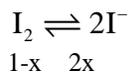


Equilibrium

EXERCISE-I (MHT CET LEVEL)

CHEMICAL EQUILIBRIUM

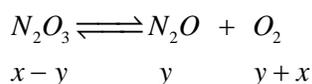
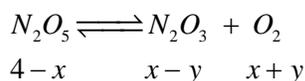
Q.1 (1)



$$K_c = \frac{(2x)^2}{(1-x)} = 10^{-6}$$

It shows that $(1-x) < 2x$

Q.2 (4)



$$\therefore [O_2] = x + y = 2.5$$

for N_2O_5 , $K_e = [N_2O_3][O_2] / [N_2O_5]$

$$\text{and } 2.5 = \frac{(x+y)(x-y)}{4-x}$$

$$\therefore x = 2.166$$

$$[N_2O_5] = 4 - x = 1.846$$

Q.3 (4)

Q.4 (1)

Q.5 (3)

Q.6 (4)

Q.7 (3,4)

Q.8 (4)

When the reaction is reversed,

$$K' = \frac{1}{K} = \frac{1}{0.25} = 4$$

Q.9 (4)

$$K_p = P_{B_1}^2 \times P_{C_1}^3$$

$$\text{Again, } K_p = P_{B_2}^2 \times (2p_{C_1})^3$$

$$\therefore P_{B_1}^2 \times P_{C_1}^3 = P_{B_2}^2 \times 8p_{C_1}^3$$

$$\therefore \frac{P_{B_1}^2}{8} = P_{B_2}^2 \text{ or, } \frac{P_{B_1}}{2\sqrt{2}} = P_{B_2}$$

Q.10 (1)

Q.11 (1)

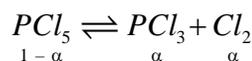
Q.12 (4)

Q.13 (3)

Q.14 (4)

Q.15 (4)

Q.16 (2)



$$\therefore K_p = \frac{\frac{\alpha}{1+\alpha} p \times \frac{\alpha}{1+\alpha} p}{\frac{1-\alpha}{1+\alpha} p} = \frac{\alpha^2 p}{1-\alpha^2}$$

$$\text{or, } K_p = \alpha^2 P$$

$$\therefore \alpha = \sqrt{\frac{K_p}{P}} \text{ when } 1-\alpha^2 = 1$$

Q.17 (4)

Q.18 (4)

Q.19 (3)

By addition of SO_2 , equilibrium will shift to RHS which is exothermic. Hence temp, will increase.

Q.20 (1)

According to Le-Chatelier's principle increase in temperature favours the endothermic reaction while decrease in temperature favour the exothermic reaction, Increase in Pressure shifts the equilibrium in that side in which number of gaseous moles decrease.

Q.21 (1)

Q.22 (3)

Q.23 (2)

Q.24 (3)

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

$$\Delta n = 1 - \left(1 + \frac{1}{2}\right) = 1 - \frac{3}{2} = -\frac{1}{2}$$

$$\therefore \frac{K_p}{K_c} = (RT)^{-1/2}$$

Q.25 (1)

$$\frac{[B]}{[A]} = 2, \frac{[C]}{[B]} = 4 \text{ and } \frac{[D]}{[C]} = 6$$

Multiply the three equations,

$$2 \times 4 \times 6 = \frac{[D]}{[A]} = K_c$$

IONICEQUILIBRIUM

Q.26 (2)

BF₃ is Lewis acid (e⁻ pair acceptor)

Q.27 (1)

Q.28 (2)

Q.29 (1)

Q.30 (3)

Q.31 (4)

Q.32 (3)

pH=3. ∴ [H⁺]10⁻³; pH=6, 10⁻³ times.

Q.33 (1)

Normal rain water has pH 5.6 Thunderstorm results in the formation NO and HNO₃ which lowers the pH.

Q.34 (2)

Q.35 (1)

-log(OH) = pOH; -log 6.2 × 10⁻⁹ = pOH;
∴ pOH = 8.21

Q.36 (2)

Q.37 (1)

Q.38 (4)

Q.39 (3)

Q.40 (1)

Q.41 (3)

Q.42 (2)

Q.43 (2)

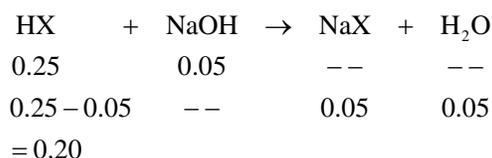
Q.44 (1)

$$\%h = \sqrt{\frac{k_w}{k_a \times k_b}} \times 100$$

$$= \sqrt{\frac{10^{-14}}{1.8 \times 10^{-5} \times 1.8 \times 10^{-5}}} \times 100$$

$$= 0.55$$

Q.45 (1)



$$K_a = \frac{[H^+][H^-]}{[HX]}$$

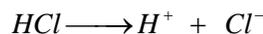
$$10^{-5} = \frac{[H^+]0.05}{0.20}$$

$$\frac{0.20}{0.05} \times 10^{-5} = [H^+]$$

$$4 \times 10^{-5} M = [H^+]$$

Q.46 (3)

Q.47 (2)

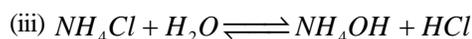


$$0.1M \quad 0.1M$$

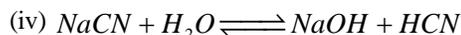
$$(i) \quad \therefore [H^+] = 0.1M$$

$$pH = -\log[H^+] = -\log 0.1 = 1$$

(ii) NaCl is a salt of strong acid and strong base so it is not hydrolysed and hence its pH is 7.



∴ The solution is acidic and its pH is less than that of 0.1M HCl.



∴ The solution is basic and its pH is more than that of 0.1M HCl.

∴ Correct order for increase in pH is

HCl < NH₄Cl < NaCl < NaCN. (7) **Buffer solution**

Q.48 (2)

Combination of NaOH and CH₃COOH is the mixture of alkali and acetic acid. Therefore this combination can not be buffer forming solution.

Q.32 (1)

Ammonia is a weak base and a salt containing its conjugate acid, the ammonium cation, such as NH₄OH functions as a buffer solution when they are present together in a solution

Q.50 (4)

Q.51 (1)

For CuS, solubility = (10⁻³¹)^{1/2};

$$\text{For Ag}_2\text{S} = \left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}} = \left(\frac{10^{-44}}{4}\right)^{\frac{1}{3}} \text{ and}$$

for HgS = (10⁻⁵⁴)^{1/2}

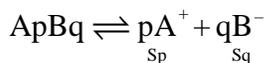
Q.52 (4)

CoS is not precipitated in acidic medium.

Q.38 (1)

IVth group needs higher S²⁻ ion concentration. In presence of HCl, the dissociation of H₂S decreases hence produces less amount of sulphide ions due to common ion effect, thus HCl decreases the solubility of H₂S which is sufficient to precipitate 2nd group radicals.

Q.54 (2)



Let the solubility be S mol/liter Thus.

$$K_{sp} = [A^+]^p [B^-]^q = [Sp]^p [Sq]^q = p^p q^q (S)^{p+q}$$

Q.55 (2)

Q.56 (4)

Q.57 (2)

Q.58 (4)

EXERCISE-II (NEET LEVEL)

Q.1 (3)

When rate of forward reaction is equal to the rate of backward reaction then equilibrium is supposed to be established.

Q.2 (3)

When rate of forward reaction is equal to rate of backward reaction the reaction is said to be in equilibrium.

Q.3 (4)

At equilibrium rate of forward reaction is equal to the rate of backward reaction.

Q.4 (4)

Equilibrium constant for the reaction $3A + 2B \rightleftharpoons$

$$C \text{ is } K = \frac{[C]}{[A]^3 [B]^2}$$

Q.5 (4)

Suppose 1 mole of A and B each taken then 0.8 mole/litre of C and D each formed remaining concentration of A and B will be $(1 - 0.8) = 0.2$ mole/litre each.

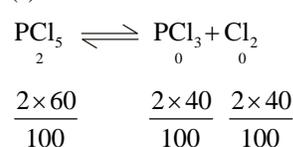
$$K_c = \frac{[C][D]}{[A][B]} = \frac{0.8 \times 0.8}{0.2 \times 0.2} = 16.0$$

Q.6 (3)

A	+	B	\rightleftharpoons	C
+		D		
Initial conc.		4,		4
0		0		
After T time conc.		(4-2)		(4-2)
2		2		

$$\text{Equilibrium constant} = \frac{[C][D]}{[A][B]} = \frac{2 \times 2}{2 \times 2} = 1$$

Q.7 (1)



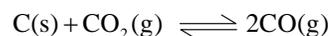
Volume of container = 2 litre.

$$K_c = \frac{\frac{2 \times 40}{100 \times 2} \times \frac{2 \times 40}{100 \times 2}}{\frac{2 \times 60}{100 \times 2}} = 0.266$$

$$K_p = \frac{[P_{CO}]^2 [P_{O_2}]}{[P_{CO_2}]^2} = \frac{[0.4]^2 \times [0.2]}{[0.6]^2} = 0.0888$$

Q.9 (2)

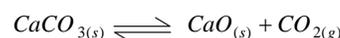
Given, $CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2(g) \uparrow$



$$K_{p_2} = \frac{[pCO]^2}{[pCO_2]}; pCO = \sqrt{[K_{p_1} \times K_{p_2}]}$$

$$pCO = \sqrt{[8 \times 10^{-2} \times 2]} = \sqrt{16 \times 10^{-2}} = 4 \times 10^{-1} = 0.4$$

Q.10 (2)



$$K_p = P_{CO_2}$$

Solid molecule does not have partial pressure so in calculation of K_p only P_{CO_2} is applicable.

Q.11 (1)

$$n_p = n_r \text{ then } K_p = K_c$$

where n_p = no. of moles of product in gaseous state

n_r = no. of moles of reactant. in gaseous state

Q.12 (4)

K_1 for reaction $2HI \rightleftharpoons H_2 + I_2$ is 0.25 K_2 for reaction $H_2 + I_2 \rightleftharpoons 2HI$ will be

$$K_2 = \frac{1}{K_1} = \frac{1}{0.25} = 4$$

Because IInd reaction is reverse of Ist.

Q.13 (4)

For reaction $2SO_3 \rightleftharpoons O_2 + 2SO_2$

Δn is +ve so K_p is more than K_c

$$\text{By } K_p = K_c (RT)^{\Delta n}$$

Q.14 (1)

$$K_p = K_c (RT)^{\Delta n}; \Delta n = 2 - 4 = -2$$

$$K_p = 6 \times 10^{-2} \times (0.0812 \times 773)^{-2}$$

$$K_p = \frac{6 \times 10^{-2}}{(0.0812 \times 773)^2} = 1.5 \times 10^{-5}$$

Q.15 (1)

Those reaction which have high value of K proceeds towards completion

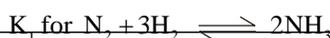
Q.16 (4)

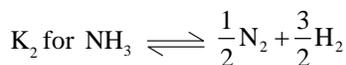
K_{c_1} for $H_2 + I_2 \rightleftharpoons 2HI$ is 50

K_{c_2} for $2HI \rightleftharpoons H_2 + I_2$

$$K_{c_2} = \frac{1}{K_{c_1}} = \frac{1}{50} = 0.02$$

Q.17 (4)





$$K_1 \times K_2 = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3} \times \frac{[\text{N}_2]^{1/2}[\text{H}_2]^{3/2}}{[\text{NH}_3]}$$

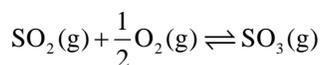
$$K_1 \times K_2 = \frac{1}{K_2}; K_2 = \frac{1}{\sqrt{K_1}}$$

Q.18 (2)

$$2.303 \log \frac{K_2}{K_1} = \frac{\Delta H}{R} \left[\frac{T_2 - T_1}{T_1 \times T_2} \right]$$

$\Delta H = +ve$ for the reaction ; so reaction is endothermic and for endothermic reaction K decreases with decrease in temperature

Q.19 (2)



initial mole 5 5 0

$$\text{at equilibrium } 5 - \frac{60}{100} \times 5 \quad 5 - \frac{60}{100} \times \frac{5}{2} \quad \frac{60}{100} \times 5$$

Total moles
at equilibrium

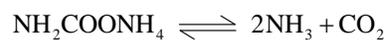
$$= 10 - \frac{60 \times 5}{2 \times 100} = 8.5$$

Q.20 (1)

$$\frac{22}{100} \times 3.2 = 0.704$$

at equil. moles of $\text{HI} = 3.2 - 0.704 = 2.496$

Q.21 (4)



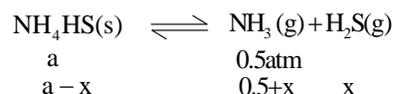
$$\alpha = \frac{D-d}{(n-1)d} \text{ where } D \text{ is the density (initial)}$$

$$D = \frac{\text{mol. wt}}{2} = \frac{78}{2} = 39$$

no. of product = 3 d = final density

$$\alpha = \frac{39-13}{(3-1)13} = 1, \text{ so } \alpha = 1$$

Q.22 (4)

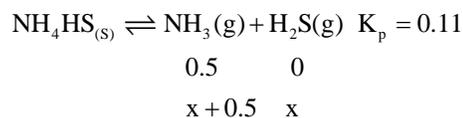


Total pressure = $0.5 + 2x = 0.84$

i.e., $x = 0.17$

$$K_p = P_{\text{NH}_3} \cdot P_{\text{H}_2\text{S}} = 0.1139 = (0.67)(0.17) = 0.1139$$

Q.23 (2)



$$K_p = P_{\text{NH}_3} \times P_{\text{H}_2\text{S}}$$

$$0.11 = (0.5+x) \times x$$

$$x = 0.17 \text{ atm}$$

equilibrium pressure of $\text{NH}_3 = 0.5 + x$

$$= 0.5 + 0.17$$

$$= 0.67 \text{ atm}$$

Q.24 (1)

For this reaction Δn is negative & ΔH is positive so reaction proceed backward increase in temperature.

Q.25 (4)

Q.25 (3)

Decreases the activation energy of both forward and backward reaction

Q.26 (1)



The above reaction is endothermic so for higher production of NO , and the temperature should be high.

Q.27 (2)

$$\text{If } \Delta G^\circ = 0$$

$$\Delta G^\circ = -2.303 RT \log K_p$$

$$\log K_p = 0 \quad (\because \log 1 = 0)$$

$$K_p = 1.$$

Q.28 (1)

For a system at equilibrium at constant temperature and pressure gibb's energy change (ΔG) = 0

Q.29 (2)

At equilibrium ; $\Delta G = 0$

Q.30 (1)

CO doesn't have a vacant d-orbital.

Q.31 (4)



Acid

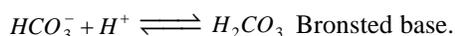
Conjugate base

Q.32 (1)

$\text{FeCl}_3 + 3\text{H}_2\text{O} \rightleftharpoons \text{Fe}(\text{OH})_3 + 3\text{HCl}$. Strong acid and weak base

Q.33 (2)

Those substance which accept the proton are called Bronsted base and which donate the proton are called Bronsted acid.



