

① $pOH = 10.0$ $\therefore pH + pOH = 14$

$\Rightarrow pH = 14 - 10 = 4$

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

$\Rightarrow [H^+] = 10^{-4}$

Ans: - 4

② A buffer solⁿ is

a mixture of weak acid & its salt with strong base
or

a mixture of weak base & its salt with strong acid
or

salt of weak acid & weak base

Ans: - 1

weak acid (CH_3COOH) + its salt with strong base
(CH_3COONa)

③

Ans: - 4

weak base (NH_4OH) + its salt with ~~strong~~ strong
acid (NH_4Cl)

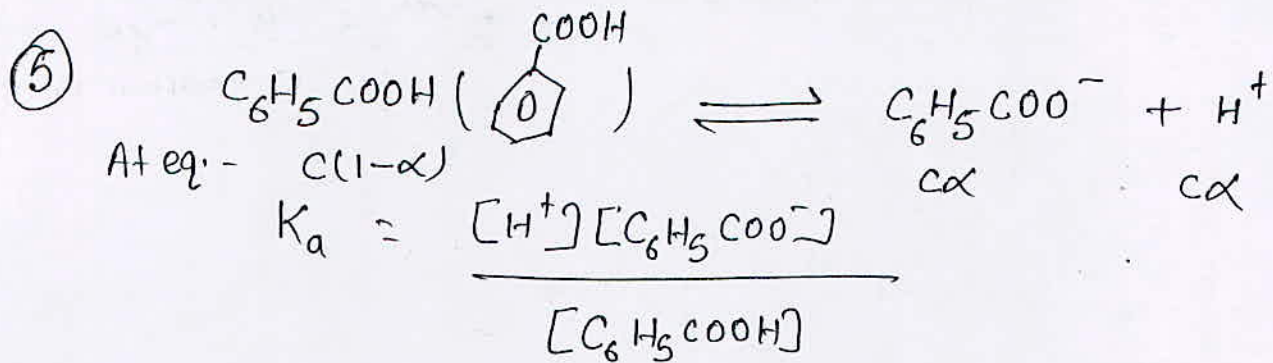
④ $\therefore pH = -\log [H^+]$

$pH = 2 \Rightarrow [H^+] = 10^{-2}$ / $pH = 4 \Rightarrow [H^+] = 10^{-4}$

$\therefore [H^+]$ is decreasing from 10^{-2} to 10^{-4}

\therefore Ans: - 4 - Decreased hundred times

~~Answer~~



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

$$c = 0.006 M, K_a = 6 \times 10^{-5}$$

$$\Rightarrow 6 \times 10^{-5} = \frac{6 \times 10^{-3} \alpha^2}{1-\alpha}$$

$$\Rightarrow 10^{-2} = \frac{\alpha^2}{1-\alpha}$$

Assuming $1 \gg \alpha$ & $1-\alpha \approx 1$

$$\Rightarrow 10^{-2} = \alpha^2 \therefore \alpha = 10^{-1}$$

$$\therefore [H^+] = c\alpha = 6 \times 10^{-3} \times 10^{-1} = 6 \times 10^{-4}$$

Ans:- 2

⑥ $pH = 4$ $\therefore pH + pOH = 14$

$$\Rightarrow pOH = 14 - 4 = 10$$

$$= -\log[OH^-]$$

$$\therefore [OH^-] = 10^{-10}$$

Ans:- 2

8) $\text{pH} = -\log[\text{H}^+]$

∴ As the $[\text{H}^+]$ increases pH decreases.

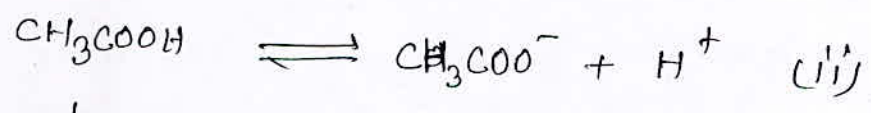
Hence for 'B' $\text{pH} = 2.5$ (least) (Strongest Acid)

~~Ans:- 4~~
Ans:- 4

9) Ionisation constant of water = $[\text{H}^+][\text{OH}^-]$
 (K_w)

∴ K_w at $25^\circ\text{C} = 1.00 \times 10^{-14}$ (constant)

Ans:- 3

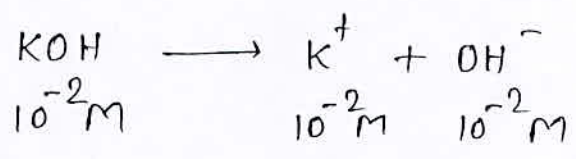


Due to common ion effect the equilibrium of (ii) reaction will shift in backward direction.

∴ $[\text{H}^+]$ will decrease

Ans:- 2

11) Ans:- 1



∴ $\text{pOH} = -\log[\text{OH}^-] = -\log 10^{-2} = 2$

$\text{pH} = 14 - \text{pOH} = 12$

(12) $[NaOH] = [OH^-] = 10^{-3} M$ [$\because NaOH$ is a strong base
 \therefore It will dissociate completely in aq. solⁿ]

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

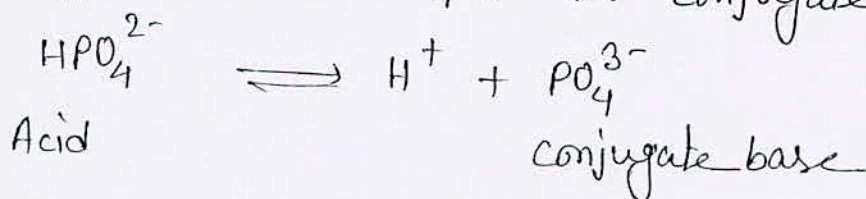
$$= 3$$

$$\therefore pH = 14 - 3 = 11$$

Ans: - 4

(13) Remove H^+ from given acid (HPO_4^{2-}) for conjugate base

Ans: - 1



(14) Ans: - 1 Buffer solution is pH resistant

(15) Ans: - 3

(16) Ans: - 2 Strength of an acid depends on its tendency to donate protons (H^+)

(17) $[NaOH] = [OH^-] = 10^{-5} M$

$$\therefore pOH = -\log[OH^-] = 5$$

$$pH = 14 - 5 = 9$$

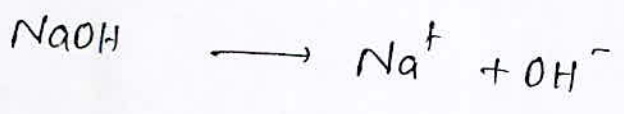
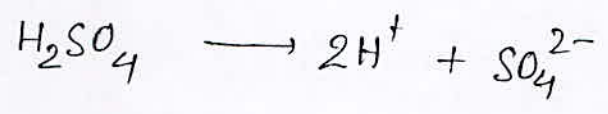
Ans: - 3



for conjugate base " NH_3 " should act as an ~~acid~~ acid

Ans: - 2

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milli moles of 'H⁺' = 2 × 0.2 × 100 = 40 millimoles

