ?

$K_f = 1.86K$ Kg mol^{-1}

$\Delta T_f = K_f . m$

$$\therefore m = \frac{\Delta T_f}{K_f}$$

$$= \frac{0.093K}{1.86\ K\ Kgmol^{-1}}$$

$= 0.05$ mol Kg^{-1}

$= 0.05m$

47. $P^0_{C_6H_6} = 640$mm Hg

$W_2 = 2.2$ g (non volabile solute)

$W_1 = 40$ g (benzene)

$P_{solution} = 600$ mm Hg

$M_2 = ?$

$$\frac{P^o - P}{P^0} = x_2$$

$$\frac{640 - 600}{640} = \frac{n_2}{n_1 + n_2} \quad [\because n_1 >> n_2 ; n_1 + n_2 \approx n_1]$$

$$\frac{40}{640} = \frac{n_2}{n_1}$$

$$0.0625 = \frac{W_2 \times M_1}{M_2 \times W_1}$$

$$M_2 = \frac{2.2 \times 78}{0.0625 \times 40}$$

$= 68.64$g mol^{-1}

UNIT -10

CHEMICAL BONDING

KEY FOR MCQs

1. Compound — No. of valance electron on the central atom

XeF_2	10
$AlCl_3$	6
SF_6	12
SCl_2	8

(option d)

2. $\overset{\cdot\cdot}{\underset{A}{O}} = C = \overset{\cdot\cdot}{\underset{B}{O}}$

formal charge of $O_A / O_B = N_V - \left(N_e + \frac{N_b}{2}\right)$

$= 6 - \left(4 + \frac{4}{2}\right)$

$= 6 - 6 = 0$

formal charge of C $= 4 - \left(0 + \frac{8}{2}\right)$

$= 4 - 4 = 0$

$\therefore$ Option (d) – (0, 0, 0)

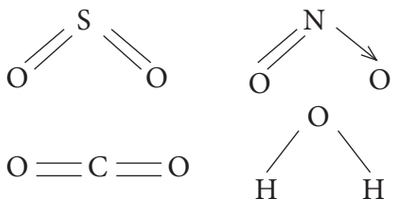
3. $\ddot{N}H_3$, $\ddot{P}H_3$ - electron rich,

$CH_3 - CH_3$ – Covalent neutral molecule.

BH_3 - electron deficient

option (c)

4.



water contain only σ bonds and no π bonds

option (d) is correct

5. $CH_3 - C \equiv C - C(=O) - H$

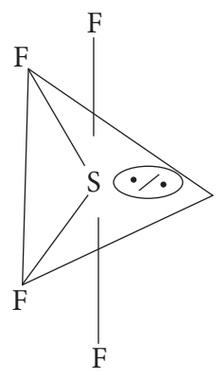
2 – butynal

no. of σ bonds = 8[4C-H;,3C-C;1C-O]

no. of π bonds = 3[2C-C; 1C-O]

$\therefore$ ratio = $\frac{8}{3}$

6.



Normal bond angle in regular trigonal bipyramidal are 90° and 120°

due to *l*.p - b.p repulsion, bond angle reduced 89°, 117°

option (d)

Correct Statement :

7. Oxygen molecule is paramagnetic

Correct Reason

It has two unpaired electron in its antibonding molecular orbital.

Option (c) assertion true and reason false.

8. Option (b) - two half filled orbitals overlap.

9. ClF_3 – Sp^3d hybridisation

NF_3 - Sp^3 hybridisation

BF_3 - Sp^2 hybridisation

Option (d) is correct.

10. Option (b) is correct Sp^3 hybridisation.

Oribital geometry tetrahedron, bond angle 109°28'

11. bond order = $\frac{1}{2}(n_b - n_a)$

bond order of $O_2^{2-} = \frac{1}{2}(8 - 6) = 1$

bond order of $C_2^{+} = \frac{1}{2}(5 - 2) = 1.5$

bond order of $O_2 = \frac{1}{2}(8 - 4) = 2$

bond order of $C_2^{2-} = \frac{1}{2}(8 - 2) = 3$

12. PCl_5 – Sp^3d hybridisation

S, P_x, P_y, P_z and $d_{x^2-y^2}$

option (c) is correct.