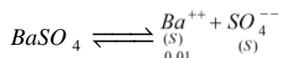
Q.34 (4)

10^{-3} N KOH will give $[\text{OH}^-] = 10^{-3} \text{ M}$

$$\text{pOH} = 3$$

$$\because \text{pH} + \text{pOH} = 14, \text{ pH} = 14 - 3 = 11$$

- Q.35** (4)
 K_w increases with increase in temperature
- Q.36** (2)
 For pure water $[H^+] = [OH^-]$, $\therefore K_w = 10^{-12}$
- Q.37** (1)
 Because pure water has a $pH = 7$
- Q.38** (2)
 $NH_2^- \rightleftharpoons NH^{-2} + H^+$
 Conjugate acid, base pair
- Q.39** (2)
 $CH_3COOH + HF \rightleftharpoons CH_3COOH_2^+ + F^-$. HF gives H^+ to the CH_3COOH . So it is a conjugate base of HF
- Q.40** (3)
 $HPO_3^{2-} + H^+ \rightarrow H_2PO_3^-$
 Base conjugate acid
- Q.41** (3)
 $pH = 4$ means; $[H^+] = 10^{-4} M$
- Q.42** (1)
 $[OH^-] = 10^{-2} M$; $pOH = 2$
 $pH + pOH = 14$; $pH = 14 - pOH$
 $pH = 14 - 2 = 12$
- Q.43** (2)
 $\frac{N}{100} = 0.01 N HCl$; $[H^+] = 10^{-2} M$; $pH = 2$
 $[OH^-] = 10^{-2} M$ for NaOH
 $pH + pOH = 14$; $pH = 14 - 2$; $pH = 12$
- Q.44** (3)
 $H_2O \rightleftharpoons [H^+][OH^-]$
 $HCl \rightarrow [H^+][Cl^-]$
 Total $[H^+] = [H^+]_{H_2O} + [H^+]_{HCl} = 10^{-7} + 10^{-8}$
 $= 10^{-7} [1 + 10^{-1}]$
 $[H^+] = 10^{-7} \times \frac{11}{10}$
 $pH = -\log[H^+] = -\log\left(10^{-7} + \frac{11}{10}\right)$; $pH = 6.958$
- Q.45** (2)
 Mathematical form of Ostwald's dilution law.
- Q.46** (1)
 In weak electrolyte the degree of dissociation is very small. So it increases with increasing dilution
- Q.47** (4)
 $[H^+] = \alpha.C = \frac{2}{100} \times .02$; $[H^+] = 4 \times 10^{-4} M$
 $pH = -\log[H^+] = 4 - \log 4$; $pH = 3.3979$
- Q.48** (1)
 $[H^+] = c \times \alpha = 0.1 \times \frac{30}{100} = 0.03 M$
- Q.49** (2)
 Alkaline, $CH_3COONa + H_2O \rightleftharpoons$
 $CH_3COOH + NaOH$
Weak acid Strong base
- Q.50** (3)
 0.001 M of $NaOH$ means $[OH^-] = .001 M$
 $= 10^{-3} M \Rightarrow pOH = 3$
 $pH + pOH = 14 \Rightarrow pH = 14 - 3 = 11$
- Q.51** (4)
 $NaClO_4$ is a salt of strong acid $HClO_4$. So it is a strong acid salt.
- Q.52** (3)
 $pK_a = -\log K_a$, $pK_b = -\log K_b$
 $pH = -\frac{1}{2}[\log K_a + \log K_w - \log K_b]$
 $= -\frac{1}{2}[-5 + \log(1 \times 10^{-14}) - (-5)]$
 $= -\frac{1}{2}[-5 - 14 + 5] = -\frac{1}{2}(-14) = 7$
- Q.53** (2)
 $[Salt] = 0.1 M$, $[Acid] = 0.1 M$
 $K_a = 1.8 \times 10^{-5}$; $pH = -\log K_a + \log \frac{[Salt]}{[Acid]}$
 $= -\log 1.8 \times 10^{-5} + \log \frac{0.1}{0.1} = -\log 1.8 \times 10^{-5}$
 $pH = 4.7$.
- Q.54** (3)
 A strong acid is not used to make a buffer
- Q.55** (4)
 NH_4OH is a weak base and NH_4Cl is a strong acid salt. so can act as Buffer.
- Q.56** (1)
 $pH = pK_a + \log \frac{[Salt]}{[Acid]} = -\log 2 \times 10^{-5} + \log \frac{10 \times 1}{50 \times 2} = 4 ..$
- Q.57** (3)
 Ionic product in the solution $= 10^{-3} \times 10^{-16} = 10^{-19}$
 The metal sulphide having the 10 lowest solubility will precipitate first, provided the ionic product is higher than the k_{sp} . Here all salts are of the same type, so the sulphide having lowest k_{sp} will precipitates first provided $k_{sp} < 10^{-19}$. HgS has the lowest k_{sp} , so it will precipitate first
- Q.58** (3)

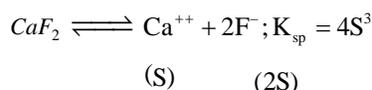


$$K_{sp} = [Ba^{2+}][SO_4^{2-}]$$

$$K_{sp} = 0.01 \times 5$$

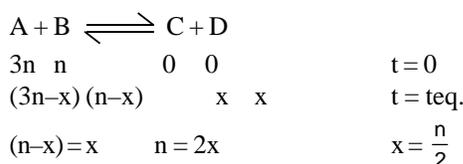
$$[SO_4^{2-}] = \frac{K_{sp}}{S(Ba^{++})} = \frac{1 \times 10^{-9}}{0.01} = 10^{-7} \text{ mole / litre}$$

Q.59 (2)

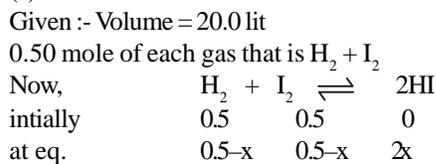


EXERCISE-III (JEE MAIN LEVEL)

Q.1 (1)



Q.2 (2)



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

$$49 = \frac{(2x)^2}{(0.5-x)^2} \quad (\text{as } K_{eq} = 49)$$

$$7 = \frac{2x}{0.5-x}$$

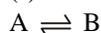
$$2x = 3.5 - 7x$$

$$9x = 3.5$$

$$x = 0.39$$

$$\text{conc. of } [HI] = \frac{2x}{20} - \frac{x}{10} \Rightarrow \frac{.39}{10} = 0.039$$

Q.3 (4)



The rate transformation of A to B just equal to rate of transformation of B to A in the system.

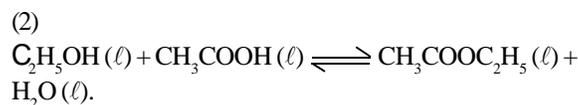
Q.4 (1)



$$a-x = b+x \quad x = \frac{K_1 a - K_2 b}{K_1 + K_2}$$

Therefore, (1) option is correct.

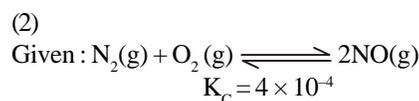
Q.5



a	a	0
0	0	0
a 0.33a	a - 0.33a	0.33a
0.33a	0.33a	0.33a

$$K_c = \frac{(0.33a) \times (0.33a)}{(0.67a) \times (0.67a)} = K_c = 1/4.$$

Q.6

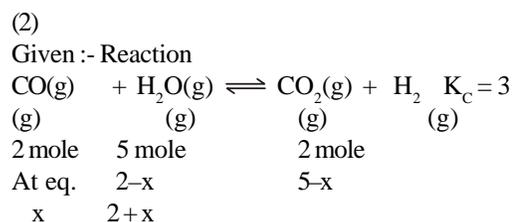


$$K'_c = ?$$

$$K'_c = \frac{1}{[K_c]^{1/2}} \Rightarrow \frac{1}{(4 \times 10^{-4})^{1/2}}$$

$$\Rightarrow \frac{1}{2 \times 10^{-2}} \Rightarrow 50$$

Q.7



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

$$3 = \frac{(x) \cdot (2+x)}{(5-x)(2-x)}$$

$$3[10 - 7x + x^2] = 2x + x^2$$

$$2x^2 - 23x + 30 = 0$$

$$\left(x - \frac{3}{2}\right)(x - 10) = 0$$

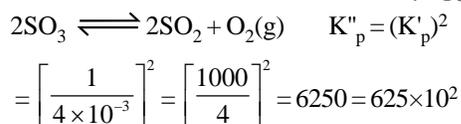
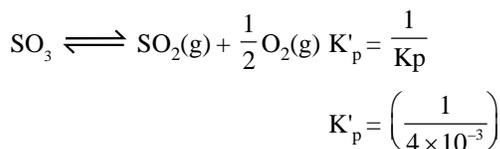
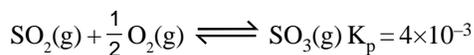
$$x = \frac{3}{2} \quad x \neq 10$$

$$\text{conc. of } H_2 = \left(2 + \frac{3}{2}\right) / 2$$

$$\Rightarrow \frac{2+1.5}{2} \Rightarrow \frac{3.5}{2}$$

$$\text{Now, } \Rightarrow 1.75$$

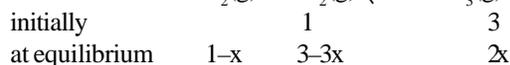
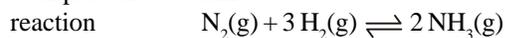
Q.8 (4)

**6.25 × 10⁴ atm.**

Q.9 (2)

Given 1 mole N₂, 3 mole H₂

total pressure = 4 atm



$$P_{\text{total}} = 1-x+3-3x+2x$$

$$= 4-2x \quad \dots(1)$$

an given in question

P_{total} fall to 3 atm

$$\therefore P_{\text{total}} = 3 \quad \dots(2)$$

from (1) & (2)

$$3 = 4 - 2x \Rightarrow \boxed{x = \frac{1}{2}}$$

$$P_{\text{N}_2} = \frac{1}{2}; P_{\text{H}_2} = 3 - \frac{3}{2}; P_{\text{NH}_3} (\text{eq.}) = 2 \times \frac{1}{2}$$

$$\Rightarrow \frac{3}{2} \quad \Rightarrow 1$$

$$K_p = \frac{(P_{\text{NH}_3})^2}{(P_{\text{N}_2})(P_{\text{H}_2})^3} = \frac{(1)^2}{\frac{1}{2} \times \left(\frac{3}{2}\right)^3}$$

$$\Rightarrow \frac{1}{0.5 \times (1.5)^3}$$

$$K_p \text{ for dissociation of NH}_3 \Rightarrow (0.5) \times (1.5)^3$$

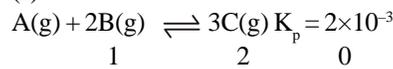
Q.10 (2)

$$K_p = 0.667 \text{ atm} = \frac{2}{3} \text{ atm} = \frac{4\alpha^2}{1-\alpha^2} \cdot P = \frac{4\alpha^2}{1-\alpha^2} \cdot \frac{1}{2}$$

$$\text{so, } \frac{4\alpha^2}{1-\alpha^2} = \frac{4}{3} \quad \Rightarrow 3\alpha^2 = 1 - \alpha^2$$

$$\text{so, } \alpha^2 = \frac{1}{4} \quad \Rightarrow \alpha = \frac{1}{2}$$

Q.11 (2)



$$K_p = \frac{[\text{C}]^3}{[\text{B}]^2 [\text{A}]} \Rightarrow \frac{(3x)^3}{(2-2x)^2 (1-x)}$$

$$K_p \Rightarrow \frac{(3x)^3}{4(1-x)^3} \quad \dots(1)$$

$$\text{as } k_p = 2 \times 10^{-3}$$

$$2 \times 10^{-3} \times 4 = d$$

$$\Rightarrow 2 \times 10^{-3} \times 4 = \frac{(3x)^3}{(1-x)^3}$$

$$2 \times 10^{-1} = \frac{3x}{(1-x)}$$

$$.2(1-x) = 3x$$

$$.2 = 3x + .2x$$

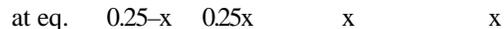
$$\Rightarrow x = \frac{0.2}{3.2} = \frac{1}{16}$$

$$\text{Now } P_c = 3x = 3 \times \frac{1}{16}$$

$$\Rightarrow \frac{3}{16} \Rightarrow 0.1875$$

Q.12 (2)

Given :- Reaction as

Here $K_p = K_c$ 

$$K_c = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{H}_2][\text{CO}_2]} \Rightarrow \frac{x^2}{(0.25-x)^2}$$

$$\Rightarrow 0.16 - \frac{x^2}{(0.25-x)^2} \quad [\text{as } K_p = K_c = 0.16]$$

$$\frac{x^2}{(0.25-x)^2} = 0.4$$

$$x = 0.1 - 0.4x$$

$$x = \frac{0.1}{1.4} = \frac{1}{14}$$

$$\% \text{ mole of CO} = \frac{(1/14)}{\text{total mole}} \times 100$$

total mole = 0.5 mole

$$\% \text{ mole of CO} = \frac{(1/14)}{0.5} \times 100$$

$$= 14.28\%$$

Q.13 (3)Given:- $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$

$$K_p = 0.5$$

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

now,

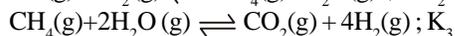
$$\Delta n_g = 2 - 2 = 0$$

$$\therefore K_p = K_c$$

$$K_c = 50$$

Q.14 (3)

Rewrite the equation as



$$\frac{1}{K_2} \times K_3 = k_1 \quad \Rightarrow \quad K_3 = K_1 K_2$$

Q.15 (1) PCl_5 dissociation a closed container

$$1 \qquad \qquad 0 \qquad \qquad 0$$

$$1 - \alpha \qquad \alpha \qquad \alpha$$

$$\text{Total mole} = 1 - \alpha + \alpha + \alpha$$

$$\Rightarrow 1 + \alpha$$

$$K_{\text{PCl}_3} (\text{mole fraction}) = \frac{\alpha}{1 + \alpha}$$

$$\therefore (\text{partial pressure}) P_{\text{PCl}_3} = \left[\frac{\alpha}{1 + \alpha} \right]^P$$

Q.16 (3)

$$x = \frac{D - d}{d}$$

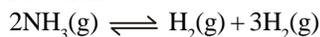
$$x = \frac{D}{d} - 1$$

$$\frac{D}{d} = x + 1$$

Q.17 (3)

Given :- Vapour density = 6

Reaction -



$$\text{initially } t = 0 \qquad 1 \qquad \qquad 0$$

$$0$$

$$\text{At eq.} \qquad 1 - \alpha \qquad \qquad \frac{\alpha}{2}$$

$$\frac{3\alpha}{2}$$

$$\text{Total no. of moles} = 1 - \alpha + \frac{\alpha}{\alpha} + \frac{3\alpha}{2}$$

$$\Rightarrow 1 - \alpha + 2\alpha$$

$$\Rightarrow 1 + \alpha$$

Apply Mass conservation

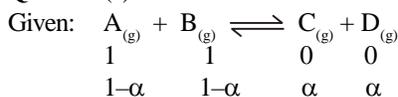
wt. of NH_3 at $t=0$ = wt. of mixture of equil.

$$1 \times [14 + 3] = (1 + \alpha) 2 \times 17$$

$$17 = (1 + \alpha) \times 2 \times 17$$

$$\frac{17}{12} - 1 = \alpha$$

$$\alpha = \frac{5}{12} \Rightarrow \% \text{ of } \alpha = \frac{5}{12} \times 100 \Rightarrow 41.66$$

Q.18 (1)

$$1 \qquad \qquad 1 \qquad \qquad 0 \qquad \qquad 0$$

$$1 - \alpha \qquad 1 - \alpha \qquad \alpha \qquad \alpha$$

$$K = \frac{[\text{C}][\text{D}]}{[\text{B}][\text{A}]}$$

$$K = \frac{\alpha^2}{(1 - \alpha)^2}$$

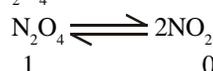
$$\sqrt{K} = \frac{\alpha}{1 - \alpha}$$

$$\frac{1 - \alpha}{\alpha} = \frac{1}{\sqrt{K}}$$

$$\frac{1}{\alpha} = \frac{1 + \sqrt{K}}{\sqrt{K}}$$

Now,

$$\alpha = \frac{\sqrt{K}}{1 + \sqrt{K}}$$

Q.19 (3)Given: N_2O_4 dissociated

$$1 \qquad \qquad 0$$

$$\text{at eq.} \quad (1 - x) \qquad 2x$$

$$\text{Total mole} = 1 - x + 2x$$

$$= 1 + x$$

Mass conservation

wt. of N_2O_4 at $t=0$ = wt. of NO_2 at eq.

$$1 \times 92 = (1 + x) \times 82$$

$$\frac{92}{82} - 1 = x$$

$$x \% = \frac{10}{82} \% = 12.2\%$$

Q.20 (3)

$$\text{initially } 1 \qquad 0 \qquad 0$$

$$\text{at eq. } 1 - x \qquad x \qquad x$$

$$\text{Total mole} = 1 - x + x + x$$

$$= 1 + x$$

apply mass conservation,

$$1 \times 208.5 = (1 + x) \times (2 \times 57.9)$$

$$\frac{208.5}{115.8} = 1 + x$$

$$\Rightarrow 1 + x = 1.80$$

$$x = 0.80$$

Q.21

(2)

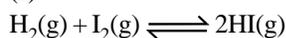
We know that

$$d = \frac{D}{1 + (n-1)\alpha}$$

where n is number of mole of gases produced from one mole of a gas

Q.22

(2)



$$\log \frac{K_2}{K_1} = \frac{\Delta H}{2.303R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

$$\log \frac{50}{66.9} = \frac{\Delta H}{2.303R} \left[\frac{1}{623} - \frac{1}{721} \right]$$

After calculation negative value of ΔH is obtained.