" " " 'OH⁻' = 0.2 × 100 = 20 millimoles

∴ [H⁺] > [OH⁻]

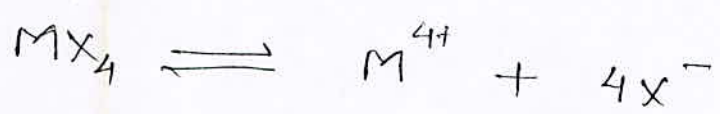
∴ solⁿ will be acidic

Ans! - 1

20

21 Ans! - 2 Lewis acid is electron pair acceptor.

22



$$[M^{4+}] = S \quad \& \quad [X^-] = 4S$$

$$K_{sp} = [M^{4+}][X^-]^4 = S \cdot (4S)^4 = 256 \times S^5$$

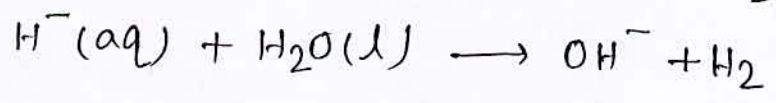
$$S = \left(\frac{K_{sp}}{256} \right)^{1/5} \quad \text{Ans! - 1}$$

23

Ans! - 2

∴ H⁻ is stronger base than OH⁻

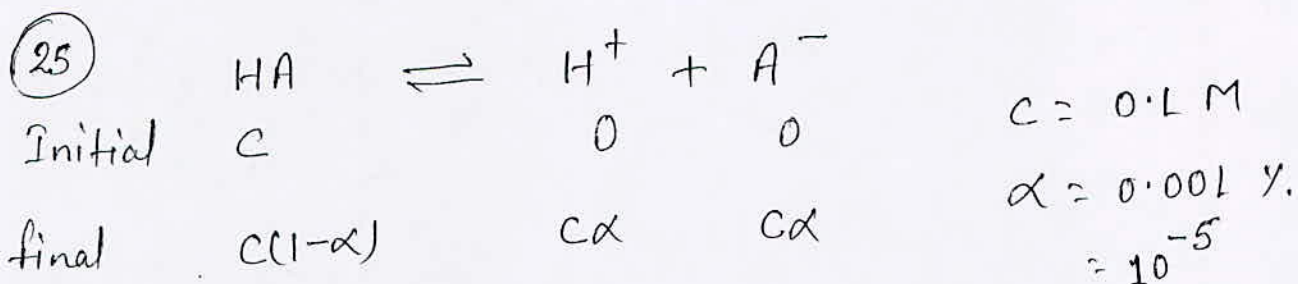
∴ H⁻ will accept H⁺ from H₂O



(24) BF_3 is an electron deficient compound.

\therefore It will act as electron pair acceptor or Lewis Acid

Ans: - 2



$$\text{Ionisation const. of acid} = \frac{[\text{H}^+][\text{A}^-]}{[\text{HA}]} = \frac{C^2\alpha^2}{C(1-\alpha)}$$

$\therefore \alpha$ is very small

$$\therefore 1-\alpha \approx 1$$

$$K_a = 0.1 \times (10^{-5})^2 = 10^{-11}$$

Ans: - 4

(26) for $\frac{N}{100}$ HCl solⁿ - $[\text{H}^+] = \frac{1}{100} = 10^{-2}$

$$\therefore \text{pH} = -\log[\text{H}^+] = 2$$

for $\frac{N}{100}$ NaOH solⁿ - $[\text{OH}^-] = \frac{1}{100} = 10^{-2}$

$$\text{pOH} = -\log[\text{OH}^-] = 2$$

$$\therefore \text{pH} = 14 - 2 = 12$$

Ans: - 2

(27) $\text{Ba}(\text{OH})_2$ is a strong base.

\therefore contribution of $[\text{OH}^-]$ from water can be neglected as compared to $\text{Ba}(\text{OH})_2$.

~~$[\text{OH}^-] = 2 \times [\text{Ba}(\text{OH})_2] = 2 \times 0.01 = 0.02$~~

~~pOH = -log [OH⁻]~~

~~moles of OH⁻~~ $[OH^-] = \frac{\text{moles of OH}^-}{\text{Vol}^m \text{ of sol}^n (L)}$

$$= \frac{2 \times 50 \times 0.01}{1000 \times \frac{100}{1000}} = 0.01 = 10^{-2}$$

∴ pOH = -log [OH⁻] = 2

∴ $pH = 14 - 2 = 12$ | Ans: -3

28) Ans: -1 Basic Buffer — weak base (NH₄OH) + its salt with strong acid (NH₄Cl)

29) Ans: -4 option - 1 - Acidic Buffer
option - 3 - Basic Buffer

30) Ans: -2 $pH = -\log_{10} [H^+]$

31) for acidic buffer $pH = pKa + \log \frac{[Salt]}{[Acid]}$

$$\Rightarrow 5.8 = 4.8 + \log \frac{[Salt]}{[Acid]}$$

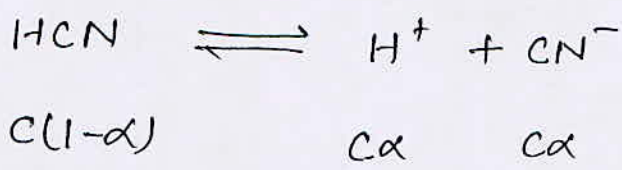
$$\Rightarrow \log \frac{[Salt]}{[Acid]} = 1 \quad \therefore \frac{[Salt]}{[Acid]} = 10^1$$

$$\therefore \frac{[Acid]}{[Salt]} = 10^{-1} = 0.1$$

Ans: -2

32

Conc. at eq.



$$c = 0.1$$

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

$$K_a = \frac{[\text{H}^+][\text{CN}^-]}{[\text{HCN}]} = \frac{c\alpha^2}{c(1-\alpha)}$$

$$4 \times 10^{-10} = \frac{c\alpha^2}{1-\alpha}$$

$\therefore K_a$ is very small.

\therefore We can assume

$$1-\alpha \approx 1$$

$$4 \times 10^{-10} = \frac{0.1 \times \alpha^2}{1}$$

$$\Rightarrow \alpha^2 = 4 \times 10^{-9} = 40 \times 10^{-10}$$

$$\therefore \alpha \approx 6.3 \times 10^{-5}$$

~~HCN~~ $[\text{CN}^-] = c\alpha = 0.1 \times 6.3 \times 10^{-5}$

$$= 6.3 \times 10^{-6}$$

Ans! - 3

33

Ans! - 2

Lewis acid is electron pair acceptor.

BCl_3 is electron deficient & will accept electron pair from PH_3 .

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35) for minimum change in pH, ~~the~~ buffer capacity will be max^m.

