

Topic :- Equilibrium

2 (d)

It is $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$.

3 (a)

$$[\text{OH}^-] = 2 \times 0.05 = 0.1$$

$$\therefore \text{pOH} = 1 \text{ and } \text{pH} = 13.$$

4 (b)

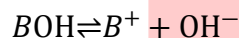
For a reaction, $K_c = \frac{[\text{product}]}{[\text{reactant}]}$

Hence,

if $K_c > 1$, then $[\text{Product}] > [\text{Reactant}]$

5 (c)

For base BOH



Dissociation constant $K_b = \frac{[\text{B}^+][\text{OH}^-]}{[\text{BOH}]}$

\therefore Higher the value of K_b , more will be dissociation of base and stronger will be base and *vice-versa*.

\therefore Weakest base among given choices is having $K_b = 7.2 \times 10^{-11}$.

6 (a)



$$\begin{array}{ccc} 1 & 0 & 0 \\ 1-x & x & x/2 \end{array}$$

$$\therefore K_p = \frac{x^2 \cdot x}{2(1-x)^2} \cdot \left[\frac{P}{1+\frac{x}{2}} \right]^1 = \frac{x^3 \cdot P}{2}$$

$$\left(1-x \approx 1 \text{ and } 1+\frac{x}{2} \approx 1, \text{ since } x \ll 1 \right)$$

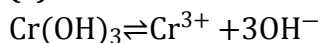
$$\text{Or } P = \frac{3\sqrt{2K_p}}{P}$$

7 (b)

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

$\Delta n_g = -1$ (For the reaction, $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$). Thus, for this reaction, K_p is less than K_c

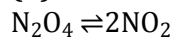
8 (a)



$$\begin{aligned}
 & \begin{matrix} (s) & (3s) \\ K_{sp} = s \times (3s)^3 \\ & = 27s^4 \\ 2.7 \times 10^{-31} & = 27s^4 \end{matrix} \\
 \therefore & \quad s = \sqrt[4]{\frac{K_{sp}}{27}} = \sqrt[4]{\frac{2.7 \times 10^{-31}}{27}} \\
 & \quad = \sqrt[4]{10^{-32}} \\
 & \quad = 10^{-8} \text{ mol/L}
 \end{aligned}$$

9

(d)



$$\begin{array}{ccc}
 1 & & 0 \\
 1-\alpha & & 2\alpha
 \end{array}$$

$$K_p = \frac{(n_{\text{NO}_2})^2}{n_{\text{N}_2\text{O}_4}} \times \left[\frac{P}{\Sigma n} \right]^{-1}$$

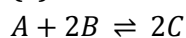
For 33% dissociation: $K_p = \frac{(2 \times 0.33)^2}{0.67} \times \left[\frac{P}{1.33} \right]^{-1}$

For 40% dissociation: $K_p = \frac{(2 \times 0.40)^2}{0.60} \times \left[\frac{P}{1.40} \right]^{-1}$

$$\therefore \frac{P_1}{P_2} = 1.56 \approx 1.60 = \frac{8}{5}$$

10

(a)



$$\begin{array}{ccc}
 2 & 3 & 2 \\
 (2-0.5) & (3-0.5) & (2 \times 0.5)
 \end{array}$$

initial moles
at equilibrium

Molar concentration of A = $\frac{1.5}{2}$

Molar concentration of B = $\frac{2.5}{2}$

Molar concentration of C = $\frac{1}{2}$

$$\begin{aligned}
 K &= \frac{[C]^2}{[A][B]^2} = \frac{1 \times 1 \times 2 \times 2 \times 2 \times 2}{2 \times 2 \times 1.5 \times 2.5 \times 2.5} \\
 &= \frac{2}{1.5 \times 2.5 \times 2.5} = 0.21
 \end{aligned}$$

11

(d)

In $\frac{N}{1000}$ KOH solution, $[\text{OH}^-] = 10^{-3} \text{ M}$

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

$$= +3\log 10 = 3$$

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

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

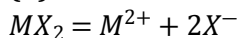
$$= 14 - 3$$

$$= 11$$

12 (a)

Tears are alkaline in nature.

14 (b)



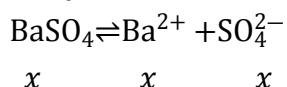
$$s \quad 2s$$

$$K_{sp} = (2s)^2(s) = 4s^3$$

$$\Rightarrow s = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{4 \times 10^{-12}}{4}} = 1.0 \times 10^{-4} \text{M}$$

15 (d)

Let solubility of $\text{BaSO}_4 = x \text{ mol L}^{-1}$



\therefore Ions at equilibrium

$$K_{sp} = [\text{Ba}^{2+}][\text{SO}_4^{2-}]$$
$$= x \times x$$
$$x^2$$

Given, $K_{sp} = 1.5 \times 10^{-9}$

$$(1.5 \times 10^{-9}) = x^2$$

or $\sqrt{1.5 \times 10^{-9}} = x$

$$x = 3.9 \times 10^{-5} \text{ mol/L}$$

16 (d)

Strongest Bronsted base is that which has weakest conjugate acid.

Base	Conjugate acid (base + H^+)
ClO^-	HClO
ClO_2^-	HClO_2
ClO_3^-	HClO_3
ClO_4^-	HClO_4

\therefore HClO is weak conjugate acid.

\therefore ClO^- is strongest Bronsted base.

17 (b)

At equilibrium $Q = K_c$ (or $Q = K_p$)

18 (a)

Oxalic acid = $x \text{ mol/L}$

Oxalic acid KMnO_4

$$M_1V_1 = M_2V_2$$

$$40 \text{ mL} \times x = 16 \text{ mL} \times 0.05$$

$$x = \frac{16 \times 0.05}{40} = \frac{1}{50}$$

$$x = \frac{1}{50} \text{ M}$$

Now, convert molarity into normality

$N \times \text{eq.wt} = M \times \text{mol.wt. of oxalic acid}$

$$N \times 45 = \frac{1}{50} \times 90$$

$$N = \frac{1}{25}$$

This normality represents the hydrogen ion concentration.

So, $[\text{H}^+] = \frac{1}{25}$

$$\text{pH} = \log \frac{1}{[\text{H}^+]}$$

$$= \log 25 = 1.3$$

19

(c)

Simple cations such as Ag^+ , Cu^{2+} , Fe^{3+} etc. can accept pairs of electrons and hence are Lewis acids.

20

(d)

Aspirin is a weak acid. Due to common ion effect, it is unionised in acid medium but completely ionised in alkaline medium

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	B	D	A	B	C	A	B	A	D	A
Q.	11	12	13	14	15	16	17	18	19	20
A.	D	A	D	B	D	D	B	A	C	D

PE