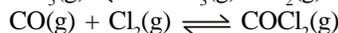
Q.23

(3)

Solubility of gas is directly proportional to the pressure of gas above liquid.

Q.24

(2)

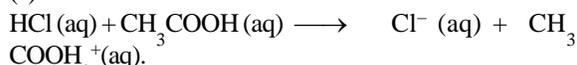


Ni will react with CO hence concentration of CO will reduce

\Rightarrow Second equilibrium shifted backward which increase the concⁿ of Cl_2 thus first equilibrium also shifted backward.

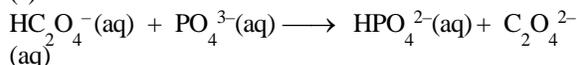
Q.25

(4)



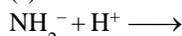
Q.26

(4)



Q.27

(1)



Q.28

(3)

Amphiprotic : can accept and Release H^+

Only H_2PO_4^- & HCO_3^-

Q.29

(4)

Fact based

Q.30

(1)

$[\text{OH}^-]$ = in pure water.

So as temperature increases K_w decreases $[\text{OH}^-]$ decreases.

Q.31

(2)

$$[\text{H}^+] = 5.5 \times 10^{-2} \text{ M}$$

$$\therefore \text{pH} = 2 - 0.74 = 1.26$$

Q.32

(2)

In this solution, source of OH^- is water

$$\therefore \alpha = [\text{OH}^-]$$

$$\alpha = 1.8 \times 10^{-11} \text{ M}$$

$$\% \text{ ionisation} = 1.8 \times 10^{-9} \text{ M}$$

Q.33

(4)

$$[\text{H}^+] = 10^{-2}; [\text{H}^+]_2 = 10^{-6}$$

$$= 10^4$$

Q.34

(2)

(1) At 25°C , $[\text{H}^+]$ in a solution of $10^{-8} \text{ M HCl} > 10^{-7} \text{ M}$.

$$(2) [\text{H}^+] = 10^{-8} \text{ M}$$

$$(3) [\text{OH}^-] = 4 \times 10^{-6} \text{ M} \Rightarrow [\text{H}^+] = 2.5 \times 10^{-9} \text{ M}$$

$$(4) [\text{H}^+] = 10^{-9} \text{ M}$$

Q.35

(3)

$$[\text{H}^+] = 0.016 \text{ M}$$

$$[\text{H}^+][\text{OH}^-] = 10^{-14} \Rightarrow [\text{OH}^-] = 6.25 \times 10^{-13} \text{ M}$$

Q.36

(1)

Initial

Final

$$\text{pH} = 12$$

$$\text{pH} = 11$$

$$[\text{H}^+] = 10^{-12} \text{ M}$$

$$[\text{H}^+] = 10^{-11} \text{ M}$$

$$[\text{OH}^-] = 10^{-2} \text{ M}$$

$$[\text{OH}^-] = 10^{-3} \text{ M}$$

Initial No. of mole of $\text{OH}^- = 10^{-2}$ Final No. of mole of $\text{OH}^- = 10^{-3}$

So no. of mole of OH^- removed = $[.01 - 0.001] = 0.009$

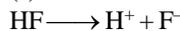
Q.37

(4)

As concentration of solution decreases, degree of dissociation of weak electrolyte increases.

Q.38

(3)



$$\text{p}K_a = \text{p}K_b + \text{p}K_w \text{ [For conjugate Acid-Base]}$$

$$\Rightarrow \text{p}K_a = 14 - 10.87 = 3.17$$

$$K_a = 6.76 \times 10^{-4}$$

Q.39

(3)

NaCl Solution : pH is the, pH of water.

As $T \uparrow$, $K_w \uparrow$, & $[\text{H}^+] \uparrow$

pH at $25^\circ\text{C} < 7$

Q.40

(2)

Volume of resulting solution = 100 ml

$$[\text{H}^+] = 10^{-3}$$

$$\Rightarrow \text{pH} = 3.$$

Q.41

(4)

m. equivalent of KOH = 8

m. equivalent of HCOOH = 16

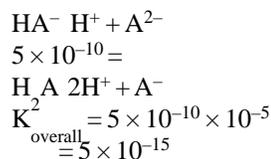
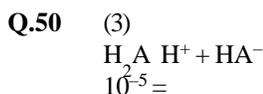
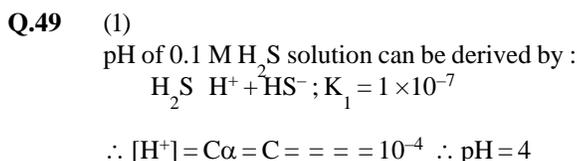
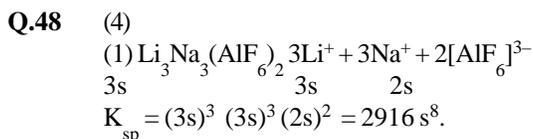
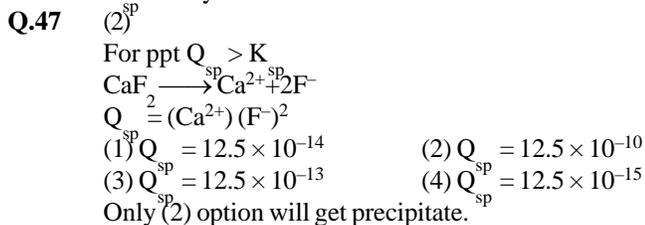
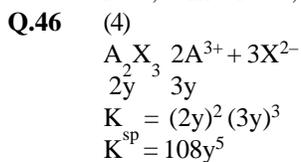
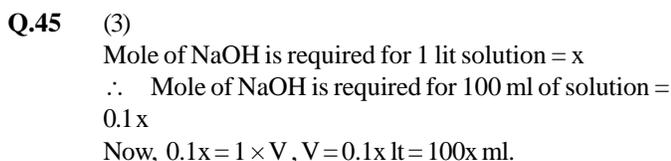
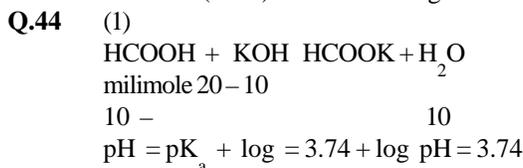
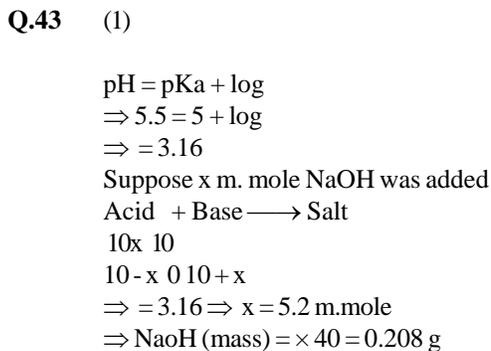
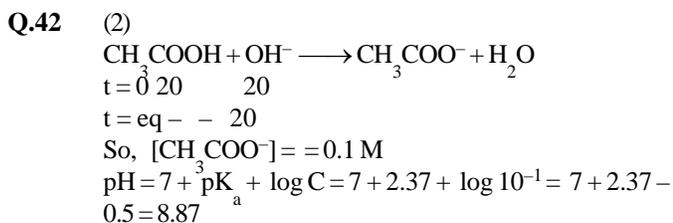
Remaining m. eq. (HCOOH) = 8

Formed m. eq. (HCOOK) = 8

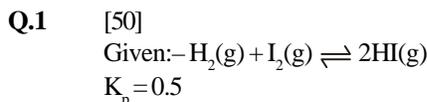
\Rightarrow Acidic Buffer

$$\text{pH} = \text{p}K_a = 4 - \log 2 = 3.7$$

$$\text{pOH} = 10.3$$

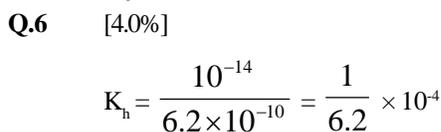
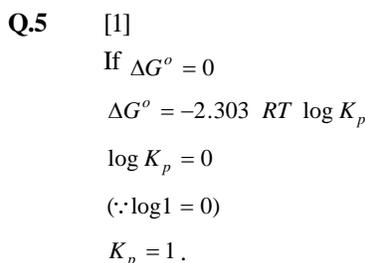
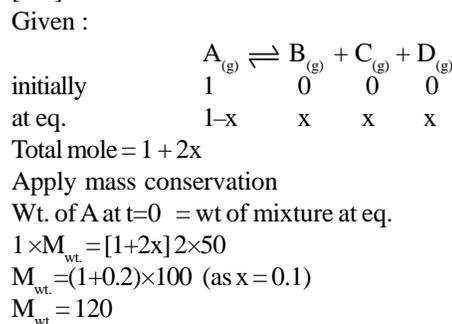
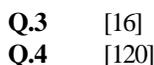
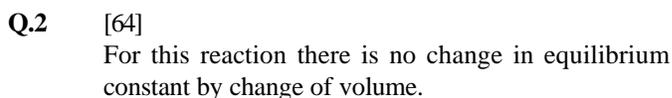


EXERCISE-IV



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

now,
 $\Delta n_g = 2 - 2 = 0$
 $\therefore K_p = K_c$
 $K_c = 50$



$$\frac{K_h}{c} = 1.6 \times 10^{-3}$$

Assuming $h \ll 1$

$$h^2 = \frac{K_h}{c}$$

$$h = 0.04$$

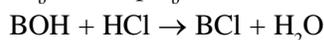
Percent hydrolysis = 4%

Q.7 [10]

$$\frac{\alpha_2}{\alpha_1} = \sqrt{\frac{K_a \cdot C_2}{K_a \cdot C_1}} = \sqrt{\frac{C_2}{C_1}} = 10$$

Q.8 (9)

$$K_b = 10^{-5}, pK_b = 5$$



At half neutralization, 50% of the base is converted to its salt, with strong acid HCl, it forms a basic buffer.

$$pOH = pK_b + \log \frac{[\text{salt}]}{[\text{base}]}$$

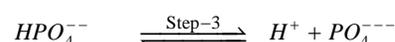
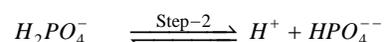
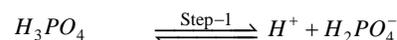
$$pOH = 5 + \log \frac{[\text{salt}]}{[\text{base}]}$$

$$[\text{salt}] = [\text{base}]$$

$$pOH = 5$$

$$pH = 14 - pOH = 9$$

Q.9 [3]



Q.10 [10,000]

$$[H^+]_1 = 10^{-2}; [H^+]_2 = 10^{-6}$$

$$= 10^4$$

Q.11 (4)

Q.12 (3)

Q.13 (2)

Q.14 (1)

Q.15 (4)

Q.16 (3)

PREVIOUS YEAR'S

KCET

Q.1 (3)

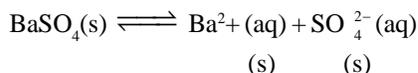
The equilibrium reaction of AgBr is



$$\text{Molar solubility (S) of AgBr} = \sqrt{4.9 \times 10^{-13}}$$

$$= 7.0 \times 10^{-7} \text{ mol dm}^{-3}$$

Q.2 (4)



$$K_{sp} = S \times S = S^2$$

$$1.1 \times 10^{-10} = S^2$$

$$S = 1.05 \times 10^{-5} \text{ mol L}^{-1}$$

Q.3 (4)

Q.4 (2)

Q.5 (1)

Q.6 (4)

Q.7 (3)

Q.8 (3)

Q.9 (3)

Q.10 (1)

Q.11 (3)

Q.12 (3)

Q.13 (4)

Q.14 (Bouns)

Q.15 (3)

Q.16 (3)

Q.17 (1)

Q.18 (4)

Q.19 (1)

Q.20 (2)

Q.21 (3)

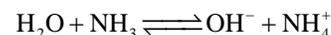
Q.22 (4)

Q.23 (2)

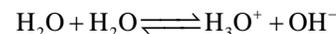
Q.24 (2)

Water is amphoteric in nature i.e it can acts as an acid as well as base

It acts as an acid with NH_3 and a base with H_2S



The auto protolysis (self ionisation) of water takes place as follows



acid base

Q.25 (3)

Givne, $K_b = 1.8 \times 10^{-5}$

$$pK_b = -\log K_b$$

$$= -\log 1.8 \times 10^{-5} = 4.74$$

$$pOH = pK_b + \log \frac{[\text{Salt}]}{[\text{base}]}$$

$$= 4.74 + \log \frac{0.20}{0.30}$$

$$= 4.74 - 0.176 = 4.56$$

$$pH + pOH = 14$$

$$pH = 14 - 4.56 = 9.44$$

Q.26 (3)

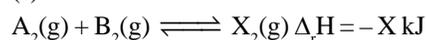
Q.27 (1)

Q.28 (1)

NEET/AIPMT

CHEMICAL EQUILIBRIUM

Q.1 (3)



On increasing pressure equilibrium shifts in a direction where pressure decreases i.e. forward direction.

On decreasing temperature, equilibrium shifts in exothermic direction i.e., forward direction.

So, high pressure and low temperature favours maximum formation of product.

Q.2

(2)

Q.3

(4)



$$K_C = \frac{[\text{O}_3]^2}{[\text{O}_2]^3}$$

$$3 \times 10^{-59} = \frac{[\text{O}_3]^2}{(4 \times 10^{-2})^3}$$

$$\begin{aligned} [\text{O}_3]^2 &= 3 \times 10^{-59} \times 64 \times 10^{-6} \\ &= 19.2 \times 10^{-64} \\ &= 4.38 \times 10^{-32} \text{M} \end{aligned}$$

Q.4

(4)

$$\bullet \text{ Meq of HCl} = 75 \times \frac{1}{5} \times 1 = 15$$

$$\bullet \text{ Meq of NaOH} = 25 \times \frac{1}{5} \times 1 = 15$$

$$\bullet \text{ Meq of HCl in resulting solution} = 10$$

$$\bullet \text{ Molarity of } [\text{H}^+] \text{ in resulting mixture} = \frac{10}{100} = \frac{1}{10}$$

$$\text{pH} = -\log [\text{H}^+] = -\log \left[\frac{1}{10} \right] = 1.0$$

Q.5

(3)

$$\begin{aligned} \text{Solubility of BaSO}_4, s &= \frac{2.42 \times 10^{-3}}{233} \text{ (mol L}^{-1}\text{)} \\ &= 1.04 \times 10^{-5} \text{ (mol L}^{-1}\text{)} \end{aligned}$$



$$\begin{aligned} K_{sp} &= [\text{Ba}^{2+}][\text{SO}_4^{2-}] = s^2 \\ &= (1.04 \times 10^{-5})^2 \\ &= 1.08 \times 10^{-10} \text{ mol}^2 \text{L}^{-2} \end{aligned}$$

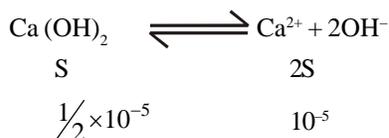
Q.6

(1)

pH of saturated solution of $\text{Ca}(\text{OH})_2 = 9$

pOH of saturated solution of $\text{Ca}(\text{OH})_2 = 5$

$$\text{OH}^- = 10^{-5}$$



$$\text{solubility } (s) = \frac{1}{2} \times 2 \times 10^{-5}$$

$$K_{sp} = [\text{Ca}^{2+}][\text{OH}^-]^2$$

$$\left[\frac{1}{2} \times 10^{-5} \right] \left[10^{-5} \right]^2 = 0.5 \times 10^{-15}$$

Q.7

(3)

Bronsted acid

Conjugate base

 H_2O OH^-

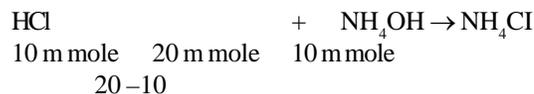
HF

 F^-

Q.8

(3)

Acid- Base Titration :



HCl is limiting reagent

Solution contain NH_4OH & NH_4Cl
(WB)

(SAWB)

The basic buffer will form.

Q.9

(4)

Q.10

(2)

Q.11

(4)

Weak acid (CH_3COOH) and salt of weak acid-strong base (CH_3COONa) form an acidic buffer.