13. Option (b) $O_2 > O_3 > H_2O_2$

$2 > 1.5 > 1$

14. O_2^{2-} is diamagnetic. Additional two electrons paired in antibonding molecular oribital $\pi^*_{2P_y}$ and $\pi^*_{2P_z}$ (option (b))

15. Bond order = $\frac{1}{2}(n_b - n_a)$

$2.5 = \frac{1}{2}(8 - n_a)$

$\Rightarrow 5 = 8 - n_a$

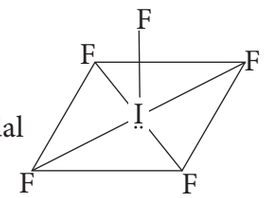
$\Rightarrow n_a = 8\text{-}5 = 3$ (option a)

16. IF_5 - 5 bond pair + 1 lone pair

hybridisation Sp^3d^2

Shape

Square pyramidal



17. Correct statement :

All five Sp^3d hybrid orbitals are equivalent

$\therefore$ incorrect statement : Option (c)

18. SeF_4, XeO_2F_2 - Sp^3d hybridisation,

option (a) T-shaped, one line pair on central atom.

19. H_2O - Central atom Sp^3 hybridised

NO_2^- - Central atom Sp^2 hybridised

BF_3 - Central atom Sp^2 hybridised

NH_2^- - Central atom Sp^3 hybridised

option (c) is correct.

20. NO_3^- - Sp^2 hybridisation, planar

H_3O^+ - Sp^3 hybridisation, pyramidal

option (a) is correct.

21. $\overset{Sp^3}{CH_3} - \overset{Sp^2}{CH} = \overset{Sp}{C} = \overset{Sp^3}{CH} - \overset{Sp^3}{CH_3}$ (option a)

22. XeF_2 is isostructural with ICl_2^-

23. $\overset{Sp^3}{CH_4}, \overset{Sp^3}{CH_3} - CH_3, \overset{Sp^2}{CH_2} = CH_2, \quad \overset{Sp}{CH} \equiv CH$

25, 25, 33.3, 50

option (a) is correct.

24. Co_2 - Linear

C_2H_2 - Linar

option (c) is correct.

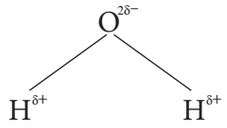
25. l.p - l.p > l.p - b.p > b.p - b.p

option (c) is correct

26. ClF_3 - Sp^3d hybridisation, 'T' shaped

option (c) is correct.

27.



option (d)

28. Correct statement is - the resonance hybrid should have lower energy than any of the contributing structure

Hence is correct statement is option (c)

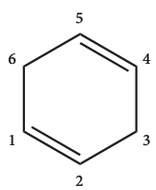
29. NH_4Cl (option (a))

30. 4U

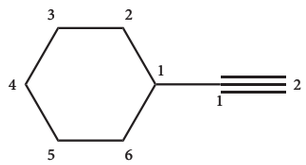
UNIT - 11

EVALUATE YOURSELF - KEY

2.

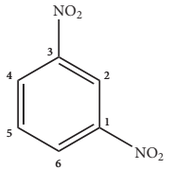


cyclohexa- 1,4-diene

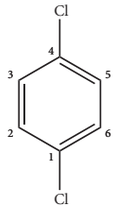


ethynyl cyclohexane

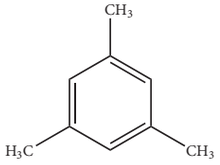
3.



1,3- dinitrobenzene



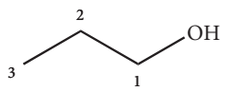
p-dichlorobenzene



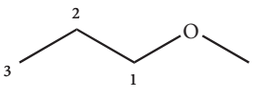
1, 3, 5 trimethylbenzene

4.