This is possible only when ~~the~~ [salt] = [acid]

∴ pH = pKa

Ans! - 3

36) Same as Q.No. - 19

37) [OH⁻] = 10⁻⁷ ⇒ pOH = -log[OH⁻] = 7

∴ pH = 14 - 7 = 7

Ans! - 1

38) Same as Q.No. 25

39) Normality of Ba(OH)₂ = 10⁻⁴

∴ pOH = 4

∴ pH + pOH = 14 ⇒ pH = 10

Ans! - 2

40) $\frac{N}{10}$ NaOH solⁿ

[OH⁻] = ~~10~~ $\frac{1}{10} = 10^{-1}$

∴ pOH = -log[OH⁻] = 1

∴ pH = 14 - pOH = 14 - 1 = 13

Ans! - 4

- (21) Ionisation of water is an endothermic reaction.
 \therefore as temperature increases, $K_w \uparrow$

Ans: - 2

- (42) Solubility product \propto solubility
 Solubility of ionic compound $\propto \frac{1}{\text{Size of cation}}$
 \therefore Least soluble Be(OH)_2

Ans: - 4

- (43) Solubility of $\text{AgCl} = 1.435 \times 10^{-3} \text{ gm/L}$

$$S = \frac{1.435 \times 10^{-3} \text{ mol/L}}{143.5}$$



$$\begin{aligned} \therefore K_{sp} &= [\text{Ag}^+][\text{Cl}^-] \\ &= S \cdot S = S^2 = (1 \times 10^{-5})^2 = 10^{-10} \end{aligned}$$

Ans: - 2

- (44) $(\text{CH}_3\text{COONa} + \text{CH}_3\text{COOH})$ Acidic buffer

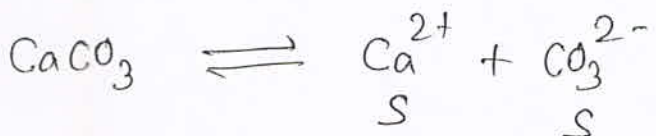
$$\text{pH} = \text{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$= -\log K_a + \log \frac{10 \times 1 \times 60}{60 \times 50 \times 2} \quad \left\{ \begin{array}{l} \text{[Salt]} = \frac{10 \times 1}{50 + 10} \end{array} \right.$$

$$\begin{aligned} &= -\log 1.8 \times 10^{-5} + \log 10^{-1} = -\log 1.8 + \log 10^{-5} + \log 10^{-1} \\ &= -\log 1.8 + 5 - 1 = -0.3 + 4 \approx 4 \end{aligned}$$

Ans: - 1

45



$$S = 3.05 \times 10^{-4} \text{ mols/L}$$

$$K_{sp} = [\text{Ca}^{2+}][\text{CO}_3^{2-}] = S^2$$

$$= (3.05 \times 10^{-4})^2 = 9.3 \times 10^{-8}$$

Ans! - 4

46



- (49) 100 ml of $\frac{M}{10}$ NaOH solⁿ.
 milli moles of NaOH = $100 \times \frac{1}{10} = 10$
- 50 ml of $\frac{M}{5}$ HCl solⁿ
 milli moles of HCl = $50 \times \frac{1}{5} = 10$
- \therefore moles of ~~the~~ acid = moles of base
 Hence resulting solⁿ will be neutral & pH = 7
- Ans: - 3**

- (50) **Ans: - 1** NaClO
 Salt of weak acid (HClO) & strong base (NaOH)
 on hydrolysis
 $\text{ClO}^- + \text{H}_2\text{O} \rightleftharpoons \text{HClO} + \text{OH}^-$
 solⁿ will be basic & pH will be max^m.

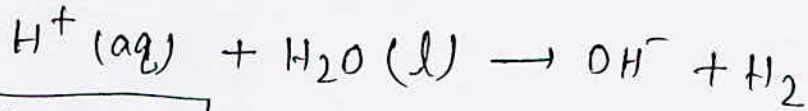
- (52) **Ans: - 1** pH < 7 acidic solⁿ
 or
 hydrolysis ~~hydroly~~ of salt of strong acid & weak base.

- (51) $\text{CaF}_2 \rightleftharpoons \text{Ca}^{2+} + 2\text{F}^-$
 $\therefore \quad \quad \quad S \quad \quad \quad 2S$ $S = \text{solubility}$
 ~~3.2×10^{-11}~~
- $K_{sp} = [\text{Ca}^{2+}][\text{F}^-]^2 = S \cdot (2S)^2 = 4S^3$
- $\Rightarrow 3.2 \times 10^{-11} = 4S^3 \Rightarrow S^3 = \frac{8 \times 10^{-12}}{4} = 2 \times 10^{-12}$
- $\therefore \underline{S = 2 \times 10^{-4} \text{ mol/L}}$ **Ans: - 1**

(52)

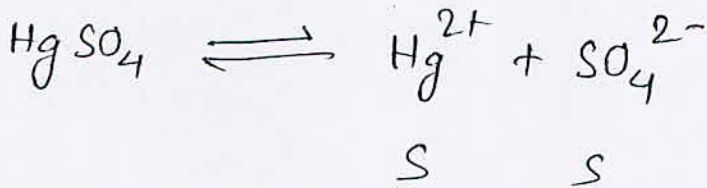
$\therefore H^-$ is stronger base.

\therefore it will accept proton (H^+) from H_2O .



Ans! - 2

(54)



$S =$ solubility

$$\therefore K_{sp} = [Hg^{2+}][SO_4^{2-}] = S^2 = 6.4 \times 10^{-5}$$

$$\Rightarrow S^2 = 64 \times 10^{-6}$$

$$\Rightarrow S = 8 \times 10^{-3}$$

Ans! - 1

(55)



$$K_{OH} = \frac{[BOH][H^+]}{[B^+]} \quad \text{--- } K_b$$

$$K_h = \frac{[BOH][H^+][OH^-]}{[B^+][OH^-]} = \frac{K_w}{K_b}$$
$$= \frac{10^{-14}}{10^{-6}} = 1 \times 10^{-8}$$

Ans! - 3

(56)

Active mass of urea = Concentration of urea in dilute solⁿ

$$= \frac{2404}{60 \times 10}$$

[Mol. mass of urea = 60 gm/mol]

$$= 0.4 \text{ mol/L}$$

Ans! - 3

LEVEL - 02

①

$$\textcircled{1} \quad [\text{OH}^-] = 10^{-7} \quad \therefore \text{pOH} = -\log[\text{OH}^-] = -\log 10^{-7}$$

$$\therefore \text{pH} + \text{pOH} = 14 = 7$$

$$\therefore \text{pH} = 14 - 7 = 7 \quad \boxed{\text{Ans!- 1}}$$

② Ans!-

③ $\frac{N}{10}$ NaOH solⁿ

$$[\text{OH}^-] = \frac{1}{10} = 10^{-1}$$

$$\text{pOH} = -\log[\text{OH}^-] = -\log 10^{-1} = 1$$

$$\text{pH} = 14 - \text{pOH} = 14 - 1 = 13 \quad \boxed{\text{Ans!- 4}}$$

④ Ans!- 2

Na_2CO_3 - salt of weak acid (H_2CO_3) & strong base (NaOH).