Sodium acetate (CH_3COONa) \ 0.10 M;

pH of acidic buffer solution is given by

$$\text{pH} = \text{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

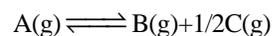
$$= 4.57 + \log \left(\frac{0.1}{0.04} \right)$$

$$= 5.57$$

JEE MAIN

Q.1

(2)



Initial mole	1	0	0
Final moles	$1-\alpha$	α	$\alpha/2$

(Dod $\rightarrow \alpha$)

$$\text{Final total moles} = \left(1 + \frac{\alpha}{2} \right)$$

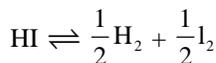
$$P_{\text{total}} = P_{\text{atm}}$$

$$K_p = \frac{(P_B)^1 \times (P_C)^{1/2}}{(P_A)^1} = \frac{\left(\frac{\alpha}{1 + \frac{\alpha}{2}} \times P \right)^1 \left(\frac{\alpha/2}{1 + \frac{\alpha}{2}} \times P \right)^{1/2}}{\left(\frac{1-\alpha}{1 + \frac{\alpha}{2}} \times P \right)^1}$$

$$K_p = \frac{(\alpha) \left(\frac{\alpha}{2} \right)^{1/2} (P)^{3/2}}{(1-\alpha) \left(1 + \frac{\alpha}{2} \right)^{1/2}}$$

$$K_p = \frac{\alpha^{\frac{3}{2}} p^{\frac{1}{2}}}{(2+\alpha)^{1/2} (1-\alpha)}$$

Q.2 (2735)



$$1-0.4 \left(\frac{0.4}{2}\right)^{1/2} \quad \left(\frac{0.4}{2}\right)^{1/2}$$

$$K_{\text{eq}} = \frac{\left(\frac{0.4}{2}\right)^{1/2} \left(\frac{0.4}{2}\right)^{1/2}}{0.6} = \frac{(0.2)^{1/2} (0.2)^{1/2}}{0.6}$$

$$K_{\text{eq}} = \frac{0.2}{0.6} = \frac{1}{3}$$

$$\Delta G^\circ = -nRT \ln K_{\text{eq}}$$

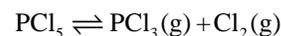
$$= -1 \times 8.31 \times 300 \ln \left(\frac{1}{3}\right)$$

$$\Delta G^\circ = 2735 \text{ J mol}^{-1}$$

$$= 2735 \text{ Ans.}$$

Q.3 (125)

Q.4 (1)



$$t=0 \quad 5 \quad 0 \quad 0$$

$$t = \text{eq} \quad 5-n \quad n \quad n$$

$$\text{Total moles} = 5 - n + n + n$$

$$= 5 + n$$

$$PV = nRT$$

$$N = 4$$

$$P_{\text{Total}} = 6$$

$$P_{\text{Ar}} = 2 \text{ atm}$$

$$\text{For 4 moles} \rightarrow 2 \text{ atm}$$

$$5 + n = 8$$

$$n = 3$$

$$K_p = \frac{P_{\text{PCl}_3} P_{\text{Cl}_2}}{P_{\text{PCl}_5}} = \frac{\left(\frac{3}{12} \times 6\right) \left(\frac{3}{12} \times 6\right)}{\left(\frac{2}{12} \times 6\right)}$$

$$= \frac{27}{12} = \frac{9}{4} = 2.25$$

$$\approx 2$$

Q.5 [1107]



$$\text{Initial moles} \quad 5 \quad 0 \quad 0$$

$$\text{at equilibrium} \quad 5(1-\alpha) \quad 5\alpha \quad 5\alpha$$

$$\alpha = \text{degree of dissociation}$$

$$\text{total moles} = 5(1-\alpha) + 5\alpha + 5\alpha = 5(1+\alpha)$$

$$2 \text{ moles of } \text{N}_2 \text{ is present, so total moles at equilibrium}$$

$$= 5(1+\alpha) + 2 \quad \dots(1)$$

$$\text{By gas equation}$$

$$PV = nRT$$

$$R = 2.46 \text{ atm ; } V = 200 \text{ Ltr}$$

$$R = 0.082 \text{ L atm K}^{-1} ; T = 600 \text{ K}$$

$$\frac{2.46 \times 200}{0.082 \times 600} = n$$

$$\text{So } n = 10 \text{ moles}$$

$$\text{By equation (1)}$$

$$5(1+\alpha) + 2 = 10$$

$$1 + \alpha = \frac{8}{5}$$

$$\text{Degree of dissociation} = \alpha = \frac{3}{5} = 0.60$$

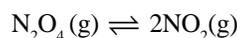
$$\text{At equilibrium } P_{\text{PCl}_5} = \frac{5(1-\alpha)}{7+5\alpha} \times 2.46 = \frac{0.2}{10} \times 2.46$$

$$P_{\text{PCl}_3} = P_{\text{Cl}_2} = \frac{5\alpha}{7+5\alpha} \times 2.46 = \frac{3}{10} \times 2.46$$

$$k_p = \frac{P_{\text{PCl}_3} \cdot P_{\text{Cl}_2}}{P_{\text{PCl}_5}} = \frac{\frac{3}{10} \times 2.46 \times \frac{3}{10} \times 2.46}{\frac{0.2}{10} \times 2.46}$$

$$= 1.107 = 1107 \times 10^{-3} = 1107$$

Q.6 [710]



$$1-\alpha \quad 2\alpha$$

$$k_p = \frac{4\alpha^2 p}{1-\alpha} = \frac{4 \times (0.5)^2 \times 1}{1 - (0.5)^2} = \frac{1}{0.75}$$

$$k_p = \frac{4}{3}$$

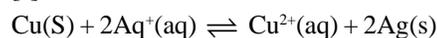
$$\Delta G^\circ = -2.3 RT \log K_p$$

$$= -2.3 \times 8.31 \times 300 \times \log (1.33)$$

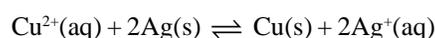
$$= -710.4 \text{ J mol}^{-1} \approx 710 \text{ J mol}^{-1}$$

$$= 710$$

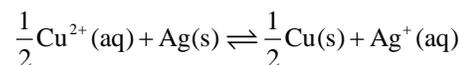
Q.7 [2]



$$K = 2 \times 10^{15}$$



$$K' = \frac{1}{K} = \frac{1}{2 \times 10^{15}}$$



$$K'' = (K')^{1/2}$$

$$= \left(\frac{1}{2 \times 10^{15}}\right)^{1/2}$$

$$= (5 \times 10^{-16})^{1/2}$$

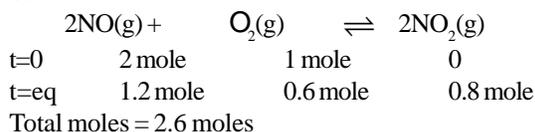
$$= \sqrt{5} \times 10^{-8}$$

$$= 2.23 \times 10^{-8}$$

$$= x \times 10^{-8}$$

$$x \approx 2$$

Q.8 (2)



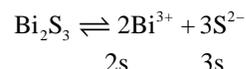
$$K_p = \frac{(P_{\text{NO}_2})^2}{(P_{\text{NO}})^2 (P_{\text{O}_2})} = \frac{\left(\frac{0.8}{2.6} \times 1\right)^2}{\left(\frac{1.2}{2.6}\right)^2 \left(\frac{0.6}{2.6}\right)} = \frac{(0.8)^2 \times 2.6}{(1.2)^2 \times 0.6}$$

$$= 1.9259$$

Q.9 (4)

Water act as a lewis base not lewis acid

Q.10 (1)



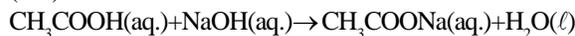
$$k_{\text{sp}} = (2s)^2 (3s)^3$$

$$= 108 (s)^5$$

$$(s)^5 = \frac{1.08 \times 10^{-73}}{108}$$

$$\Rightarrow s = 10^{-15}$$

Q.11 (476)

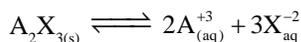


Milimoles	5	2.5	
Milimoles	0	2.5	2.5

after reaction

Resultant solution is acidic buffer solution with some concentration of acid and salts. So pH of solution will be 4.76×10^{-2}

Q.12 (3)



$$\text{Solubility} = s \text{M} \quad 2s \quad 3s$$

$$(2s)^2 (3s)^3 = 1.1 \times 10^{-23}$$

$$108 s^5 = 1.1 \times 10^{-23}$$

$$s \approx 10^{-5} \text{ M} = 10^{-5} \frac{\text{mol}}{\text{L}} = 0.01 \frac{\text{mol}}{\text{m}^3}$$

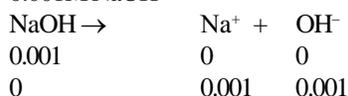
Now

$$\Rightarrow \wedge_m = \wedge_m^\infty = \frac{k}{m} = \frac{k}{s}$$

$$\Rightarrow \wedge_m^\infty = \frac{3 \times 10^{-5}}{0.01} = 3 \times 10^{-3} \text{ S-m}^2/\text{mol}$$

Q.13 (11)

0.001M NaOH



$$\text{pOH} = -\log[\text{OH}] = -\log[10^{-3}] = 3$$

$$\text{pH} + \text{pOH} = 14, \text{pH} = 14 - 3 = 11$$

Q.14 (2)

$$\text{pH} = \text{pK}_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$4 = 5 - \log 1.3 + \log \frac{[\text{CH}_3\text{CH}_2\text{COO}^-]}{[\text{CH}_3\text{CH}_2\text{COOH}]}$$

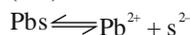
$$\log \frac{[\text{CH}_3\text{CH}_2\text{COO}^-]}{[\text{CH}_3\text{CH}_2\text{COOH}]} = \log 1.3 - 1 = \log \frac{1.3}{10}$$

$$\frac{[\text{CH}_3\text{CH}_2\text{COO}^-]}{[\text{CH}_3\text{CH}_2\text{COOH}]} = 0.13$$

Q.15 (4)

Solubility of AgCl will be maximum in, Deionized water because there is no common ion effect. Hence option (D) is correct.

Q.16 (282)



$$k_{\text{sp}} = s^2$$

s → Solubility

k_{sp} = solubility product

$$s = \sqrt{k_{\text{sp}}}$$

$$= \sqrt{8 \times 10^{-28}} \quad \therefore \text{Given } K_{\text{sp}} = 8 \times 10^{-28}$$

$$= \sqrt{8} \times 10^{-14} = 2\sqrt{2} \times 10^{-14}$$

$$= 2.82 \times 10^{-14} = 282 \times 10^{-16} \text{ mol/L} = x \times 10^{-16}$$

$$x = 282$$

Q.17 (27)

K_a of Butyric acid ⇒ $2 \times 10^{-5} \text{PKa} = 4.7$

pH of 0.2 M solution

$$\text{pH} = \frac{1}{2} \text{pK}_a - \frac{1}{2} \log C = \frac{1}{2} (4.7) - \frac{1}{2} \log (0.2)$$

$$= 2.35 + 0.35 = 2.7$$

$$\text{pH} = 27 \times 10^{-1}$$

Q.18 (4)

On adding two reactions equilibrium constant gets multiplied.

Q.19 [0]

Solubility of CaF₂ = 2.34 × 10⁻³ g/100 ml

$$= 2.34 \times 10^{-2} \text{ g/1000 ml}$$

$$= 3 \times 10^{-4} \text{ mole/lit}$$

$$K_{\text{sp}} \text{ of CaF}_2 = 4\text{S}^3 = 4 \times (3 \times 10^{-4})^3$$

$$= 10.8 \times 10^{-9} = 10.8 \times 10^{-9} \left(\frac{\text{M}}{\text{L}}\right)^3$$

Q.20 (3)

V_{solution} = 1 litre

$$\text{pH} = 8.26$$

$$\Rightarrow \text{pOH} = 14 - 8.26$$

$$[\text{NH}_3] = 0.2 \text{ M} = [\text{Base}] = 5.74$$

$$\text{PK}^{\text{b}}(\text{NH}_3) = 4.74$$

For basic buffer :

$$\text{pOH} = \text{PK}^{\text{b}} + \log \frac{[\text{Salt}]}{[\text{Base}]}$$

$$5.74 = 4.74 + \log \frac{[\text{NH}_4\text{Cl}]}{0.2}$$

$$1 = \log [\text{NH}_4\text{Cl}] - \log (1/5)$$

$$\begin{aligned} \text{Log} [\text{NH}_4\text{Cl}] &= 1 - \log 5 \\ &= \log 10 - \log 5 \\ &= \log \frac{10}{5} = \log 2 \end{aligned}$$

$$\begin{aligned} [\text{NH}_4\text{Cl}] &= 2\text{M} \\ V_{\text{solution}} &= 1\text{l} \\ \text{Moles of } \text{NH}_4\text{Cl} &= 2 \times 1 = 2 \text{ mol} \\ \text{Mass of } \text{NH}_4\text{Cl} &= 2 \times \text{GMM} \\ &= 2 \times 53.5 \\ &= 107.0\text{gm} \end{aligned}$$

Q.21 (2)

$$[\text{H}^+] = \frac{0.01 \times 200 + 2 \times 0.01 \times 400}{600} \Rightarrow \frac{5}{3} \times 10^{-2}$$

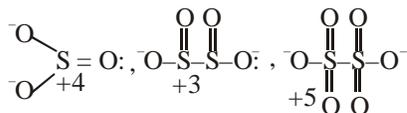
$$\begin{aligned} \text{pH} &= -\log [\text{H}^+] \\ &= -\log \left(\frac{5}{3} \times 10^{-2} \right) \\ &= - \left[\log \frac{5}{3} + \log 10^{-2} \right] \\ &= - [\log 5 - \log 3 - 2] \\ &= -0.7 + 0.48 + 2 \\ &= 2.48 - 0.7 \\ &= 1.78 \end{aligned}$$

Redox Reaction

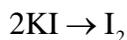
EXERCISE-I (MHT CET LEVEL)

Q.1 (4)

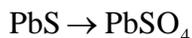
According to chemical bond method



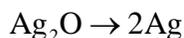
Q.2 (4)

SO₂ changes to H₂SO₄ (O.N. changes from +4 to +6 oxidation)

(O.S. changes from -1 to 0 oxidation)



(O.S. changes from -2 to 6 oxidation)



(O.S. changes from +1 to 0 oxidation)

Q.3 (4)

$$3\text{Br}_2 + 6\text{CO}_3^{2-} + 3\text{H}_2\text{O} \rightarrow 5\text{Br}^- + \text{BrO}_3^- + 6\text{HCO}_3^-$$

O.N. of Br₂ changes from 0 to -1 and +5, hence it is reduced as well as oxidised.

Q.4 (3)



$$2 + 4x - 12 = 0$$

$$4x - 10 = 0$$

$$x = \frac{10}{4} = \frac{+5}{2}$$

$$\text{Oxidation state of S is } = \frac{+5}{2}$$

Q.5 (3)

Compound
O.S. of NN₂O

+1

NO

+2

NO₂

+4

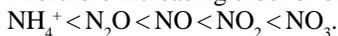
NO₃⁻

+5

NH₄⁺

-3

Therefore increasing order of oxidation state of N is :



Q.6 (4)

Q.7 (3)

Q.8 (4)

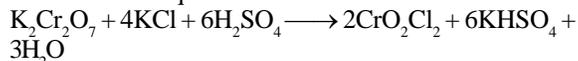
Q.9 (3)

Q.10 (3)

Q.11 (2)

Q.12 (4)

The balanced equation is



Q.13 (2)

Q.14 (1)

In redox reaction,

g equivalent of reducing agent = g. equivalent of oxidising agent

Hence 1g equ. of reducing agent = P g equ. of oxidising agent.