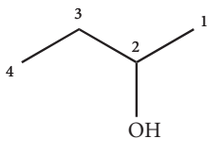
$C_4H_{10}O$ isomers



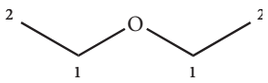
propan-1-ol



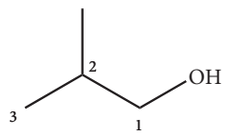
1-methoxypropane



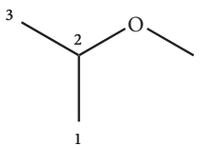
butan-2-ol



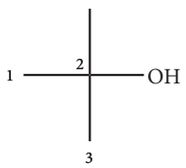
ethoxyethane



2-methylpropan-1-ol



2-methoxypropane



2-methylpropan-2-ol

5. Weight of organic substance w = 0.2346 g

Weight of water (x) = 0.2754 g

Weight of CO_2 (y) = 0.4488 g

$$\text{Percentage of carbon} = \frac{12}{44} \times \frac{y}{w} \times 100$$
$$= \frac{12}{44} \times \frac{0.4488}{0.2346} \times 100$$
$$= 52.17\,\%$$

$$\text{Percentage of hydrogen} = \frac{2}{18} \times \frac{x}{w} \times 100$$
$$= \frac{2}{18} \times \frac{0.2754}{0.2346} \times 100$$
$$= 13.04\,\%$$

$$\text{Percentage of oxygen} = [100 - (52.17 + 13.04)]$$
$$= 100 - 65.21 = 34.79\,\%$$

6. Weight of organic substance (w)=0.16 g

Weight of Barium sulphate (x) = 0.35 g

$$\text{Percentage of Sulphur} = \frac{32}{233} \times \frac{x}{w} \times 100$$
$$= \frac{32}{233} \times \frac{0.35}{0.16} \times 100$$
$$= 30.04\,\%$$

7. Weight of organic substance (w)=0.185 g

Weight of silver bromide (x) = 0.320 g

$$\text{Percentage of bromine} = \frac{80}{188} \times \frac{x}{w} \times 100$$
$$= \frac{80}{188} \times \frac{0.32}{0.185} \times 100$$
$$= 73.6\,\%$$

Weight of organic substance (w)=0.40 g

Weight of silver iodide (x) = 0.235 g

$$\text{Percentage of iodine} = \frac{127}{235} \times \frac{x}{w} \times 100$$
$$= \frac{127}{235} \times \frac{0.235}{0.40} \times 100$$
$$= 31.75\,\%$$

8. Weight of organic substance (w)=0.33 g

Weight of $Mg_2P_2O_7$ (x) = 0.397 g

$$\text{Percentage of phosphorous} = \frac{62}{222} \times \frac{x}{w} \times 100$$
$$= \frac{62}{222} \times \frac{0.397}{0.33} \times 100$$
$$= 33.59\,\%$$

9. Weight of organic compound (w) = 0.3 g

Strength of sulphuric acid used (N) = 0.1 N

Volume of sulphuric acid used (V) = 30 mL

30 ml of 0.1 N sulphuric acid = 30 ml of 0.1 N ammonia

$$\text{Percentage of nitrogen} = \left(\frac{14 \times NV}{1000 \times w}\right) \times 100$$
$$= \left(\frac{14 \times 0.1 \times 30}{1000 \times 0.3}\right) \times 100$$
$$= 14\,\%$$

UNIT -11
MCQs

1. (a)	2. (a)	3. (c)	4. (a)	5. (d)	6. (a)
7. (b)	8. (c)	9. (a)	10. (a)	11. (b)	12. (c)
13. (c)	14. (c)	15. (d)	16. (b)	17. (c)	18. (c)
19. (b)	20. (b)	21. (c)	22. (d)	23. (c)	24. (b)
25. (b)	26. (a)	27. (c)	28. (d)	29. (b)	30. (a)

