

16.(D) pH = 1

$$\therefore [H^+] = 10^{-1} = 0.1 \text{ M}$$

$$\text{pH} = 2$$

$$\therefore [H^+] = 10^{-2} = 0.01 \text{ M}$$

For dilution of HCl, $M_1V_1 = M_2V_2$

$$0.1 \times 1 = 0.01 \times V_2$$

$$V_2 = 10 \text{ L}$$

Volume of water to be added $10 - 1 = 9 \text{ L}$

17.(C) $HQ \rightleftharpoons H^+ + Q^-$

$[H^+] = \sqrt{K_a C}$ by Ostwald's dilution law

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

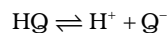
$$C = 0.1 \text{ M}$$

$$\text{Thus, } 10^{-3} = \sqrt{K_a \times 0.1}$$

$$10^{-6} = K_a \times 0.1$$

$$\therefore K_a = 10^{-5}$$

Alternation Method



Initial concentration 0.1 M 0 0

Given, pH = 3. This suggests $[H^+] = 10^{-3} \text{ M}$ at equilibrium = 10^{-3} M .

Hence, $[HQ] = 0.1 \text{ M} - 10^{-3} \text{ M} = 0.1 \text{ M}$ [$10^{-3} \text{ M} \ll 0.1 \text{ M}$]

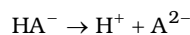
K_a for the above reaction is given by:

$$K_a = \frac{[H^+][Q^-]}{[HQ]} = \frac{[10^{-3}][10^{-3}]}{[0.1]}$$

$$K_a = 1 \times 10^{-5}$$

18.(C) $H_2A \rightleftharpoons HA^- + H^+$

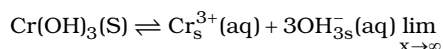
$$\therefore K_1 = 1.0 \times 10^{-5} = \frac{[H^+][HA^-]}{[H_2A]} \text{ (given)}$$



$$\therefore K_2 = 5.0 \times 10^{-10} = \frac{[H^+][A^{2-}]}{[HA^-]} \text{ (given)}$$

$$K = \frac{[H^+]^2[A^{2-}]}{[H_2A]} = K_1 \times K_2 = (1.0 \times 10^{-5}) \times (5 \times 10^{-10}) = 5 \times 10^{-15}$$

19.(C) Let molar solubility of $\text{Cr}(\text{OH})_3 = S \text{ mol L}^{-1}$



$$K_{sp} = 1.6 \times 10^{-30} = [\text{Cr}^{3+}][\text{OH}^-]^3 = (S)(3S)^3 = 27 S^4$$

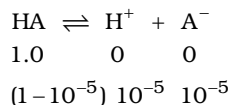
$$\therefore S^4 = \frac{1.6 \times 10^{-30}}{27} \quad \therefore S = \sqrt[4]{\frac{1.6 \times 10^{-30}}{27}}$$

20.(C) The pK_a values of HCO_3^- , H_3O^+ and HSO_4^- are 10.25, -1.74 and 1.92 respectively and HSO_3F is super acid. (iv) > (ii) > (iii) > (i)

21.(A) pH of a solution = 5

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

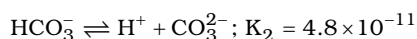
HA (a weak acid) ionizes as



$$K_a \frac{[H^+][A^-]}{[HA]} = \frac{10^{-5} \times 10^{-5}}{(1-10^{-5})} = \frac{10^{-10}}{1} [1 \gg 10^{-5}] = 1 \times 10^{-10} M$$

22.(A) Only in reaction (III), $H_2PO_4^-$ gives H^+ to H_2O . Thus, behaves as an acid.

23.(C) $H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$; $K_1 = 4.2 \times 10^{-7}$



$$K_1 \gg K_2$$

$$\therefore [H^+] = [HCO_3^-]$$

$$K_2 = \frac{[H^+][CO_3^{2-}]}{[HCO_3^-]}$$

$$\text{So, } [CO_3^{2-}] = K_2 = 4.8 \times 10^{-11}$$

24. (B) $[AgBr] = [Ag^+] = 0.05 M$

$$K_{sp}[AgBr] = [Ag^+][Br^-]$$

$$\Rightarrow [Br^-] = \frac{K_{sp}(AgBr)}{[Ag^+]} = \frac{5.0 \times 10^{-13}}{0.05} = 10^{-11} M [mol L^{-1}]$$

$$\text{Moles of KBr needed to precipitate AgBr} = [Br^-] \times V = 10^{-11} \text{ mol } L^{-1} \times 1 L = 10^{-11} \text{ mol}$$

$$\text{Therefore, amount of KBr needed to precipitate AgBr} = 10^{-11} \text{ mol} \times 120 \text{ g mol}^{-1} = 1.2 \times 10^{-9} \text{ g}$$

25. (B) $Mg(OH)_2 \rightleftharpoons Mg^{2+} + 2OH^-$

$$K_{sp} = [Mg^{2+}][OH^-]^2$$

$$[OH^-] = \sqrt{\frac{K_{sp}}{[Mg^{2+}]}} = \sqrt{\frac{1 \times 10^{-11}}{0.001}} = 10^{-4}$$

$$pOH = -\log [OH^-] = -\log [10^{-4}]$$

$$pOH = 4 \quad \therefore \quad pH = 14 - pOH = 14 - 4 = 10$$

26.(D) pH = 1 $\therefore [H^+] = 10^{-1} = 0.1 M$

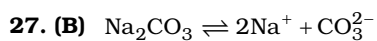
$$pH = 2 \quad \therefore [H^+] = 10^{-2} = 0.01 M$$

For dilution of HCl, $M_1V_1 = M_2V_2$

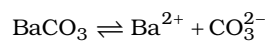
$$0.1 \times 1 = 0.01 \times V_2$$

$$V_2 = 10 L$$

$$\text{Volume of water to be added} = 10 - 1 = 9 L$$



$$[\text{Na}_2\text{CO}_3] = [\text{CO}_3^{2-}] = 1 \times 10^{-4} \text{ M}$$



$$K_{\text{sp}}(\text{BaCO}_3) = [\text{Ba}^{2+}] [\text{CO}_3^{2-}]$$

$$[\text{Ba}^{2+}] = \frac{K_{\text{sp}}(\text{BaCO}_3)}{[\text{CO}_3^{2-}]}$$

$$[\text{Ba}^{2+}] = \frac{5.1 \times 10^{-9}}{1 \times 10^{-4}}$$

$$[\text{Ba}^{2+}] = 5.1 \times 10^{-5} \text{ M}$$

Hence, at 5.1×10^{-5} concentration of Ba^{2+} , a precipitate will begin to form.

28.(C) pH of a salt made up of weak acid and weak base is calculated by using expression

$$\text{pH} = 7 + \frac{1}{2} \text{pK}_a - \frac{1}{2} \text{pK}_b = 7 + \frac{3.2}{2} - \frac{3.4}{2} = 6.9$$

29.(D) CH_3COOK is a salt of a weak acid and a strong base

\therefore Most basic

30.(A) Methyl orange is used for titration of strong acid and weak base.