Q.15 (2)

Q.16 (1)

Q.17 (2)

Q.18 (3)

Q.19 (1)

Q.20 (1)

Q.21 (2)

KCl x = -1

KClO₃

potassium chloride +1 + x - 6 = 0

x = +5

potassium chlorate.

$$\therefore \text{Ratio of oxidation state of Cl} = \frac{-1}{5}$$

Q.22 (1)

Am shows maximum number of oxidation states, +3, +4, +5, +6

EXERCISE-II (NEET LEVEL)

Q.1 (3)

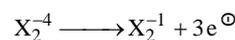
Q.2 (4)

Q.3 (2)

Q.4 (3)

X₂H₄

or



$$2x = -1$$

$$x = -\frac{1}{2}$$

- Q.5** (4)
 $\text{MnO}_4^- \rightarrow x + 4(-2) = -1; x = +7$
 $[\text{Cr}(\text{CN})_6]^{3-} \rightarrow x + 6(-1) = -3; x = +3$
 $[\text{NiF}_6]^{3-} \rightarrow x + 6(-1) = -2; x = +4$
 $\text{CrO}_2\text{Cl}_2 \rightarrow x + 2(-2) + 2(-1) = 0; x = +6$
- Q.6** (3)
 $\text{MnO}_4^- + \text{SO}_3^{2-} + \text{H}^+ \rightarrow \text{SO}_4^{2-} + \text{Mn}^{2+} + \text{H}_2\text{O}$
 Here MnO_4^- is reduced into Mn^{2+} and SO_3^{2-} is oxidized into SO_4^{2-}
- Q.7** (3)
 $\text{H}_3\text{PO}_2 \rightarrow 3(+1) + x + 2(-2) = 0; x = +1$
- Q.8** (3)
 $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
 $\text{K}_4\text{Fe}(\text{CN})_6 \rightarrow 4(+1) + x + 6(-1) = 0; x = +2$
 $\text{Fe}(\text{CO})_5 \rightarrow x + 0 \times 5 = 0; x = 0$
 $\text{Fe}_{0.94} \rightarrow 0.94x + (-2) = 0; x = \frac{200}{94}$
- Q.9** (1)
 $\text{K}_3\text{Fe}(\text{CN})_6 \rightarrow +3 + x + 6(-1) = 0; x = +3$
 $\text{Fe}_2\text{O}_3 \rightarrow 2x + 3(-2) = 0; x = +3$
- Q.10** (1)
 $\text{Br}_2 \rightarrow \text{BrO}_3^-$
- Q.11** (4)
 $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$
 In this reaction oxidation of H_2 occurs and reduction of Br_2 occurs.
- Q.12** (4)
 XeF_5^-
 $x + 5(-1) = -1$
 $x = +4$
- Q.13** (3)
 Cd and Cl_2 both are in elemental form having zero oxidation state.
- Q.14** (1)
 $2\text{FeCl}_3 + \text{H}_2\text{S} \rightarrow \text{FeCl}_2 + 2\text{HCl} + \text{S}$
 O.A R.A
 FeCl_3 is reduced to FeCl_2 and H_2S is oxidized to S.
- Q.15** (3)
- Q.16** (1)
 Oxidizing agent gains electrons so they have high reduction potential.
- Q.17** (4)
 Perchloric acid (HClO_4)
 $+1 + x + 4(-2) = 0; x = +7$
- Q.18** (4)
- Q.19** (2)
 $\text{Fe} + \text{HNO}_3 \rightarrow \text{Fe}(\text{NO}_3)_2 + \text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$
 Half reaction method:
 $\text{Fe} \rightarrow \text{Fe}^{2+} + 2e^- \dots (1) \times 4$
 $\text{NO}_3^- + 10\text{H}^+ + 8e^- \rightarrow \text{NH}_4^+ + 3\text{H}_2\text{O} \dots (2)$
 Equation (1) $\times 4 +$ (2)
- $4\text{Fe} + \text{NO}_3^- + 10\text{H}^+ \rightarrow 4\text{Fe}^{2+} + \text{NH}_4^+ + 3\text{H}_2\text{O}$
 Addⁿ of spectator ion
 $4\text{Fe} + 10\text{HNO}_3 \rightarrow 4\text{Fe}(\text{NO}_3)_2 + \text{NH}_4\text{NO}_3 + 3\text{H}_2\text{O}$
- Q.20** (3)
 $\text{MnO}_4^- + 5\text{Fe}^{2+} + 8\text{H}^+ \rightarrow \text{Mn}^{2+} + 5\text{Fe}^{3+} + 4\text{H}_2\text{O}$
- Q.21** (1)
 $\text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} + \text{H}^+ \rightarrow \text{Mn}^{2+} + \text{CO}_2 + \text{H}_2\text{O}$
 On balancing the above equation, we get
 $2\text{MnO}_4^- + 5\text{C}_2\text{O}_4^{2-} + 16\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 8\text{H}_2\text{O}$
- Q.22** (2)
 $\text{NO}_3^- + 4\text{H}^+ \rightarrow 2\text{H}_2\text{O} + \text{N}^{\text{O}}$
 Change in oxidation state of N = $5 - 2 = 3$
 here oxidation decreases from +5 to +2, so reduction occurs therefore 3 electron should be added to right side
- Q.23** (4)
 $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$
 Oxidation number of Cr decreases from +6 to +3 change in O.N per atom = $6 - 3 = 3$
 there are two Cr atom in $\text{Cr}_2\text{O}_7^{2-}$ so total no. of e-transfer = $3 \times 2 = 6$
- Q.24** (4)
 $\text{Na}_3\text{AsO}_3 \rightarrow 3(+1) + x + 3(-2) = 0; x = +3$
 so in its oxidizing product; O.N. of As should be more than +3
 $\text{As}_2\text{O}_3 \rightarrow 2x + 3(-2) = -3; x = 1.5$
 $\text{AsO}_3^{3-} \rightarrow x + 3(-2) = -3; x = +3$
 $\text{AsO}_2^{4-} \rightarrow x + 2(-2) = -4; x = 0$
 $\text{AsO}_4^{3-} \rightarrow x + 4(-2) = -3; x = +5$
- Q.25** (2)
 HNO_3 or $\text{N}^{+5} + 4e^- \rightarrow \text{N}^{+1}$
 $\text{HNO}_3 + 4e^- \rightarrow \frac{1}{2}\text{N}_2\text{O}$
- Q.26** (3)
- Q.27** (4)
 $\text{MnO}_2 + 4\text{H}^+ + e^- \rightarrow \text{Mn}^{3+} + 2\text{H}_2\text{O}$
 Oxidation number of Mn changes from +4 to +3
- Q.28** (3)
 Total charge of a molecule = 0
 In case of $\text{A}_3(\text{BC}_4)_2$
 $3 \times (+2) + 2 \times [+5 + 4(-2)] = 0$
- Q.29** (1)
 $\text{N}_2 \rightarrow \text{NH}_3$ (v.f. = valence factor)
 O.N. = 0 O.N. = -3
 $\uparrow \qquad \qquad \qquad \uparrow$
 v.f. = 6
- Q.30** (4)
 $\text{N}_2 \rightarrow \text{NH}_3$
 Eq. wt. = $\frac{28}{6}$

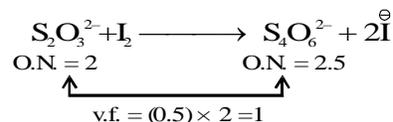
Change in O.N of N in $\text{NH}_3 = 0 - (-3) = 3$

No. of atom of N in $\text{NH}_3 = 1$

Valency factor of $\text{NH}_3 = 3 \times 1 = 3$

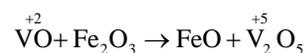
$$\text{E.w of } \text{NH}_3 = \frac{\text{molecular wt}}{\text{Valency factor}} = \frac{17}{3}$$

Q.31 (1)



$$\text{Eq. wt.} = \frac{\text{Mol wt}}{1}$$

Q.32 (3)



Change in O.N of V = $+5 - (+2) = 3$

No of atom of V in $\text{V}_2\text{O}_5 = 2$

Valency factor of $\text{V}_2\text{O}_5 = 3 \times 2 = 6$

$$\text{Ew} = \frac{\text{Mw}}{\text{V.F}} = \frac{\text{Mol.wt}}{6}$$

Q.33 (2)



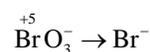
Change in O.N of I = $0 - (-1) = 1$

No. of I atom in $\text{I}_2 = 2$

Valency factor = $2 \times 1 = 2$

$$\text{Ew} = \frac{\text{Mol.wt}}{2}$$

Q.34 (3)



Change in O.N of Br = $5 - (-1) = 6$

No of atom of Br in $\text{BrO}_3^- = 1$

Valency factor = $6 \times 1 = 6$

$$\text{Ew} = \frac{\text{Mol.wt}}{6}$$

Q.35 (3)

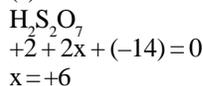


change in O.N = $-n_2 - (-n_1) = n_1 - n_2$

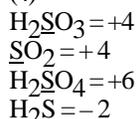
$x = n_1 - n_2$

EXERCISE-III (JEE MAIN LEVEL)

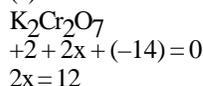
Q.1 (4)



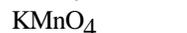
Q.2 (4)



Q.3 (1)



$x = +6$



$$+1 + x + (-8) = 0$$

$x = 7$

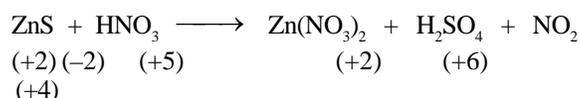
Q.4 (4)



Q.5 (3)



Q.6 (4)



Q.7 (1)



$$a = -\frac{1}{3}$$

or KI_3 is $\text{KI} + \text{I}_2$

\therefore I has two oxidation no. -1 and 0 respectively.

However factually speaking oxidation number of I in KI_3 is on average of two values -1 and 0 .

$$\text{Average O.N.} = \frac{-1 + 2 \times (0)}{3} = -\frac{1}{3}$$

Q.8 (2)

Q.9 (2)

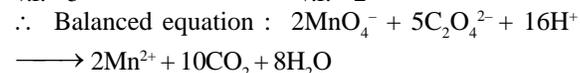
Q.10 (3)

Q.11 (1)

Q.12 (1)



V.f. = 5 V.f. = 2

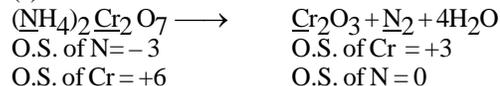


Q.13 (1)

Q.14 (1)

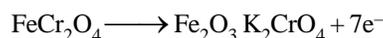
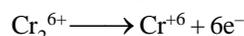
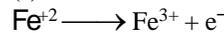
Q.15 (4)

Q.16 (1)



Q.17 (1)

Q.18 (3)



Q.19 (1)

Q.20 (3)

n factor for $\text{Mn}^{+3} = 1/2$

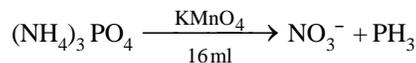
Q.21 (1)

Q.22 (1)

n.F. = 3

equivalent wt. of $\text{FeC}_2\text{O}_4 = M/3$

Q.23 (3)



$-3 \quad +5 \qquad \qquad \qquad +5 \quad -3$

$+24 - 8 = 16$

$50 \times 0.2 \text{ M}$

n-factor of KMnO_4 in acidic medium = 5

n-factor of $(\text{NH}_4)_3\text{PO}_4 = 16$

Eq. of $(\text{NH}_4)_3\text{PO}_4 = \text{Eq. of KMnO}_4$

$$\frac{0.2 \times 50}{1000} \times 16 = \frac{N \times 16}{1000}$$

$N = 10$

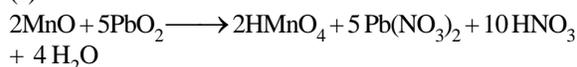
Q.24 (4)

Eq. of $\text{NaH}_2\text{PO}_3 + \text{Eq. of NaHCO}_3 = \text{Eq. of NaOH}$

$$\frac{20 \times 0.1}{1000} \times 1 + \frac{40 \times 0.1}{1000} \times 1 = x$$

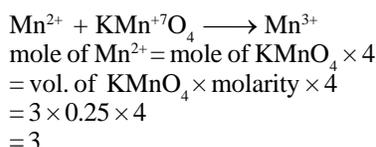
$x = 6 \times 10^{-3}$

Q.25 (1)



EXERCISE-IV

Q.1 [50%]



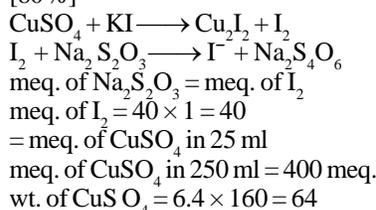
(in acidic medium, n-factor for KMnO_4 is 5 so molarity = normality / 5)

$$\text{mole of Mn}_3\text{O}_4 = \frac{1}{3} \text{ mole of Mn}^{2+}$$

= 1 mole
 = 229 gm

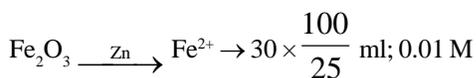
$$\% \text{ of Mn}_3\text{O}_4 = \frac{229}{458} \times 100 = 50\%$$

Q.2 [80%]



$$\% \text{ Purity} = \frac{64}{80} \times 100 = 80\%$$

Q.3 [5]



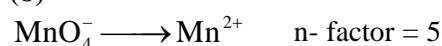
$$100 \times N = 120 \times .01 \times n$$

$$N = 1.2 \times 10^{-2} n$$

$$\frac{0.48}{160} \times \frac{1000}{100} = 1.2 \times 10^{-2} n$$

$n = 5$

Q.4 (8)



Equivalents

of

$$\text{MnO}_4^- = 1.61 \times 10^{-3} \times 5 = 8.05 \times 10^{-3}$$

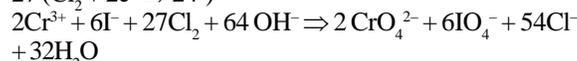
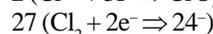
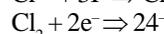
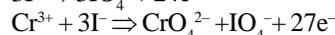
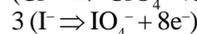
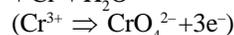
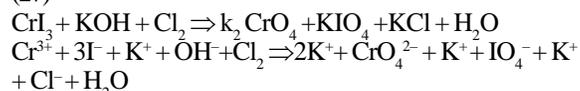
$$\text{Equivalents of A}^{n+} = 8.05 \times 10^{-3}$$

$$N \text{ -factor of } \text{AO}_3^- = 5 - n$$

$$\therefore (5 - n) \times 2.68 \times 10^{-3} = 8.05 \times 10^{-3}$$

$$5 - n = 3 \quad n = 2$$

Q.5 (27)

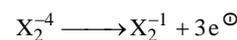


Q.6 [0]

Q.7 [3]



or



$$2x = -1$$

$$x = -\frac{1}{2}$$

Q.8 [5]

Q.9 [5]

Q.10 [10]

Q.11 (2)

Q.12 (1)

Q.13 (1)

Q.14 (1)

Q.15 (1)

Q.16 (2)

PREVIOUS YEAR'S

Q.1 (1)

Q.2 (1)

Q.3 (3)

Q.4 (2)

Q.5 (2)

Q.6 (4)

Q.7 (1)

Q.8 (2)

Q.9 (2)

Q.10 (2)

Q.11 (4)

Q.12 (1)

Q.13 (4)

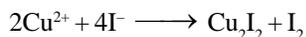
Q.14 (1)

$$= \sqrt{3(3+2)} = \sqrt{15} = 3.87$$

$$= 4 \text{ BM}$$

Q.11 [4]

Hypo solution = 20 ml & 0.02 M

CuSO₄ Solⁿ = 10 mlMeq of hypo solution = (M × V) × n_f

$$= 20 \times 0.02 \times 1$$

$$= 0.4$$

Meq of hypo = meq of I₂ = 0.4Meq of CuSO₄ = 0.4Moles of CuSO₄ = Meq × n_f

$$= 0.4 \times 1$$

$$= 0.4 \text{ mol.}$$

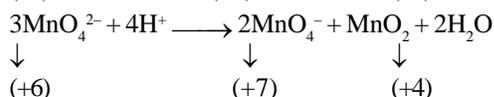
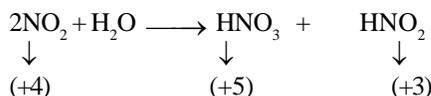
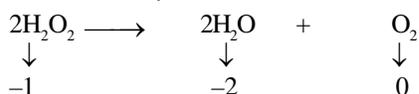
$$\text{Molarity} = \frac{\text{mol}}{\text{volume}} = \frac{0.4}{10}$$

$$= 0.04 \text{ M}$$

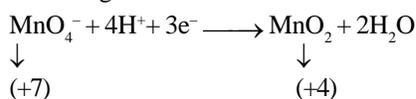
$$= 4 \times 10^{-2} \text{ M}$$

Q.12 (3)

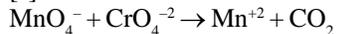
In disproportionation reaction same element is simultaneously oxidized or reduced



⇒ Above reactions are disproportionation while following reaction is not

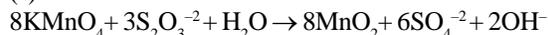


Q.13 [1]

O. No. of C in C₂O₄²⁻ = +3O. No. of C in CO₂ = +4

Change in O. No. of C = 1

Q.14 (4)



Q.15 (1)

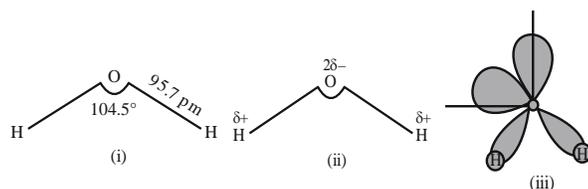
KMnO₄ oxidise HCl to Cl₂ that's why for acidic medium

HCl is not used in permanganate titration.