Question No : 38

(i) 2,3,5-trimethylhexane

(ii) 2-bromo-3-methylbutane

(iii) methoxymethane

(iv) 2-hydroxybutanal

(v) buta-1,3-diene

(vi) 4-chloropent-2-yne

(vii) 1-bromobut-2-ene

(viii) 5-oxohexanoic acid

(ix) 3-ethyl-4-ethenylheptane

(x) 2,4,4-trimethylpent-2-ene

(xi) 2- methyl-1-phenylpropan-1-amine

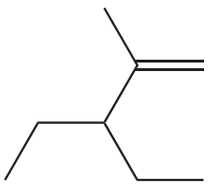
(xii) 2,2- dimethyl-4oxopentanenitrile

(xiii) 2-ethoxypropane

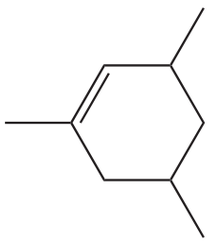
(xiv) 1-fluoro-4-methyl-2-nitrobenzene

(xv) 3-bromo-2-methylpentanal

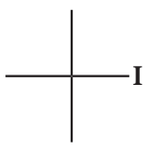
Question No : 39

(i) 

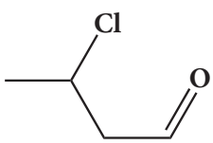
3-ethyl-2-methyl-1-pentene

(ii) 

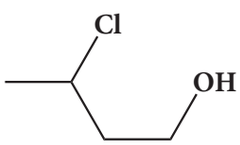
1,3,5-trimethylcyclohex-1-ene

(iii) 

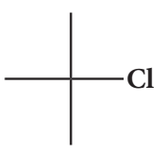
tertiarybutyl iodide

(iv) 

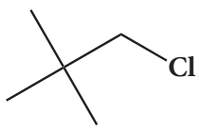
3-Chlorobutanal

(v) 

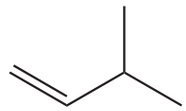
3-Chlorobutanol

(vi) 

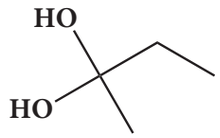
2-chloro-2-methylpropane

(vii) 

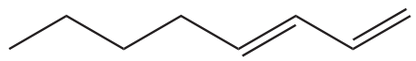
2,2-dimethyl-1-chloropropane

(viii) 

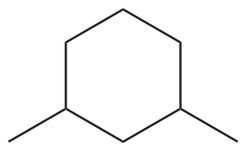
3-methylbut-1-ene

(ix) 

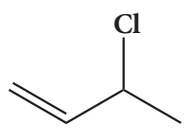
butan-2,2-diol

(x) 

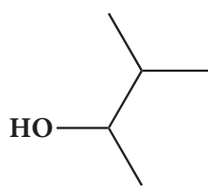
octan-1,3-diene

(xi) 

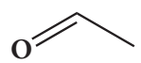
1,3-dimethylcyclohexane

(xii) 

3-chlorobut-1-ene

(xiii) 

3-methylbutan-2-ol

(xiv) 

acetaldehyde

UNIT -12

MCQs

1.(d)	2.(a)	3. (b)	4. (c)	5. (d)	6. (c)
7. (d)	8. (d)	9. (c)	10. (a)	11. (a)	12. (d)
13. (c)	14. (d)	15. (c)			

UNIT -13

MCQs

1.(b)	2.(b)	3. (d)	4. (a)	5. (c)	6. (d)
7. (c)	8. (b)	9. (a)	10. (c)	11. (d)	12. (a)
13. (a)	14. (a)	15. (c)	16. (a)	17. (c)	18. (d)
19. (d)	20. (a)	21. (d)	22. (d)	23. (a)	24. (b)
25. (d)	26. (b)	27. (a)	28. (a)	29. (c)	30. (d)

UNIT -14

MCQs

1.(b)	2.(a)	3. (a)	4. (b)	5. (a)	6. (d)
7. (b)	8. (c)	9. (b)	10. (a)	11. (c)	12. (c)
13. (d)	14. (b)	15. (c)	16. (b)	17. (d)	18. (b)
19. (a)	20. (d)	21. (a)	22. (c)	23. (c)	24. (b)
25. (c)					

UNIT -15

MCQs

1.(d)	2.(a)	3. (b)	4. (c)	5. (c)	6. (b)
7. (C)	8. (c)	9. (a)	10. (c)	11. (d)	12. (c)
13. (c)	14. (b)	15. (d)	16. (a)	17. (d)	