Its solⁿ will ^{be} basic & hence highest pH.

⑤ for buffer solⁿ

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

$$\therefore [\text{Salt}] = [\text{Acid}]$$

$$\text{K}_b \text{ for } \text{X}^- = 10^{-10}$$

$$\therefore \text{K}_a \text{ for conjugate acid HX} = \frac{\text{K}_w}{\text{K}_b} = \frac{10^{-14}}{10^{-10}} = 10^{-4}$$

$$\therefore \text{pH} = \text{pK}_a + \log 1 = \text{pK}_a = -\log \text{K}_a$$

$$\text{pH} = -\log 10^{-4} = 4$$

Ans!- 1

$$\textcircled{6} \quad \therefore \text{pH} = \text{pK}_a + \log \frac{[\text{salt}]}{[\text{acid}]}$$

$$\begin{aligned} \Rightarrow 6 &= -\log K_a + \log \frac{[\text{salt}]}{[\text{acid}]} \\ &= -\log 10^{-5} + \log \frac{[\text{salt}]}{[\text{acid}]} \end{aligned}$$

$$\Rightarrow \log \frac{[\text{salt}]}{[\text{acid}]} = 6 - 5 = 1$$

$$\therefore \frac{[\text{salt}]}{[\text{acid}]} = 10^1 = 10:1$$

Ans! - 2

$\textcircled{7}$ $\therefore \text{pH} = 13$ \therefore after adding substance Y, the solⁿ became basic.

\therefore Y is salt of weak acid & strong base

Ans! - 4



$$K_a = \frac{[\text{F}^-][\text{H}^+][\text{OH}^-]}{[\text{HF}][\text{OH}^-]} = \frac{K_w}{\frac{[\text{HF}][\text{OH}^-]}{[\text{F}^-]}}$$

$$\left\{ \begin{array}{l} \text{F}^- + \text{H}_2\text{O} \rightleftharpoons \text{HF} + \text{OH}^- \\ K_b = \frac{[\text{OH}^-][\text{HF}]}{[\text{F}^-]} \end{array} \right\} K_a = \frac{K_w}{K_b}$$

$$\therefore \text{pK}_a = \text{pK}_w - \text{pK}_b$$

$$= 14 - 10.83$$

$$\text{pK}_a = 3.17$$

$$\therefore \text{pK}_a = -\log K_a$$

$$\Rightarrow \log K_a = -3.17 = 4 - 0.83 \quad [\text{take antilog on both sides}]$$

$$\therefore K_a = 6.75 \times 10^{-4}$$

Ans! - 3

9) **Ans! - 2** Bronsted acid is proton ~~donor~~ donor (H^+)

10)

11) **Ans! - 1** Bronsted acids are proton donors.

12) **Ans! - 1**

13) When NH_3 is added to the solution, ~~it~~ it will become less acidic or more basic.

$\therefore [H_3O^+] \downarrow$

Ans! - 3

14) $[HCl] = 10^{-12} M$

HCl solⁿ will be an acidic solⁿ.

$\therefore [HCl]$ is very less.

$\therefore [H^+]$ from H_2O can not be neglected.

$\therefore [H^+]_{total} \approx 7$

$\therefore pH \approx 7$ (slightly less than 7)

Ans! - 3

15) **Ans! - 1** Salt of weak acid & strong base. Its solⁿ will be basic.

16) $10^{-7} N$ HCl solⁿ. (Acidic solⁿ $\therefore pH < 7$)

In this case $[H^+] = [H^+]_{from HCl} + [H^+]_{from H_2O}$

$\therefore pH \approx 6.97$

Ans! - 2

(17)

(18) Ans:- 4 ~~the bond is stronger~~

(19) Ans:- 1 As the oxidation state of central atom ↑
Acidic char: ↑

(20) At 90°C $[H_3O^+] = 10^{-6}$
 $\therefore [OH^-] = 10^{-6}$
 $K_w = [H_3O^+][OH^-] = 10^{-12}$

○ Ans:- 2

(21) $HA \rightleftharpoons H^+ + A^-$
Initial $C \quad 0 \quad 0$
At eq. $C(1-\alpha) \quad C\alpha \quad C\alpha$
$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)} = \frac{C\alpha^2}{1-\alpha}$$

○ for weak acid ' α ' is very small
 $\therefore 1-\alpha \approx 1$

$\Rightarrow K_a = C\alpha^2$
 $\therefore C K_a = C^2 \alpha^2$
 $\Rightarrow C\alpha = \sqrt{K_a C} = [H^+]$

Ans:- 1

(22) $\therefore CH_3COOH$ is a weak acid

$\therefore [H^+] = \sqrt{K_a C}$
 $\Rightarrow 3.4 \times 10^{-4} = \sqrt{1.7 \times 10^{-5} \times C} \quad \therefore C = \frac{(3.4 \times 10^{-4})^2}{1.7 \times 10^{-5}}$
 $C = 6.8 \times 10^{-3}$

Ans:- 4

(23) solⁿ of NH₄OH & NH₄Cl → Basic Buffer.

∴ pH = pK_b + log [Salt] / [Base]

⇒ 14 - 9.25 = pK_b + log 0.1 / 0.1

~~pK_b = 9.25~~ ∴ pK_b = 4.75

[Ans: - 2]

(24) [Ans: - 2] Na₂CO₃ - salt of strong base (NaOH) & weak ~~acid~~ dibasic acid (H₂CO₃)

∴ Its solⁿ will be more basic.

(25) At 80°c [H₃O⁺] = 1 × 10⁻⁶
for neutral water [OH⁻] = [H₃O⁺]
∴ K_w = [OH⁻][H₃O⁺] = 1 × 10⁻⁶ × 1 × 10⁻⁶
= 1 × 10⁻¹²

[Ans: - 3]

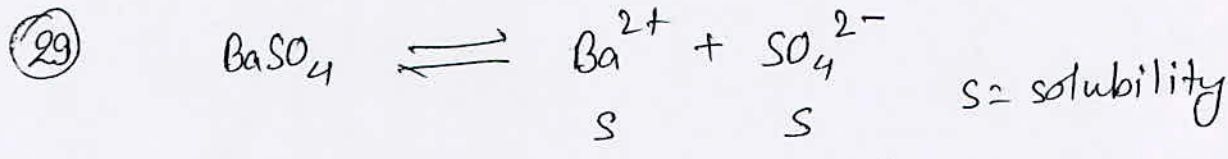
(26) [Ans: - 2] K_{sp} ∝ solubility.

(27) for CaF₂ K_{sp} = [Ca²⁺][F⁻]² [v = initial vol^m, 2v = final vol^m]
∴ [Ans: - 2] = (10⁻² × v / 2v) × (10⁻³ × v / 2v)²

~~5 × 10⁻³ × 25 × 10⁻⁸~~
~~= 125 × 10⁻¹¹ = 12.5 × 10⁻¹⁰~~
= 10⁻⁸ / 8 > K_{sp}

∴ precipitate will be obtained.