Hydrogen

EXERCISE-I (MHT CET LEVEL)

- Q.1** (3)
The high boiling point of water is due to H-bonding
- Q.2** (4)
- Q.3** (1)
 ${}^3_1\text{H} \Rightarrow n + p = 3.$
- Q.4** (3)
 \Rightarrow Alkali metals because of valency e^- one
 \Rightarrow Halogen due to forming salts like halogens NaCl, NaH.
- Q.5** (1)
- Q.6** (4)

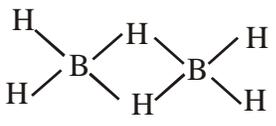


- Q.7** (4)
- Q.8** (4)
- Q.9** (4)
- Q.10** (4)
The density of water is 1gcm^{-3} at 4°C
so molarity = $\frac{1000}{18} = 55.5\text{ M}.$
- Q.11** (3)
- Q.12** (3)
- Q.13** (1)
- Q.14** (3)
 $\text{KO}_2 \rightarrow \text{O}_2^-$
 $\text{BaO}_2 \rightarrow \text{O}_2^{-2}$
- Q.15** (2)
- Q.16** (3)
Electrolysis of 50% sulphuric acid gives per disulphuric acid ($\text{H}_2\text{S}_2\text{O}_8$) which on distillation yields 30% solution of hydrogen peroxide.
- Q.17** (1)
- Q.18** (2)

EXERCISE-II (NEET LEVEL)

- Q.1** (3)
- Q.2** (4)
- Q.3** (3)
- Q.4** (4)
- Q.5** (4)
- Q.6** (4)
- Q.7** (2)
- Q.8** (2)
- Q.9** (1)
Due to open cage like structure.
- Q.10** (1)
 $\text{Ca}(\text{HCO}_3)_2 + \text{Ca}(\text{OH})_2 \rightarrow 2\text{CaCO}_3 + 2\text{H}_2\text{O}$
- Q.11** (4)
Permanent hardness cannot be removed by boiling of water but temporary hardness can be removed.
- Q.12** (2)
Due to production of nascent oxygen.
- Q.13** (1)
 $\text{H}_2\text{O}_2 + 2\text{KI} \rightarrow \text{I}_2$, O.S. of I (-1) changes to I_2 (Zero) There is increases in oxidation number, hence oxidation.
- Q.14** (3)
- Q.15** (2)
 $\text{Cl}_2 + \text{H}_2\text{O}_2 \rightarrow 2\text{HCl} + \text{O}_2$
In this reaction H_2O_2 works as reducing agent
- Q.16** (3)
 $\text{Na}_2\text{O}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}_2$
- Q.17** (3)
 $\text{H}_2\text{S} + \text{H}_2\text{O}_2 \rightarrow \text{S} + 2\text{H}_2\text{O}$
In this reaction H_2O_2 shows oxidising nature
- Q.18** (1)
 H_2O_2 reduces O_3 to O_2
 $\text{O}_3 + \text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + 2\text{O}_2$
- Q.19** (3)
Reactivity of H_2 is least among then due to bond dissociation.
- Q.20** (2)
- Q.21** (3)
- Q.22** (2)

EXERCISE-III (JEE MAIN LEVEL)

- Q.1** (4)
Hydrogen does not has lone pair of electron so it can not form coordinate bond with other atoms or molecules.
- Q.2** (4)
Hydrogen and alkali metals are electropositive their electronegativity is very less i.e. H - 2.1, Li 1.0, Na 0.9, k = 0.8, Rb = 0.8
- Q.3** (1)
Ionisation energy of hydrogen is (1312 kJ mol⁻¹) which is too high than that of alkali metals and low than that of halogens.
- Q.4** (1)
Hydrogen accepts electron to form anion and get inert gas configuration like halogens.
 $H + e^- \longrightarrow H^-$ (hydride ion)
 $X + e^- \longrightarrow X^-$
 halogen halide ion
- Q.5** (3)
The ratio of protium, deuterium and tritium in nature is not certain.
- Q.6** (3)
Hydrogen does not combine with helium.
- Q.7** (4)
 $Zn + NaOH \longrightarrow Na_2ZnO_2 + H_2 \uparrow$
 Sodium zincate
- Q.8** (3)
Occlusion.
- Q.9** (3)
H-Be-H

- Q.10** (2)
 $H^-_{(aq)} + H-OH_{(l)} \longrightarrow H_{2(g)} + OH^-_{(aq)}$
 $CaH_2 + 2H_2O \longrightarrow 2H_2 + Ca(OH)_2$
- Q.11** (2)
In bosch process water gas is used for production of H₂.
- Q.12** (4)
H₂
- Q.13** (3)
At Anode
 $2H^- \longrightarrow H_2 + 2e^-$

- Q.14** (1)
Due to Ca and Mg salts
- Q.15** (2)
D₂O Heavy water
- Q.16** (2)
Slowing down the speed of high energy neutrons.
- Q.17** (2)
 $Ma_3N_2 + 6H_2O \longrightarrow 3Mg(OD)_2 + 2ND_3$
- Q.18** (3)
- Q.19** (2)
 $Na_2O_2 + 2HCl \longrightarrow 2NaCl + H_2O_2$
 $Na_2O_2 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O_2$
- Q.20** (3)
- Q.21** (4)
H₂O₂ when oxidised in acidic or basic medium it produces O₂
 $2MnO_4^- + 6H^+ + 5H_2O_2 \longrightarrow 2Mn^{2+} + 8H_2O + 5O_2$ (acidic medium)
 $2MnO_4^- + 3H_2O_2 \longrightarrow 2MnO_2 + 3O_2 + 2H_2O$ (basic medium)
- Q.22** (4)
H₂O₂ can be used as antiseptic, bleaching agent and propellant.
- Q.23** (3)
It undergoes autoxidation on prolonged standing.
- Q.24** (2)
- Q.25** (3)

EXERCISE-IV**INTEGRITYTYPE**

- Q.1** **750 ml of O₂ at NTP.** According to definition, 1 ml of '30 volume' H₂O₂ gives 30 ml of O₂ at NTP
 \therefore 25 ml of '30 volume' H₂O₂ gives 30 × 25 ml of O₂ at NTP = **750 ml of O₂ at NTP.**
- Q.2** 3
H₂S₂O₈ on completely hydrolysis gives2..... mole of H₂SO₄ &1..... mole of H₂O₂.
- Q.3** [4]
No. of Peroxy linkage in H₂S₂O₈, CrO₅ & H₂TiO₄ are 1, 2 and 1 respectively.
- Q.4** (4)
- Q.5** (2)
- Q.6** (3)
- Q.7** (1)
- Q.8** (1)
- Q.9** (4)

PREVIOUS YEAR'S

MHT CET

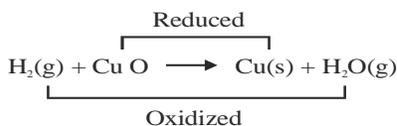
- Q.1 (2)
 Q.2 (3)
 Q.3 (2)
 Q.4 (1)
 Q.5 (1)
 Q.6 (4)
 Q.7 (3)
 Q.8 (1)
 Q.9 (1)

NEET/AIPMT

- Q.1 (2)
 Clark's method
 $\text{Ca}(\text{HCO}_3)_2 + \text{Ca}(\text{OH})_2 \rightarrow 2\text{CaCO}_3\downarrow + 2\text{H}_2\text{O}$
 $\text{Mg}(\text{HCO}_3)_2 + \text{Ca}(\text{OH})_2 \rightarrow 2\text{CaCO}_3\downarrow + \text{Mg}(\text{OH})_2 + 2\text{H}_2\text{O}$
 Clark's method is used to remove temporary Hardness of water
- Q.2 (4)
 Electron deficient hydride \rightarrow Less than $8e^-$ (B_2H_6)
 Electron precise hydride \rightarrow having $8e^-$ without l.p. (GeH_4)
 Electron rich hydride \rightarrow having $8e^-$ with l.p. (HF)

JEE MAIN

- Q.1 (2)
 Industrial method of preparation of NH_3
 $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$
- Q.2 (3)
 H_2O_2 structure in solid phase at 110K. dihedral angle is 90.2° but in gaseous phase angle is 115.5° .
- Q.3 (4)
- Q.4 (2)



Under hot condition

- Q.5 (4)
 They have different neutrons and mass number.
- Q.6 (3)



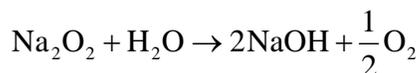
Change in oxidation state of Mn from Mn^{+7} to Mn^{+4} is reduce. It means H_2O_2 is acting as reducing agent. Option (C) is correct.

- Q.7 (1)
 Baking soda $\rightarrow \text{NaHCO}_3$
 Caustic soda $\rightarrow \text{NaOH}$
 Washing soda $\rightarrow \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
 Carbonate ion is present in baking soda and washing soda.
- Q.8 (1)
 Electrolysis of Brine (aq-NaCl)
 H_2 is obtained as byproduct at cathode
 at anode $\rightarrow 2\text{Cl}^- \rightarrow \text{Cl}_2 + 2e^-$
 At cathode $\rightarrow 2\text{H}_2\text{O} + 2e^- \rightarrow \text{H}_2 + 2\text{OH}^-$
 Solution $\rightarrow \text{Na}^+ + \text{OH}^- \rightarrow \text{NaOH}$
- Q.9 (1)
 In electrochemical series Cu is present below H_2 , So least tendency to liberate H_2 from mineral acid.
- Q.10 (1)
 $\text{H}_2\text{O}_2 + \text{H}_2\text{SO}_4 + \text{KMnO}_4 + \text{O}_2 + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$
- Q.11 (3)
 Fact (NCERT based)
- Q.12 (1)
 Fact
- Q.13 (3)
 $\overset{-1}{\text{H}}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$
 \rightarrow the oxidation state of oxygen in hydrogen peroxide is -1 , means it can be oxidized to zero; and reduced to -2 . Hence it can act as both oxidising as well as reducing agent; so statement is correct
 \rightarrow Density of H_2O_2 is 1.44 g/ml which is more than D_2O $\{1.106 \text{ g/ml}\}$ at 298 K so statement 2 is false
- Q.14 (4)
 $2\text{KMnO}_4 + 3\text{H}_2\text{SO}_4 + 5\text{H}_2\text{O}_2 \rightarrow \text{K}_2\text{SO}_4 + 2\text{MnSO}_4 + 8\text{H}_2\text{O} + 5\text{O}_2$
- Q.15 (+5)
 $\text{H}_2\text{O}_2 + \overset{+7}{\text{K}}\overset{+5}{\text{IO}}_4 \rightarrow \overset{+5}{\text{K}}\overset{+3}{\text{IO}}_3 + \text{O}_2 + \text{H}_2\text{O}$

The s-Block Elements

EXERCISE-I (MHT CET LEVEL)

Q.1 (3)



Q.2 (2)

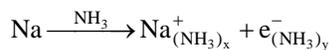
Q.3 (1)

Greater size of HCO_3^- not stable with Li^+

Q.4 (1)

In polyatomic anions stability inversely depends on polarising power of cation.

Q.5 (4)



Q.6 (4)

The stability of alkali metal hydrides decreases from Li to Cs. It is due to the fact that M-H bonds become weaker with increase in size of alkali metals as we move down the group from Li to Cs. Thus the order of stability of hydrides is



Q.7 (1)



Down the group basic character increases

Q.8 (2)

Q.9 (1)

Impurity of MgCl_2 hygroscopic in nature.

Q.10 (2)

Q.11 (2)

Beryllium resembles with aluminium due to similarity in the size of ions and similarity in electropositive character. This type of resemblance between first element of a group in second period with second element of the next group is termed as diagonal relationship.

Q.12 (2)

The basic character of oxides increases down the group.

Q.13 (4)

Element –	Mg	Al	Si	P
Atomic radii (Å) –	1.60	1.43	1.32	1.28

as we move across the period nuclear charge increases, hence, size decreases.

Q.14 (2)

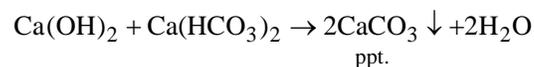
Q.15 (4)

Q.16 (1)

- (i) Small atomic size.
- (ii) High electronegativity
- (iii) Absence of *d* orbitals

Q.17 (1)

This method is known as Clark's process. In this method temporary hardness is removed by adding lime water or milk of lime.



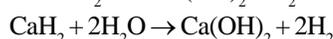
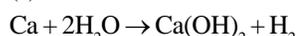
Q.18 (3)

There are four chief minerals present in a Portland cement tricalcium silicate (Ca_3SiO_5), dicalcium silicate (Ca_2SiO_4), tricalcium aluminate ($\text{Ca}_3\text{Al}_2\text{O}_6$) and calcium aluminoferrite ($\text{Ca}_4\text{AlnFe}_{2-n}\text{O}_7$).

Q.19 (1)

Calcium gives brick red colour and barium gives apple green colour in flame test.

Q.20 (1)

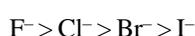


Q.21 (4)



On moving down the group basic character increases.

Q.22 (1)

M.P. of s-block metal halides \propto L.E.

Q.23 (4)

Q.24 (1)

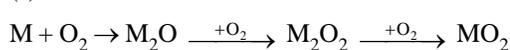
Q.25 (1)

Q.26 (4)

Q.27 (1)

EXERCISE-II (NEET LEVEL)

Q.1 (4)



M = K, Rb, Cs

Q.2 (2)

Element Na K

IE₁ 496 419IE₂ 4562 3051

Sodium has higher I.E. because of smaller atomic size.

Q.3 (4)

Smaller size ion in gas form have greater size ion in aq. medium.

- Q.4** (2)
It is hygroscopic and deliquescent and hence absorbs moisture and CO_2 to form Na_2CO_3
 $2\text{NaOH} + \text{CO}_2 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$
- Q.5** (2)
After removal of an electron the effective nuclear charge per electron increases hence the size decreases.
- Q.6** (4)
 $\text{Na} \xrightarrow{\text{NH}_3} \text{Na}^+_{(\text{NH}_3)_x} + \text{e}^-_{(\text{NH}_3)_y}$
- Q.7** (2)
- Q.8** (3)
- Q.9** (4)
 $2\text{Na} + 2\text{NH}_3 \xrightarrow{\text{heat}} 2\text{NaNH}_2 + \text{H}_2$
- Q.10** (2)
When Potassium is treated with ammonia, then potassium amide is obtained.
 $\text{K} + \text{NH}_3 \rightarrow \underset{\text{Pot. amide}}{\text{KNH}_2} + \frac{1}{2} \text{H}_2$
- Q.11** (4)
Amongst alkali metals, Cs is most reactive because of its lowest IE.
- Q.12** (2)
- Q.13** (1)
- Q.14** (4)
- Q.15** (3)
- Q.16** (1)
 CaCl_2 because it is hygroscopic
- Q.17** (1)
- Q.18** (1)
Because of smaller size, Mg^{2+} ions are extensively hydrated.
- Q.19** (3)
The valency of beryllium is +2 while that of aluminium is +3.
- Q.20** (2)
 CaCl_2 is produced as a by product in solvay ammonia process.
 $\text{NaCl} + \text{CO}_2 + \text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NaHCO}_3 + \text{NH}_4\text{Cl}$
(ii) $\text{CaCO}_3 \rightarrow \text{CO}_2 + \text{CaO}$
(iii) $2\text{NH}_4\text{Cl} + \text{CaO} \rightarrow 2\text{NH}_3 + \text{CaCl}_2 + \text{H}_2\text{O}$
By product
- Q.21** (1)
- Q.22** (1)
- Q.23** (1)
- Q.24** (3)
Magnesium hydrosilicate forms base of Talcum powder.
- Q.25** (4)
 CaSO_4
- Q.26** (2)
The $\text{Be}(\text{OH})_2$ and $\text{Al}(\text{OH})_3$ are amphoteric in nature.
- Q.27** (1)
- Q.28** (2)
- Q.29** (2)
- Q.30** (2)
- Q.31** (4)
Due to small size of Be^{+2} , high covalent character.
- Q.32** (2)
- Q.33** (3)
Zn, Be, Al, Sn, Pb oxides are amphoteric in nature.
- Q.34** (1)
 $\text{Ba}(\text{OH})_2 > \text{Sr}(\text{OH})_2 > \text{Ca}(\text{OH})_2 > \text{Mg}(\text{OH})_2$
Solubility decreasing order.
- Q.35** (4)
- Q.36** (4)
Solubility of IIA sulphates decreases down to the group.
- Q.37** (1)
- Q.38** (1)
 $\text{BeCl}_2 < \text{MgCl}_2 < \text{CaCl}_2 < \text{BaCl}_2$
As we go down the group I.E. decreases. Hence ionic character increases.

