JEE MAIN PAPER CLASS 11th

1. K_a for HCN is 5×10^{-10} at $25^\circ C$. For maintaining at constant pH of 9 , the volume of 5MKCN solution required to be added to 10ml of 2MHCN solution is

(A) 4ml (B) 7.95ml (C) 2ml (D) 9.3ml

$$pH = pK_a + \log \frac{salt}{acid}$$

$$9 = 10 - \log 5 + \log \frac{5 \times V}{2 \times 10}$$

2. One mole of N_2H_4 loses 10 moles of electrons to form a new compound, y. Assuming that all nitrogen appear in the new compound, what is the oxidation state of nitrogen in y (There is no change in the oxidation state of hydrogen)

(A) -1 (B) -3 (C) $+3$ (D) $+5$

3. The reactions

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ and $COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$

are simultaneously in equilibrium in a vessel at constant volume. If some CO is introduced into the vessel then at the new equilibrium

(A) Cl_2 is greater

(B) PCl_5 is less

(C) PCl_3 remain unchanged

(D) PCl_5 is greater

$PCl_5 \downarrow$ $PCl_3 \uparrow$

$COCl_2 \uparrow$ $CO \uparrow$ $Cl_2 \downarrow$

4. Li^{3+} and a proton are accelerated by the same potential, then de-Broglie wavelengths λ_{Li} and λ_p have the ratio (assume $m_{Li} = 9\, m_p$)

(A) $1:3\sqrt{3}$ (B) $1:1$ (C) $1:2$ (D) $1:4$

$$\lambda = \frac{h}{\sqrt{2.m.q.V}}$$

5. A solution of NH_4Cl and NH_3 has $\mathrm{pH} = 8.0$. Which of the following hydroxides may be precipitated when this solution is mixed with equal volume of $0.2\mathrm{M}$ of metal ion.

$[OH^-] = 10^{-6}$

(A) $\mathrm{Ba(OH)_2}\left(K_{sp} = 1.1 \times 10^{-4}\right)$

(B) $\mathrm{Mg(OH)_2}\left(K_{sp} = 3.5 \times 10^{-4}\right)$

(C) $\mathrm{Fe(OH)_2}\left(K_{sp} = 8.1 \times 10^{-16}\right)$

(C) $\mathrm{Ca(OH)_2}\left(K_{sp} = 2.1 \times 10^{-5}\right)$

metal

(A) $0.1\ (10^{-6})^2$

(B) $0.1 \times (10^{-6})^2$

6. $SrCO_3$ (Ksp = 10^{-10}) and $ZnCO_3$ (Ksp = 1.5×10^{-11}) are dissolved together in a solution. The ratio of $[Sr^{2+}]$ / $[Zn^{2+}]$ in the solution is:

(A) $\frac{10}{3}$ (B) $\frac{3}{10}$ (C) $\frac{20}{3}$ (D) $\frac{3}{20}$

7. pH of a weak monoacidic base is 12. What will be concentration of base ($K_b = 10^{-5}$):–

(A) 10 M (B) 0.1 M (C) 0.01 M (D) 0.001 M

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

$[OH^-] = 10^{-2} = x$

$$10^{-5} = K_b = \frac{a^2}{C - x} = \frac{10^{-4}}{C - 10^{-2}}$$

$C - 10^{-2} = 10$

$C = 10$

8. Find pH of solutions containing $0.02\text{MHA}(K_a = 10^{-2}\text{M})$

[Given : $\log 2 = 0.3$]

$$\frac{x^2}{2\times10^{-2}-x} = 10^{-2}$$

$$\frac{x^2}{2\times10^{-2}} = 10^{-2}$$

$$x^2 + 10^{-2}x - 2\times10^{-4} = 0$$

$$x = \frac{-10^{-2} + \sqrt{10^{-4} + 8\times10^{-4}}}{2}$$

$$x = \sqrt{2}\times10^{-2}$$

$$x = 10^{-2}$$

pH = 2

9. If the critical wavelength for producing photoelectric effect is 2000Å. Then what wavelength of light will be required to produce photoelectrons with double the K.E. of those produced by light of wavelength of 1500Å.

$$KE = \frac{hc}{1500} - \frac{hc}{2000}$$

$$2KE = \frac{hc}{\lambda} - \frac{hc}{2000}$$

10. 3.2 moles of hydrogen iodide were heated in a sealed bulb at $444^{\circ}C$ till the equilibrium state was reached. Its degree of dissociation at this temperature was found to be 22% The number of moles of hydrogen iodide present at equilibrium are

0.78×3.2

Nishant Jindal

Effect of hydrolysis on solubility :-

$$MA(s) \longrightarrow \underset{S}{M^+(aq)} + \underset{S-x}{A^-(aq)} \qquad K_{sp} = S(S-x)$$

$$A^- + H_2O \longrightarrow HA + OH^-$$

$S-x$ $\qquad$ x $\qquad$ ~~x~~ 10^{-6}

$$\frac{K_w}{K_a} = \frac{x \cdot 10^{-6}}{S-x}$$

→ in this question pH of the solution will be given. and given pH will be due to a Buffer.

e.g pH = 8 $\quad [OH^-] = 10^{-6} \neq x$

Nishant Jindal

$MA_{(s)} \longrightarrow M^+ + A^-$ $\quad K_{sp} = [M^+][A^-]$ —— ①

$A^- + H_2O \longrightarrow HA + OH^-$ $\quad \frac{K_w}{K_a} = \frac{[HA][OH^-]}{[A^-]}$ —— ②

$[M^+] = S = [A^-] + [HA]$ —— ③

by eq ②

$S = [A^-]\left\{1 + \frac{K_w}{K_a[OH^-]}\right\}$

by eq ①

$K_{sp} = S \cdot \frac{S}{\left\{1 + \frac{K_w}{K_a[OH^-]}\right\}}$

$S = \sqrt{K_{sp}\left[1 + \frac{[H^+]}{K_a}\right]}$

Q.30 J-Adv

pH = 7 pH = 2

$S = 10^{-4}$ 10^{-3}

$$S = \sqrt{K_{sp}\left[1 + \frac{[H^+]}{K_a}\right]}$$

$$10^{-2} = \frac{(10^{-4})^2}{(10^{-3})^2} = \frac{K_{sp}\left[1 + \frac{10^{-7}}{K_a}\right]}{K_{sp}\left[1 + \frac{10^{-2}}{K_a}\right]}$$

$$\frac{10^{-4}}{K_a} = 1 + \frac{10^{-7}}{K_a}$$

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