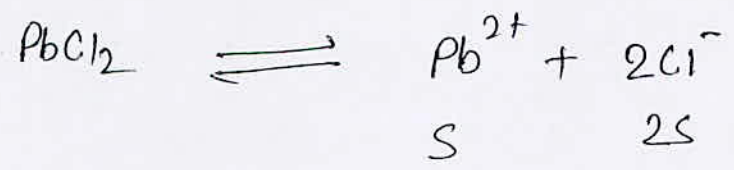
28



$K_{sp} = S^2 = 1.5 \times 10^{-9}$
 $\Rightarrow S = \sqrt{1.5 \times 10^{-9}} \approx 3.9 \times 10^{-5}$

Ans: - 2

30



$K_{sp} = S \cdot (2S)^2 = 4S^3$

$\therefore S = \sqrt[3]{\frac{K_{sp}}{4}}$ Ans: - 3

31

for PbCl_2

solubility (S) = $\left(\frac{K_{sp}}{4}\right)^{1/3}$
 $= \left(\frac{1 \times 10^{-6}}{4}\right)^{1/3}$
 $\approx 6.3 \times 10^{-3}$

Ans: - 1

32

Ans: - 2

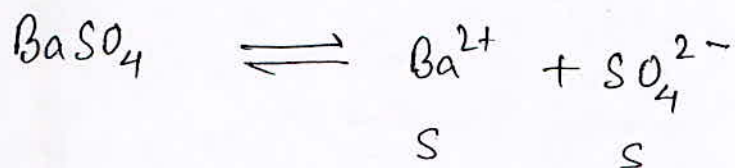
Due to common ion (Cl^-) the equilibrium will shift towards left (backwards)

33

Ans: - 4

Hydrolysis of salt of strong acid & strong base doesn't occur.

(34)



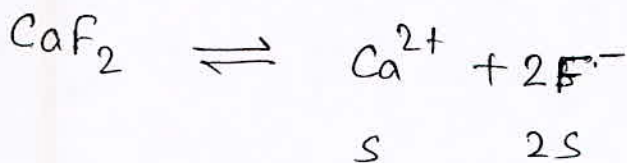
solubility in gm/L = 2.33×10^{-3}

$$\text{'' '' mol/L} = \frac{2.33}{233} \times 10^{-3} = 10^{-5}$$

$$\therefore K_{sp} = S^2 = (10^{-5})^2 = 10^{-10}$$

Ans: - 2

(35)



$$S = 2 \times 10^{-4} \text{ mols/L}$$

$$K_{sp} = S \cdot (2S)^2 = 4S^3$$

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

$$= 32 \times 10^{-12} = 3.2 \times 10^{-11}$$

Ans: - 4

(36)

For binary electrolyte (e.g. - NaCl)

$$K_{sp} = S^2 \quad \therefore S = \sqrt{K_{sp}}$$

Ans: - 3

(37)

For weak acid

$$[\text{H}^+] = c\alpha = 0.1 \times \frac{2}{100} = 2 \times 10^{-3}$$

$$\therefore [\text{H}^+][\text{OH}^-] = K_w = 10^{-14}$$

$$\therefore [\text{OH}^-] = \frac{10^{-14}}{2 \times 10^{-3}} = 5 \times 10^{-12}$$

Ans: - 3

(4)

(38) Ans! - 4 \therefore ionisation $\propto \frac{1}{\sqrt{c}}$

At infinite dilution ionisation is 100%.

(39) Ans! - 2 $K_{sp} \propto$ solubility



$$K_{sp} = 4s^3 = 1 \times 10^{-11}$$

$$\Rightarrow s = \left(\frac{K_{sp}}{4} \right)^{1/3} = \left(\frac{10 \times 10^{-12}}{4} \right)^{1/3}$$

$$= 1.36 \times 10^{-4}$$

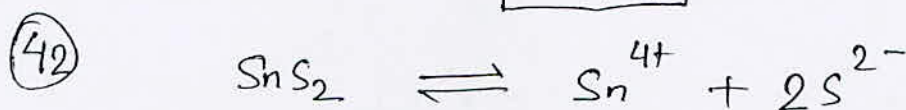
Ans! - 2

(41) At $90^\circ C$ $[H_3O^+] = 10^{-6}$

for pure water $[H_3O^+] = [OH^-]$

$$\therefore K_w = [OH^-][H_3O^+] = 10^{-6} \times 10^{-6} = 10^{-12}$$

Ans! - 2



$$\therefore K_{sp} = [Sn^{4+}][S^{2-}]^2$$

Ans! - 1



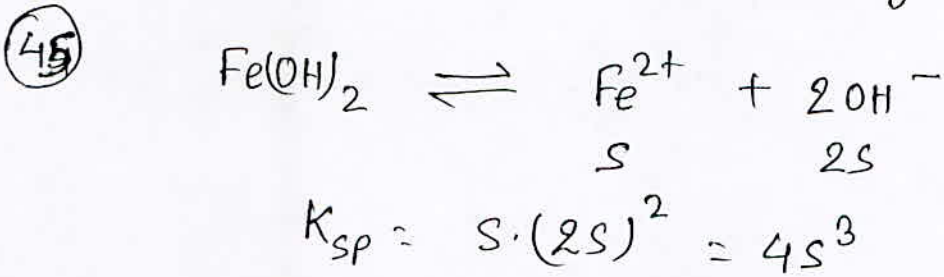
$$K_{sp} = s^2 = 5 \times 10^{-13} = 50 \times 10^{-14}$$

$$\Rightarrow s = \sqrt{50 \times 10^{-14}}$$

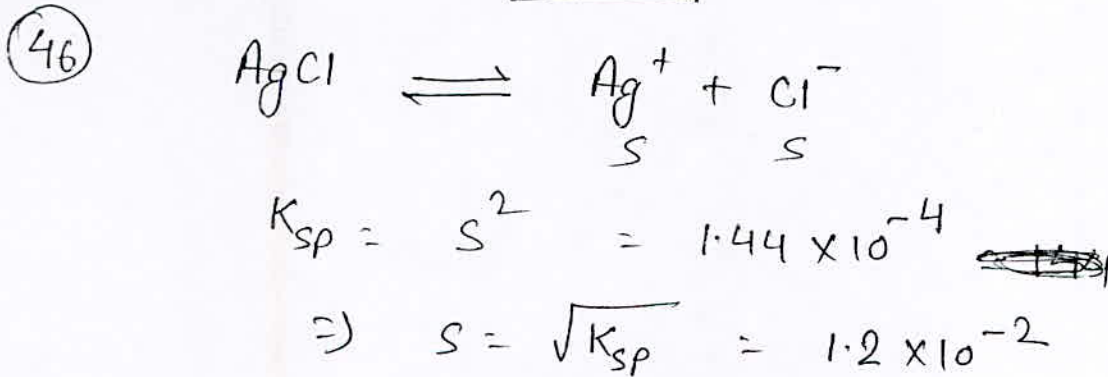
$$= 7.1 \times 10^{-7}$$

Ans! - 2

(43) Ans: - 4 AgCl is sparingly soluble.
KI - is highly soluble



Ans: - 2



Ans: - 1



In case of presence of KNO_3 (no common ion with AgCl)

$$\therefore K_{sp} = [\text{Ag}^+][\text{Cl}^-] = S \cdot S$$

$$\Rightarrow 10^{-10} = S^2$$

$$\therefore S = 1 \times 10^{-5}$$

Ans: - 2



$$K_{sp} = (2S)^2 \cdot S = 4S^3$$

$$= 4 \times (3.5 \times 10^{-6})^3$$

$$= 1.7 \times 10^{-16}$$

Ans: - 2

(49)