EXERCISE-III (JEE MAIN LEVEL)

- Q.1** (2)
The block of an element depends on the type of sub-shell which receives the last electron. As last electron enters in p-subshell of outer most shell according to Aufbau rule, the element of option (2) belongs to p-block.
- Q.2** (2)
They easily lose valence shell electron because of their low ionisation energies, on account of their bigger atomic sizes. So they behave as strong reducing agents.
- Q.3** (2)
Alkali metals have one mobile electron per atom, those may undergo oscillation producing metallic lustre.
- Q.4** (4)
The metallic bond is purely the electric attraction between the mobile electrons and positive part of the atom, the kernel. This electrical attraction depends upon the (i) number of mobile electrons per atom and (ii) the size of the atom.
The strength of metallic bond is weakest in Cs metallic lattice amongst these elements because of largest atomic radius.

- Q.5** (1)
Down the group Z_{eff} decrease & complex formation tendency decrease
- Q.6** (4)
 $M + (x + y) \text{NH}_3 \longrightarrow [\text{M}(\text{NH}_3)_x]^+ + [\text{e}(\text{NH}_3)_y]^-$; solution contains unpaired solvated electrons which are responsible for their strongly reducing and highly conducting nature.
- Q.7** (4)
Electropositive character is the measure of ease of formation of cation by losing electron. With increasing atomic size, the ionization energy decreases and, therefore, the ease of formation of cation by losing the electron increases resulting into more electropositive character of the metal. Down the group, metallic character increases due to decreases in ionisation energy and so electropositive character increase.
- Q.8** (1)
 $\text{Na} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2$
A C B (Combustible)
 $\text{Zn} + \text{NaOH} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2$
Amphoteric
 $\text{Zn} + \text{dil H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$
- Q.9** (1)
 $T.S \propto \text{Ionic character}$ (for polyatomic anion)
 Li_2CO_3 is least ionic or most covalent
- Q.10** (2)
According to Fajan's rule NaF has highest ionic character because of smaller size of anion F^- . So NaF has highest melting point. The order of melting point is generally fluoride > chloride > bromide > iodide.
- Q.11** (2)
(1) $2\text{LiNO}_3 \xrightarrow{\Delta} \text{Li}_2\text{O} + 2\text{NO}_2 \uparrow (\text{brown}) + \frac{1}{2}\text{O}_2 \uparrow$
(2) $\text{KNO}_3 \xrightarrow{\Delta} \text{KNO}_2 + \frac{1}{2}\text{O}_2 \uparrow$
(3) $\text{Pb}(\text{NO}_3)_2 \xrightarrow{\Delta} \text{PbO} + 2\text{NO}_2 \uparrow (\text{brown}) + \frac{1}{2}\text{O}_2 \uparrow$
(4) $2\text{AgNO}_3 \xrightarrow{\Delta} 2\text{Ag} + 2\text{NO}_2 \uparrow (\text{brown}) + \text{O}_2 \uparrow$
- Q.12** (2)
Alkali metal carbonates except Li_2CO_3 are stable towards heat because they are most basic in nature and basic character increases down the group and thermal stability increases down the group.
Bigger HCO_3^- anion is polarised by smaller Li^+ and thus readily decomposes to give CO_2 gas.
- Q.13** (2)
 $\text{Li}_2\text{CO}_3 \xrightarrow{\Delta} \text{Li}_2\text{O} + \text{CO}_2$
 $2\text{Na} + \text{O}_2 \longrightarrow \text{Na}_2\text{O}_2$
- Q.14** (1)
In flame test thermal excitation deexcitation takes place in cation with low Ionisation potential
- Q.15** (3)
 $\text{NaOH} + \text{I}_2 \longrightarrow \text{NaIO}_3 + \text{NaI}$, with dilute NaOH, NaI and NaOI are formed.
- Q.16** (4)
Sodium carbonate does not decompose on heating as it is stable towards heat.
- Q.17** (2)
 $\text{Na}_2\text{O}_2 + \text{H}_2\text{SO}_4 \longrightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}_2$
- Q.18** (2)
Fluorides of alkaline earth metals except BeF_2 are insoluble in water. The solubility of BeF_2 in water is due to higher hydration energy on account of small size of Be^{2+} ion and F^- ion and high charge density of Be^{2+} ion.
- Q.19** (3)
 $\text{Na} + \text{Al}_2\text{O}_3 \rightarrow \text{Na}_2\text{O} + \text{Al}$ (Position in electrochemical series)
 $\text{Na}_2\text{O} + \text{CO}_2 \rightarrow \text{Na}_2\text{CO}_3$
- Q.20** (2)
 $\text{A} \longrightarrow \text{Ca}(\text{OH})_2$
Lime water
 $\text{Ca}(\text{OH})_2 + \text{CO}_2 \longrightarrow \text{CaCO}_3 + \text{H}_2\text{O}$
Lime water White ppt (C)
 $\text{C} \rightarrow \text{CaCO}_3$ $\text{Ca}(\text{OH})_2 + \text{Na}_2\text{CO}_3 \rightarrow \text{CaCO}_3 + \text{NaOH}$
C B
- Q.21** (2)
(1) Ca salt imparts brick red colour to the flame.
(2) Sr salt imparts bright crimson colour to the flame.
(3) Ba salt imparts apple green colour to the flame.
(4) Mg salt does not impart any colour to the flame because of high ionization energy.
- Q.22** (2)
General electronic configuration of second group metals is $[\text{Noble gas}] ns^2$. As all electrons are paired, so the alkaline earth metal salts are diamagnetic.
- Q.23** (4)
Down the group size increases and, therefore, attraction

between valence shell electron and nucleus decreases and thus ionisation energy decrease.

Along the period the atomic size decreases and nuclear charge increases. So generally the ionization energy increases. However, half-filled and completely filled valence shell electron also affect the ionization energy along the period.

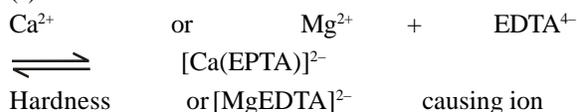
Q.24

(4)

Down the group size increases and therefore, attraction between valence shell electron and nucleus decreases and thus ionisation energy decreases.

Q.25

(3)



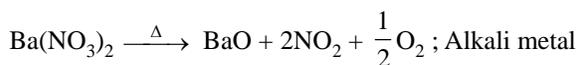
Q.26

(3)

Basic nature of hydroxides increases down the group. The strength of a base depends on ionisation of the hydroxide which depends on polarity of bond and internuclear distance between the oxygen of the hydroxide and metal atom.

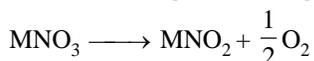
Q.27

(1)



nitrate gives only O_2 gas.

Alkali metal nitrates give only O_2 on heating below 500°C according to following reaction,



Q.28

(4)

The solubility of hydroxides of alkaline earth metal salts increases down the group from Be to Ba. This is because of the fact that down the group with increasing size of cation the hydration energy as well as lattice energy also decrease but the change in lattice energy is more as compare to that of hydration energy.

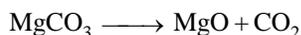
Q.29

(4)

Evident from Fajan rule

Q.30

(2)



Alkali metal carbonates except Li_2CO_3 are thermally stable.

Q.2

[7]

Except Be and Sr all are correctly matched.

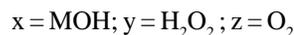
Q.3

[3]

Except Li_2CO_3 , Na_2CO_3 all form polymeric chains. AlCl_3 dimeric chain.

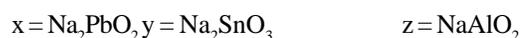
Q.4

[9]



Q.5

[15]



Q.6

[3]

By product is CaCl_2 , $x = \text{CaCO}_3$, $y = \text{CO}_2$.



Q.7

[4]

(e), (f), (g) are false.

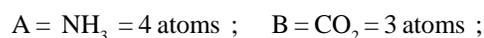
(e) On hydrolysis of Na_2CO_3 . We get an basic solution due to the formation of NaOH .

(f) K_2CO_3 can not be prepared by Solvay process.

(g) Excess of carbondioxide should be avoided since this leads to the formation of water soluble calcium hydrogen carbonate.

Q.8

[18]



Q.9

10.



Q.10

3

$$x = \frac{1}{2}$$

Q.11

(4)

Q.12

(4)

Q.13

(4)

$$\text{I.E.} \propto \frac{1}{\text{Photoelectric effect}}$$

Q.14

(1)

Q.15

(1)

Q.16

(2)

EXERCISE-IV

INTEGRITYTYPE

Q.1

[6]

It is a cyclic structure having six P–O–P linkages.

Q.1

(3)

Q.2

(1)

Q.3

(2)

Q.4

(3)

PREVIOUS YEAR'S

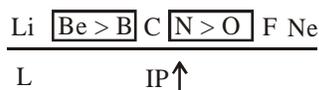
- Q.5 (2)
 Q.6 (1)
 Q.7 (3)
 Q.8 (2)
 Q.9 (3)
 Q.10 (4)
 Q.11 (4)
 Q.12 (1)
 Q.13 (1)
 Q.14 (3)
 Q.15 (4)
 Q.16 (4)
 Q.17 (4)
 Q.18 (2)
 Q.19 (2)

The flocculation power of cation decreases with decrease in the valence of cation So the correct order is $Al^{3+} > Ba^{2+} > Na^{+}$

- Q.20 (2)
 Q.21 (3)

**NEET/AIPMT
 PREVIOUS YEAR'S**

- Q.1 (4)
 Be (OH)₂ is a Amphoteric Hydroxide [Diagonal relationship with Al(OH)₃]
 Q.2 (2)



Correct order of IP

Ne > F > N > O > C Be > B > Li
 So, Answer is (3)

- Q.3 (1)
 Q.4 (3)
 Q.5 (3)
 Q.6 (3)

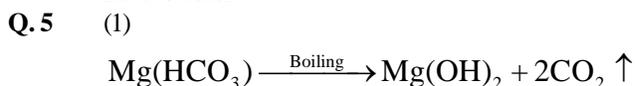
Li - Electrochemical cells
 Na - Coolant in fast breeder reactors
 KOH - absorbent for CO₂
 Cs - Photoelectric cell

- Q.7 (1)
 KO₂
 K⁺O₂⁻ (O₂⁻ - superoxide ion)

JEE-MAIN

- Q.1 (4)
 LiF and Li₂O are comparatively much less soluble in water Only K, Rb and Cs form super oxides.
 Q.2 (1)
 Sodium bicarbonate is used in fire extinguishers with H₂SO₄ is also called Baking soda

- Q.3 (4)
 Fact
 Q.4 (4)
Flame color
 Li Crimson Red
 Na Yellow
 Rb Red violet
 Be No color



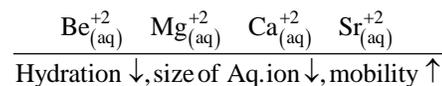
- Q.6 (2)

Cl ₂ O ₇	Acidic
Na ₂ O	Basic
Al ₂ O ₃	Amphoteric
N ₂ O	Neutral

- Q.7 (1)
 (From NCERT s-block)
 Option (A) is correct.

- Q.8 (3)
 BeCl₂ ની LiAlH₄ સાથે પ્રક્રિયા થઈ શું આપે છે ?
 (A) Be + Li[AlCl₄] + H₂ (B) Be + AlH₃ + LiCl + HCl
 (C) BeH₂ + LiCl + AlCl₃ (D) BeH₂ + Li[AlCl₄]
 Q.9 (4)

$$\text{Ionic mobility} \propto \frac{1}{\text{size}}$$



- Q.10 (3)
 All alkali nitrates on heating breakdown into nitrites and O₂ except lithium nitrate
 $NaNO_3 \xrightarrow{\Delta} NaNO_2 + O_2$
 $LiNO_3 \xrightarrow{\Delta} Li_2O + NO_2 + O_2$
 It breaks into its oxide, NO₂(g) and dioxygen gas
 So, correct option is (3) NaNO₂ and Li₂O
 Q.11 (2)
 Clark method.
 $Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$
 $Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow 2CaCO_3 + Mg(OH)_2 + 2H_2O$
 Q.12 (1)
 Due to high lattice energy LiF is less soluble in water.
 Q.13 (3)
 Order of density Ca < Mg < Be < Sr < Ba < Ra
 Ca has lower density than Mg and Be due to large size
 Q.14 (1)
 K has lower density than Na -due to large size

- Q.15** (2)
BeH₂ can not be formed direct reaction of Be and H₂ so it is prepared by reaction of BeCl₂ and LiAlH₄
$$2\text{BeCl}_2 + \text{LiAlH}_4 \rightarrow 2\text{BeH}_2 + \text{LiCl} + \text{AlCl}_3$$
- Q.16** (3)
Due to high lattice energy LiF is less soluble.
→ Li⁺ has small size so it's has very high hydration energy.
- Q.17** (1)
In group I Li has highest hydration enthalpy which has diagonal relationship with group II element Mg
- Q.18** (3)
$$\text{Ca}(\text{HCO}_3)_2 + \text{Ca}(\text{OH})_2 \rightarrow 2\text{CaCO}_3 + 2\text{H}_2\text{O}$$
$$\text{Mg}(\text{HCO}_3)_2 + 2\text{Ca}(\text{OH})_2 \rightarrow 2\text{CaCO}_3 + \text{Mg}(\text{OH})_2 + 2\text{H}_2\text{O}$$
- Q.19** (2)
Setting of cement : when mixed water, the setting of cement takes place to give a hard mass this is due to the hydration of the molecules of the constituents and their rearrangements gypsum is added to enhance the setting time gypsum : - CaSO₄.2H₂O Option (2)

The p-Block Elements

EXERCISE-I (MHT CET LEVEL)

- Q.1 (3)
Al → III A group → Forms Al_2O_3
- Q.2 (2)
Boron nitride (BN)_x is also known as inorganic graphite and it resembles with graphite in structure
- Q.3 (3)
- Q.4 (4)
- Q.5 (2)
- Q.6 (4)
Boron form different hydride of general formula B_nH_{n+4} and B_nH_{n+6} but BH_3 is unknown.
- Q.7 (1)
Concentration of Lewis acid of boron tri halides is increased in following order. $BF_3 < BCl_3 < BBr_3 < BI_3$.
- Q.8 (1)
Aluminium (III) chloride forms a dimer because it can expand its valency upto 6 & can be achieved higher coordination number easily
- Q.9 (3)
Aluminium oxide is highly stable therefore, it is not reduced by chemical reactions.
- Q.10 (2)
Type metal $Pb = 82\%$, $Sb = 15\%$, $Sn = 3\%$
- Q.11 (3)
Boron (2), *Si*, *Ge*, *As*, *Sb*, and *At* are the metalloid elements. Bismuth (*Bi*) and tin (*Sn*) are metals while carbon (3) is non-metal.
- Q.12 (2)
 $CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightarrow H^+ + HCO_3^-$.
Here $[H^+]$ increases hence, pH decreases due to which soil fertility will also decrease.
- Q.13 (4)
- Q.14 (4)
Graphite has layered structure & there is no bonding between the layers so they are held together by Vander Waals forces only.
- Q.15 (3)
Solid CO_2 is known as dry ice because it evaporates at $-78^\circ C$ without changing in the liquid state.
- Q.16 (2)
- Q.17 (1)
- Q.18 (1)
Glass reacts with HF to produce
 $H_2SiF_6 \Rightarrow SiO_2 + 6HF \rightarrow H_2SiF_6 + 2H_2O$

- Q.19 (1)
Lenses & prism is a type of Flint glass

EXERCISE-II (NEET LEVEL)

- Q.1 (1)
Caesium metal has melting point $30^\circ C$ and used in making heat sensitive thermometers & this metal is soft
- Q.2 (3)
Boron is a metalloid among the other element
- Q.3 (4)
Amphoteric substance can react with both acid and base.
- Q.4 (1)
Boric acid (H_3BO_3) is a weak monobasic acid with $K_a = 1.0 \times 10^{-9}$ & it does not act as a protonic acid (i.e. proton donor) but behaves as a Lewis acid by accepting a pair of electrons from
 $B(OH)_3 + 2H_2O \rightarrow [B(OH)_4]^- + H_3O^+$
- Q.5 (3)
The type of hybridisation is sp^3 in diborane because of each boron atom is linked with four hydrogen atoms in the diborane molecule
- ```

 H H H H
 \ / \ /
 B B
 / \ / \
 H H H H

```
- Diborane  $B_2H_6$
- Q.6 (2)  
Lower oxidation state becomes more stable on moving down the group  $Al < Ga < In < Tl$
- Q.7 (4)
- Q.8 (1)  
 $P_2O_5$  is the most acidic oxide among all the four oxides
- Q.9 (1)  
 $B_2O_3$  oxides of non-metals are acidic & of metals are basic boron is non-metal.
- Q.10 (4)  
 $B_4C$  is the hardest substance along with diamond.
- Q.11 (3)  
Due to steric hindrance caused by large Cl.
- Q.12 (4)
- Q.13 (1)  
Liquified Ga expands on solidification. Ga is less electropositive in nature. It has the weak metallic bond so it expands on solidification.
- Q.14 (1)  
Al is the most abundant metal in the earth's crust.
- Q.15 (4)  
Cryolite  $Na_3AlF_6$   
(i) Decreases the melting point of alumina  
(ii) Increases conductivity of the solution

- Q.16** (3)  
**Q.17** (3)  
 Alumining hyelroxide is soluble in sodium hydroxide forming the ion  $\text{AlO}_2^-$   
 $\text{NaOH} + \text{Al}(\text{OH})_3 \rightarrow \text{NaAlO}_2 + 2\text{H}_2\text{O}$
- Q.18** (1)  
**Q.19** (1)  
 Down the group +2 is more stable than +4 of for group 14 elements.
- Q.20** (3)  
 Carbon has 4 coordination number while silicon has achieve six coordination number it is due to the availability of low lying d-orbitals in silicon
- Q.21** (1)  
 Boron has the highest ionisation enthaply amongst the following. Ionisation enthalpy decreases down the group and increases across the period.
- Q.22** (2)  
 Carbon 60 contains 12 pentagons & 20 hexagons in its football like structure
- Q.23** (2)  
**Q.24** (2)  
**Q.25** (3)  
**Q.26** (1)  
 Carbon suboxide has linear structure with C – C bond length equal to 130 Å and C – O bond length equal to 120 Å.  
 $\text{O}=\text{C}=\text{C}=\text{C}=\text{O} \leftrightarrow \text{O}^- - \text{C} \equiv \text{C} - \text{C} \equiv \text{O}^+$
- Q.27** (3)  
**Q.28** (1)  
 $\text{SiO}_2 + 2\text{Mg} \rightarrow \text{Si} + 2\text{MgO}$
- Q.29** (3)  
 Normal glass is calcium alkali silicate glass made by fusing the alkali metal metal carbonate,  $\text{CaCO}_3$  and  $\text{SiO}_2$ .
- Q.30** (4)  
 The inert pair effect is most prominent in *Pb* because from top to bottom due to increase in number of shells.
- Q.31** (1)  
**Q.32** (1)  
**Q.33** (1)  
**Q.34** (3)  
 $\text{Pb}_3\text{O}_4$  is a mixed oxide of  $2\text{PbO}$  and  $\text{PbO}_2$
- (2)  $2\text{BI}_3 \xrightarrow[\text{or Tantalum}]{\text{red hot W}} 2\text{B} + 3\text{I}_2$ . (Van Arkel method).
- Q.3** (3)  $\text{B}_2\text{H}_6 \xrightarrow{\Delta} 2\text{B} + 3\text{H}_2$ .  
 (4)  
 $\text{CuO} + \text{B}_2\text{O}_3 \longrightarrow \text{Cu}(\text{BO}_2)_2$  (blue bead) - Copper (II) metaborate
- Q.4** (2)  
 $\text{Na}_2\text{B}_4\text{O}_7 + \text{H}_2\text{SO}_4 + 5\text{H}_2\text{O} \longrightarrow \text{Na}_2\text{SO}_4 + 4\text{H}_3\text{BO}_3$
- Q.5** (3)  
 $\text{B}_2\text{H}_6 + 6\text{H}_2\text{O} \longrightarrow 2\text{H}_3\text{BO}_3 + 6\text{H}_2$
- Q.6** (4)  
 $\text{Al}_2\text{S}_3 + 6\text{H}_2\text{O} \longrightarrow 2\text{Al}(\text{OH})_3 + 3\text{H}_2\text{S}$
- Q.7** (1)  
 There is least van der Waal's force of attraction in  $\text{BF}_3$  on account of less number of polarisable electrons among the boron halides. So  $\text{BF}_3$  is gas at  $0^\circ\text{C}$ .
- Q.8** (3)  
 $\text{B}(\text{OH})_3 + 2\text{HOH} \rightleftharpoons [\text{B}(\text{OH})_4]^- + \text{H}_3\text{O}^+$ .  
 In aqueous solution the boron completes its octet by accepting  $\text{OH}^-$  from water molecules. It therefore function as a weak monobasic lewis acid.
- Q.9** (4)  
 As it becomes passive by the action of conc.  $\text{HNO}_3$  forming a protective oxide layer on the surface.
- Q.10** (4)  
 $2\text{Al} + 2\text{NaOH} + 6\text{H}_2\text{O} \longrightarrow 2\text{NaAl}(\text{OH})_4 + 3\text{H}_2$ .
- Q.11** (2)  
 It is acidic because of the hydrolysis of  $\text{Al}_2(\text{SO}_4)_3$  according to the following reaction.  
 $\text{Al}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O} \longrightarrow 2\text{Al}(\text{OH})_3 + 3\text{H}_2\text{SO}_4$ .
- Q.12** (4)  
 M is divalent, it should be monovalent according to the formula of alum.
- Q.13** (4)  
 As a mordant in dye industry. The fabric which is to be dyed is dipped in a solution of the alum and heated with steam.  $\text{Al}(\text{OH})_3$  obtained as hydrolysis product of  $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$  deposits into the fibres and then the dye is absorbed on  $\text{Al}(\text{OH})_3$ .
- Q.14** (3)  
 According to Fajan's rule it is a covalent compound and thus easily hydrolysed. It is also a electron deficient compound containing only six electrons around Al atom and therefore is a Lewis acid.
- Q.15** (1)  
 $\text{BCl}_3$  is electron deficient compound and thus boron completes its octet by accepting a lone pair of electrons from a Lewis base.
- Q.16** (2)  
 They have valence shell electron configuration  $ns^2 np^2$

### EXERCISE-III (JEE MAIN LEVEL)

- Q.1** (2)  
 Down the group the inert pair effect is more pronounced on account of enhanced increase in effective nuclear charge.
- Q.2** (4)  
 (1)  $2\text{BX}_3 + 3\text{H}_2 \xrightarrow[\text{or Tantalum}]{\text{red hot W}} 2\text{B} + 6\text{HX}$  (X = Cl or Br)

; so two electrons of p sub shell or four electrons of s and p sub shells can participate in chemical bonding.

**Q.17** (3)

As differ in their crystal structures and physical properties.

**Q.18** (2)

Because graphite has  $\pi$ -electrons which are delocalised over the whole sheet. The electrons are mobile and thus it conducts electricity along the sheet.

**Q.19** (1)

It is chemically inert towards concentrated acids as well as bases.

**Q.20** (2)

**Q.21** (2)

Coal gas contains  $H_2$ , saturated and unsaturated hydrocarbons,  $CO$ ,  $CO_2$ ,  $N_2$  and  $O_2$ .

**Q.22** (3)

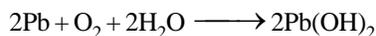
$Sn(OH)_2 + 4OH^- + H_2O \longrightarrow [Sn(OH)_6]^{4-}$  (soluble complex)

**Q.23** (3)

$Pb^{4+}$  has higher polarising power and  $Br^-$  and  $I^-$  being larger in size can easily give the electrons to  $Pb^{4+}$  i.e. as compared to  $Cl^-$ ,  $Br^-$  and  $I^-$  are good reducing agents.

**Q.24** (1)

Lead slowly dissolves in water containing dissolved oxygen to form  $Pb(OH)_2$  which makes the water poisonous. Dissolution of lead in water is called plumbosolvency.

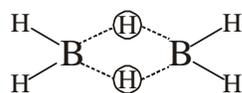


**Q.25** (4)

$Pb^{+4}$  acts as an oxidising agent due to inert pair effect. In larger  $I^-$ , valence shell electrons are loosely held by nucleus so acts as reducing agent. As a result  $Pb^{+4}$  oxidises  $I^-$  to  $I_2$  and itself reduced to  $Pb$  or  $Pb^{2+}$ .

### EXERCISE-IV

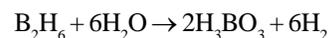
**Q.1** [6]



All terminal H-atoms are in same plane  
i.e. total 6-atoms are in same plane.

**Q.2** [5]

**Q.3** (6)



**Q.4** [6]

(c) is wrong as anthracite is the purest form of coal, not carbon.

**Q.5** [21]

$x=4$

$B, Al, In$  &  $Tl$  are solid at  $40^\circ C$ . Melting point for Gallium is  $30^\circ C$ .

$y=4$

I.E. :  $B > Al < Ga < In < Tl$

$z=3$

Al is third most abundant element after oxygen and silicon. So it has to be most abundant element in the family.

$$\Rightarrow x + 2y + 3z = 4 + (2 \times 4) + (3 \times 3) = 21.$$

**Q.6** [26]

$a=12, b=20, c=30$

$$3 \times 12 - 2 \times 20 + 30 = 26$$

**Q.7** [26]

$B_{12}H_{12}^{2-}$

$$x + y + z = 12 + 12 + 2 = 26$$

**Q.8** [8]

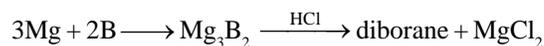
**Q.9** [5]

$B_2O_3 \longrightarrow$  Acidic oxide

$Tl_2O_3, NaAlO_2, Sr(OH)_2 \longrightarrow$  Basic nature

$Cr_2O_3, Al(OH)_3, Al_2O_3, Ga(OH)_3, Ga_2O_3 \longrightarrow$   
Amphoteric oxide

**Q.10** [5]



$$\therefore x=3 \text{ \& } y=2$$

**Q.11** (2)

**Q.12** (4)

**Q.13** (4)

**Q.14** (4)

**Q.15** (1)

**Q.16** (3)

### PREVIOUS YEAR'S

**Q.1** (3)

**Q.2** (1)

**Q.3** (2)

**Q.4** (3)

**Q.5** (2)

**Q.6** (3)

**Q.7** (4)

**Q.8** (2)

**Q.9** (3)

**Q.10** (4)

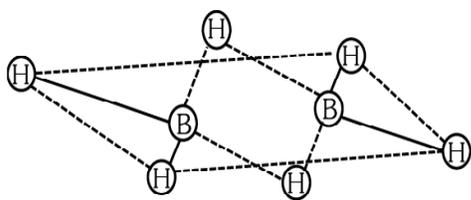
### NEET/AIPMT

**Q.1** (4)

| Elements         | B  | Ga  | Al  | In  | Tl  |
|------------------|----|-----|-----|-----|-----|
| Atomic radii(pm) | 85 | 135 | 143 | 167 | 170 |

**Q.2** (3)

**Q.3** (3)

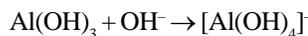


B has  $sp^3$  Hybridisation  
Non-planar

**JEEMAIN**

- Q.1** (3)  
 $B_2H_6$  has two 3C-2e bond and non planar bridge bond are different than terminal Bond, it is electron deficient so acts as lewis acid.
- Q.2** (C)  
Down the group inert pair effect increases thus stability of lower O.S. (+1) increases.
- Q.3** (3)  
 $SO_3, SiO_2$  = Acidic  
CaO = Basic  
 $Al_2O_3$  = Amphoteric
- Q.4** (1)  
→ Cs is used in photoelectric cell  
→ Ga has high boiling point hence used in high temperature thermometer.  
→ Boron fibers are used in making bullet proof vest.  
→ Silicon as silicones used for water proofing of fabrics.  
→ Options (A) is correct.
- Q.5** (4)
- Q.6** (4)  
 $Na_2B_4O_7 + H_2O \rightarrow NaOH + H_3BO_3$   
Strong base                      W.A.
- Q.7** (1)  
It is a weak mono basic acid soluble in water and in aqueous solution the boron atom completes its octet by accepting  $OH^-$  ion from water molecules.  
 $B(OH)_3(aq) + 2H_2O \rightleftharpoons [B(OH)_4]^- + H_3O^+$
- Q.8** (3)  
 $N_2(g) + 3H_2(g) \xrightarrow{Fe, Oy+K_2O+Al_2O_3} 2NH_3(g)$   
 $CO(g) + 3H_2(g) \xrightarrow{Ni} CH_4(g) + H_2O(g)$   
 $CO(g) + H_2(g) \xrightarrow{Cu} HCHO(g)$   
 $CO(g) + 2H_2(g) \xrightarrow{Cu/Zno-Cr_2O_3} CH_3(OH)(g)$
- Q.9** (2)  
Acidic →  $B_2O_3, N_2O_5, SO_3, P_4O_{10}$   
Neutral →  $NO, N_2O, CO$
- Q.10** (2)  
 $3B_2H_6 + 6NH_3 \xrightarrow[\text{excess}]{\text{high temp.}} 2B_3N_3H_6 + 12H_2$
- Q.11** (4)  
Statement-I false  
 $BeCl_2$  and  $AlCl_3$  act as lewis acid due to incomplete octet and having vacant orbitals  
 $Be(OH)_2 + OH^- \rightarrow [Be(H_2O)_4]^{2-}$

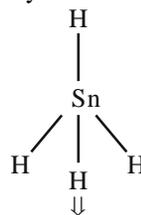
Berylate ion



Aluminate ion

⇒ So Statement-II is true

- Q.12** (1)  
Al is not obtained from sulphide ore
- Q.13** (2)  
Ga have low M.P. and it is closer to metalloid in P.T.
- Q.14** (2)  
Boron do not form  $BF_6^{-3}$  because Boron does not have vacant d orbital so, it can expand octet
- Q.15** (2)  
→ Al and Mg is used to make aircraft plates  
→ Ca ions are important for cell membrane.
- Q.16** (2)  
Borax Bead Test : - Borax on strongly heating gives transparent glassy bead.  
When this bead is placed on CoO solution and then it placed in a flame  
→ We will find blue colour  
→ This blue colour is due to the following reaction
- $$Na_2B_4O_7 \cdot 10H_2O \xrightarrow{\Delta} Na_2B_4O_7 + 10H_2O$$
- $$Na_2B_4O_7 \xrightarrow{\Delta} NaBO_2 + B_2O_3$$
- $$CoO + B_2O_3 \xrightarrow{\Delta} Co(BO_2)_2$$
- Cobalt II meta borate (blue)  
Option (2)
- Q.17** (3)  
Stannae → it is an inorganic compound  
→ it is tin hydride or tin tetra hydride



Covalent or molecular  
hydride  
→ molecular hydride  
→ But it not planar so it is tetrahedral