Density of liq. HCl = 1.17 g/cc

Assume vol^m of liq. = 1L = 1000 cc

$$\therefore n_{\text{HCl}} = \frac{1000 \times 1.17 \text{ gm}}{36.5 \text{ g/mol}}$$

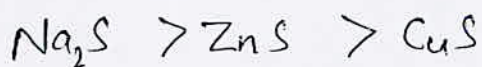
$$\therefore \text{Molarity} = \frac{1000 \times 1.17}{36.5 \times 1} \frac{\text{mol}}{\text{L}}$$

$$= 32.05$$

Ans: - 3

(50)

Ans: - 4



(51)

Ans: - 4

(52)

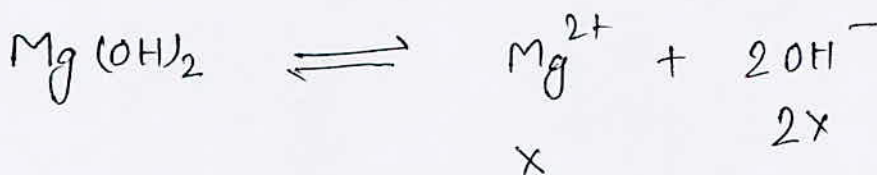
Ans: - 1

NaCl - salt of SASB

HCl - strong acid.

\therefore solⁿ will be acidic, with pH < 7

(54)



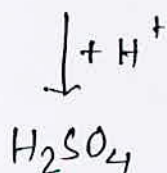
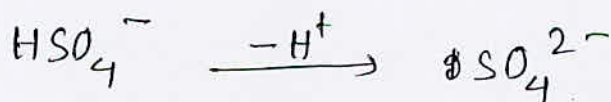
$$\therefore K_{sp} = x \cdot (2x)^2 = 4x^3$$

Ans: - 1

(53)

Bronsted acid - H^+ donor

" base - H^+ acceptor.



Ans: - 1

55) Ans:- 4 HN_3 - Hydrazoic acid (H - is acidic in nature)

56) ~~PbCl₂~~ $\rightleftharpoons \underset{S}{\text{Pb}^{2+}} + \underset{2S}{2\text{Cl}^-}$
 $K_{sp} = S \cdot (2S)^2 = 4S^3 = 4 \times (2 \times 10^{-2})^3$
 $= 3.2 \times 10^{-5}$ Ans:- 4

57) $\text{HA} \rightleftharpoons \text{H}^+ + \text{A}^-$
Initial C 0 0
At eq. C(1-α) Cα Cα
 $K_a = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)}$
For weak electrolyte 'α' is small
∴ $1-\alpha \approx 1$
 $K_a = C\alpha^2$
 $\Rightarrow \alpha = \sqrt{\frac{K_a}{C}}$ Ans:- 2

58) $\text{pH} = 4.7$ ~~$= -\log[\text{H}^+]$~~
 ~~$\text{pH} = 4.7$~~
∴ $\text{pH} + \text{pOH} = 14$
 $\Rightarrow \text{pOH} = 14 - 9.3 = 4.7$ ~~$= -\log[\text{OH}^-]$~~
 $\Rightarrow \log[\text{OH}^-] = -4.7 = -10 + 0.7$
On taking antilog on both sides
 $[\text{OH}^-] = 5 \times 10^{-10}$ Ans:- 2

59) Ans:- 3 Conjugate base of NH_3 will be obtained by removing H^+ .

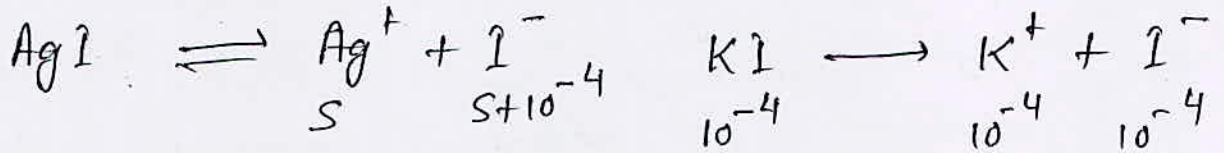
(60)

Ans! - ~~2~~ 2

$B(OH)_3$ releases H^+ when dissolved in water



(61)



Due to presence of KI , contribution of I^- from AgI can be neglected.

$$\therefore [I^-] \approx 10^{-4}$$

$$K_{sp} = S \times 10^{-4}$$

$$\Rightarrow 1 \times 10^{-16} = S \times 10^{-4} \quad \therefore S = 1 \times 10^{-12}$$

Ans! - 3

(62)

(63)

(64)

65) Ans! - 3 1×10^{-8} M HCl solⁿ will be acidic
 $\therefore \text{pH} < 7$

66) Ans! - 3 Salt with lowest K_{sp} will precipitate first.

67) Ans! - 3 H_3BO_3 is monobasic acid &
 'B' is electron deficient (Lewis Acid)

68) Ans! - 4 [4]-solⁿ of strong acid & salt of SASB

69) for precipitation to not occur.

$$K_{IP} \leq K_{sp}$$

$$\Rightarrow [A^+] [B^-] \leq 1 \times 10^{-10}$$

$$\Rightarrow [B^-] \leq \frac{10^{-10}}{10^{-5}} = 10^{-5}$$

Ans! - 1

70) 0.1 M NaOH

$$[\text{OH}^-] = 10^{-1} \quad \therefore \text{pOH} = -\log [\text{OH}^-] = -\log 10^{-1} = 1$$

$$\therefore \text{pH} + \text{pOH} = 14 \quad \therefore \text{pH} = 14 - 1 = 13$$

Ans! - 3

71) 0.005 M H_2SO_4 (H_2SO_4 is a diprotic acid)

$$\therefore [\text{H}^+] = 2 \times 0.005 = 0.01$$

$$\therefore \text{pH} = -\log [\text{H}^+] = -\log 10^{-2} = 2 \quad \text{Ans! - 3}$$

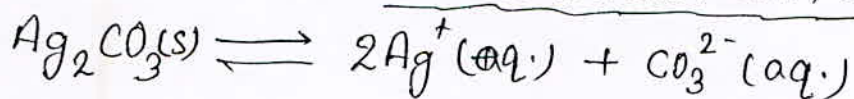


PREVIOUS YEARS QUESTIONS

(1)

Ostwald Dilution Law, Concepts of Acids & Bases

(1)



$$K_{eq} = [\text{Ag}^+]^2 [\text{CO}_3^{2-}] = K_{sp}$$

$$\therefore \Delta G = \Delta G^\circ + RT \ln Q$$

At equilibrium $\Delta G = 0$ & $Q = K_{eq}$

$$\Rightarrow \Delta G^\circ = -2.303 RT \log K_{sp}$$

$$\Rightarrow \log K_{sp} = \frac{-63.3 \times 1000}{8.314 \times 298 \times 2.303}$$

$$= -11.1 = -12 + 0.9$$

$$\Rightarrow K_{sp} = 8 \times 10^{-12}$$

Ans: - 4

(2) Ans: - 1

Na_2CO_3 - Salt of WASB. on hydrolysis, its solⁿ will become basic.

\therefore Highest pH among the given salts.

(3) Ans: - 4

Lewis ~~Acids~~ bases are electron pair donor.

BF_3 - 'B' - atom is electron deficient.

It will act as Lewis ~~an~~ acid.

(4) Ans: - 4

(5) Ans: - 4

Conjugate acid-base pairs differ by one H^+

~~at same time~~

⑥ Ans: - 3 S^{2-} will act as base only.
(e^- pair donor or H^+ acceptor)

⑦ Assuming molarity = 0.005 M
 $pH = 5 \Rightarrow [H^+] = 10^{-5}$
 $\therefore [H^+] = C\alpha$
 $C = \text{initial concentration of acid}$
 $= 5 \times 10^{-3} M$
 $\alpha = \text{degree of ionisation}$

$$\Rightarrow 10^{-5} = 5 \times 10^{-3} \times \alpha$$

$$\Rightarrow \alpha = \frac{10^{-5}}{5 \times 10^{-3}} = 2 \times 10^{-3}$$

$$\therefore \% \alpha = 2 \times 10^{-3} \times 100 = 0.2$$

Ans: - 2

⑧ Ans: - 4 Lewis acid is electron deficient.



$$\text{Total +ve charge} = [H^+]$$

$$\text{" -ve " } = [OH^-] + [CH_3COO^-]$$

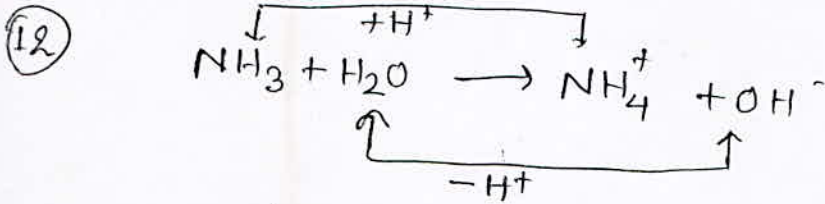
$$\therefore [H^+] = [OH^-] + [CH_3COO^-]$$

Ans: - 3

⑩ Equivalents of acid = $NV = \frac{1}{10} \times \frac{25}{1000}$
 $= 0.0025$
 \therefore " " base required to ~~not~~ neutralise = 0.0025

Ans: - 2

(11) **Ans:- 2** conjugate acid-base pair differ by H^+ (proton)



proton donor ~~for~~ for above reaction is H_2O .

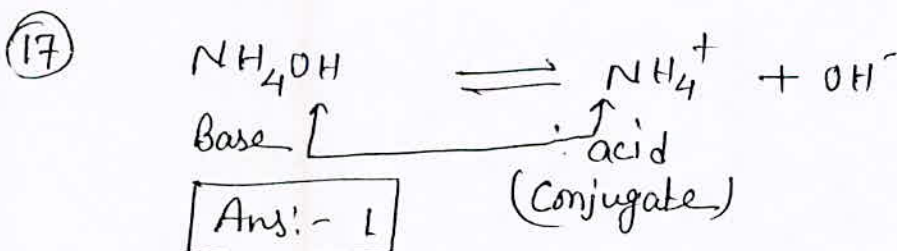
Ans:- 5

(13) **Ans:- 2** Vinegar is 7-8% acetic acid (CH_3COOH) solⁿ

(14) **Ans:- 4** Conjugate ^{base} of H_2PO_4 can be obtained by removing one H^+ . i.e. HPO_4^-

(15) **Ans:- 4** In conjugate Acid-Base pair, if acid is strong its conjugate base will be weak. for weak acid its ~~to~~ conjugate base will be strong. $HClO$ is weakest among $HClO_4, HClO_3, HClO_2, HClO$ $\therefore ClO^-$ will be strongest base.

(16) **Ans:- 1** In $(CH_3)_3B$ Boron-atom is electron deficient. \therefore Acts as Lewis acid



(18) **Ans:- 4** Conjugate base of weak acid will be strong. In this case CH_3COO^-

~~Answer~~

(19)

(20) 10 cm³ of 0.2 M HCl solⁿ

$$[H^+] = 0.2 = 2 \times 10^{-1}$$

$$\therefore [H^+][OH^-] = 10^{-14}$$

$$\Rightarrow [OH^-] = \frac{10^{-14}}{2 \times 10^{-1}} = 5 \times 10^{-14}$$

$$\begin{aligned} \text{moles of } OH^- &= 5 \times 10^{-14} \times \frac{10}{1000} \\ &= 5 \times 10^{-16} \end{aligned}$$

$$\begin{aligned} \therefore \text{No. of } OH^- \text{ ions} &= N_A \times \text{moles of } OH^- \\ &= 6.02 \times 10^{23} \times 5 \times 10^{-16} \\ &= 30 \times 10^7 = 3 \times 10^8 \end{aligned}$$

Ans: - 2

(21)

$$[H^+] = c\alpha$$

c = initial conc. of acid

α = degree of dissociation

$$\begin{aligned} &= 2 \times 10^{-2} \times \frac{4}{100} \\ &= 8 \times 10^{-4} \end{aligned}$$

$$\therefore [H^+][OH^-] = 10^{-14}$$

$$\therefore [OH^-] = \frac{10^{-14}}{8 \times 10^{-4}} = \frac{1}{8} \times 10^{-10}$$

$$= 1.25 \times 10^{-11}$$

Ans: - 4

(22)



C

0

0

~~C~~
C(1- α)~~0~~
C α ~~0~~
C α

$$\therefore K_b = \frac{\cancel{C\alpha} \cdot \cancel{C\alpha}}{\cancel{C(1-\alpha)}} = \frac{C\alpha^2}{C(1-\alpha)}$$

 \therefore BOH is weak base \therefore α will be very small

$$\& 1-\alpha \approx 1$$

$$K_b = \frac{C\alpha^2}{1} = C\alpha \cdot \alpha \quad [\because [\text{OH}^-] = C\alpha = 1.5 \times 10^{-3} \text{ M}]$$

$$\Rightarrow \alpha = \frac{K_b}{C\alpha} = \frac{1.5 \times 10^{-5}}{1.5 \times 10^{-3}} = 10^{-2}$$

$$\therefore C\alpha = 1.5 \times 10^{-3}$$

$$\Rightarrow C = \frac{1.5 \times 10^{-3}}{10^{-2}} = 1.5 \times 10^{-1} = 0.15 \text{ M}$$

Ans: - 4

(23)

Ans: - 1

H_3BO_3 is weak monobasic Lewis acid
(B-atom is e^- deficient)

(24)

Ans: - 1



C

0

0

C(1- α)C α C α

$$K = \frac{[\text{A}^+][\text{B}^-]}{[\text{AB}]} = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)} = \frac{C\alpha^2}{1-\alpha}$$

$$\Rightarrow K - K\alpha = C\alpha^2$$

$$\Rightarrow C\alpha^2 + K\alpha - K = 0$$

Ans: - 1

25

26 Ans: - 1

27 Ans: - 4 In $\text{CH}_3\text{-OH}$, H is attached to O (highly electronegative).
 \therefore more acidic.

28 Ans: - ~~4~~ 4 Lewis acid is electron deficient species.

29 Bronsted-Lowry acid is proton (H^+) donor.
 \therefore Ans: - 3

30 Ans: - 1 $^{+4}\text{MnO}_2$ - it can act as both acid as well as base

31 Ans: - 3

$$\begin{array}{c} \text{O} \\ || \\ \text{H} - \text{P} - \text{O}^- \\ | \\ \text{H} \end{array}$$

No acidic H

$$\begin{array}{c} \text{O} \\ || \\ - \text{O} - \text{P} - \text{O}^- \\ | \\ \text{H} \end{array}$$

one acidic H
Act as both acid & base

32 Ans: - 3 B(OH)_3 is electron deficient & acts as Lewis acid.

33 Ans: - 3 $\text{H}_2\text{O} < \text{CH}_3\text{OH} < \text{OH}^- < \text{CH}_3\text{O}^-$
 \downarrow
~~conjugate base of~~

34) Ans: - 1

35) $pH = 5 \therefore [H^+] = 10^{-5}$

If c is initial conc. of acid & α is degree of ionisation, then

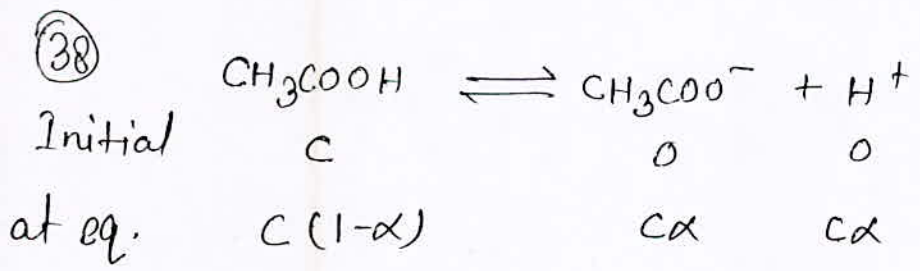
$$[H^+] = c\alpha = 5 \times 10^{-3} \times \alpha$$

$$\Rightarrow \alpha = \frac{10^{-5}}{5 \times 10^{-3}} = 2 \times 10^{-3} = 0.2 \times 10^{-2}$$

Ans: - 2

36) Ans: - 2 Bronsted & Lowry acid is proton donor i.e. tendency to lose protons.

37) Ans: - 1 Hydrated salt $AlCl_3 \cdot 6H_2O$ electron deficiency is satisfied by presence of lone pairs of H_2O



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

$\therefore CH_3COOH$ is weak acid.
 $\therefore \alpha$ will be very small such that $1-\alpha \approx 1$

$$\Rightarrow 1 \times 10^{-5} = \frac{0.1 \times \alpha^2}{1} \Rightarrow \alpha^2 = 10^{-4} \therefore \alpha = 10^{-2}$$

Ans: - 4

39) Ans: - 3 Conjugate acid of $S_2O_8^{2-}$ is $HS_2O_8^-$

40) Ans: - 3 $\alpha = \sqrt{\frac{K_a}{c}}$ on dilution $c \downarrow$
& $\alpha \uparrow$

41) Ans: - 3 Among the given, OH^- is least ~~acidic~~ acidic (Basic nature), then H_2O is neutral and rest ~~NH_4^+~~ ~~NH_3~~ are acidic.

42) For monoprotic acid, conc. = 1.00 M
 $\alpha = 0.01\%$
 $= 0.01 \times 10^{-2}$ (Very small)
 \therefore acid is weak monobasic acid.

$$\begin{aligned} \therefore K_a &= c\alpha^2 \\ &= 1 \times (1 \times 10^{-4})^2 \\ &= 10^{-8} \end{aligned}$$

Ans: - 1

43)

44) For weak acid,
 $K_a = c\alpha^2$ $c =$ Initial conc. of acid
 $\alpha =$ degree of ionisation

$$\begin{aligned} &= 0.1 \times \left(\frac{1.34}{100}\right)^2 \\ &= 1.79 \times 10^{-5} \end{aligned}$$

Ans: - 2

45

Ans! - 4

46

Dissociation const. \propto conc. of OH^-

\therefore less the K_b , weaker will be the base

Ans! - 3

47

48

Ans! - 2

Ostwald law is applicable to weak electrolytes

49

Ans! - 4

$\text{CH}_3\text{NH}_3^+ \text{Cl}^-$ - salt

In solⁿ it will exist in the form of its ions.

50

Ans! - 4

BX_3 - B - is electron deficient & acts as e^- pair acceptor.

51

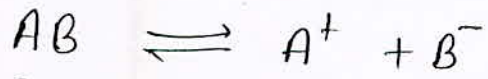
Ans! - 3

Among - HF, HCl, HBr, HI -

HF is weakest acid.

\therefore F^- is strongest conjugate base.

52



Initial - C

0 0

$$K_a = \frac{c\alpha \cdot c\alpha}{c(1-\alpha)} = \frac{c\alpha^2}{1-\alpha}$$

At eq. $c(1-\alpha)$

$c\alpha$ $c\alpha$

Ans! - 1

(54) Ans: -1

(55) Ans: -1 or 2

(56) $K_a = 3.2 \times 10^{-5}$ (very small)
 \therefore weak acid.

for acid

$$\alpha = \sqrt{\frac{K_a}{c}} = \sqrt{\frac{3.2 \times 10^{-5}}{0.2}}$$

$$= \sqrt{\frac{3.2 \times 10^{-5}}{2 \times 10^{-1}}}$$

$$= \sqrt{\frac{3.2 \times 10^{-5}}{2}}$$

$$= \sqrt{1.6 \times 10^{-4}} = 1.26 \times 10^{-2}$$

Ans: -2

f