

$$(1) \quad K_{sp} = (1)^1 (3)^3 S^4 = 27 S^4$$

$$S = \left( \frac{K_{sp}}{27} \right)^{1/4}$$

$$(2) \quad K_a = \frac{x^2}{c-x} = \frac{(10^{-5})^2}{1-10^{-5}} = 10^{-10} \quad (x = [H^+])$$

(3)

for ppt.

$$Q_{sp} > K_{sp}$$

$$Q_{sp} = [Ca^{+2}] [F^-]^2$$

(4)

$$K_a = \frac{x^2}{c-x} = \frac{(10^{-3})^2}{0.1-10^{-3}} = \frac{10^{-6}}{0.1} = 10^{-5}$$

(5)

for dilution,  $M_1 V_1 = M_2 V_2$

$$10^{-1} \times 1 = 10^{-2} \times V_2$$

$$V_2 = 10 L$$

$$\text{Volume of H}_2\text{O added} = V_2 - V_1 = 10 - 1 = 9 L$$

(6)

$$K_{sp} = [Ba^{+2}] [CO_3^{2-}]$$

$$[Ba^{+2}] = \frac{K_{sp}}{[CO_3^{2-}]} = \frac{5.1 \times 10^{-9}}{10^{-4}} = 5.1 \times 10^{-5} M$$

(7)

$$[OH^-] = M = 5 \times 10^{-2}$$

$$pOH = 2 - \log 5 \quad ; \quad pH = 14 - pOH \\ = 12 + \log 5 = 12.70$$

(8)

$$Hg_2Cl_2 \Rightarrow K_{sp} = (1)^1 (2)^2 S^3 = 4 S^3$$

$$Cr_2(SO_4)_3 \Rightarrow K_{sp} = (2)^2 (3)^3 S^5 = 108 S^5$$

$$BaSO_4 \Rightarrow K_{sp} = (1)^1 (1)^1 S^2 = S^2$$

$$CrCl_3 \Rightarrow K_{sp} = (1)^1 (3)^3 S^4 = 27 S^4$$

(9)

$$pH = pK_a + \log\left(\frac{S}{A}\right) \quad (\text{Buffer solution})$$

$$= 4.76 + \log\left(\frac{7.5/82}{(5/60)}\right) = 4.80$$

(10)

Buffer solution resist pH change, so when small amount of acid or base is added pH remain almost same.

(11)

$$K_{sp} = (3)^3 (4)^4 S^7 = 6912 S^7$$

(12)

$$pH = 7 + \frac{1}{2} pK_a - \frac{1}{2} pK_b = 6.9$$

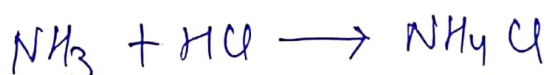
(13)

$$pH = pK_a + \log\left(\frac{S}{A}\right)$$

$$6 = 5 + \log\left(\frac{S}{A}\right) \Rightarrow \log\left(\frac{S}{A}\right) = 1$$

$$\Rightarrow \left(\frac{S}{A}\right) = 10$$

(14)



10

5

-

5

X  
↑ Basic Buffer ↑

5

$$pOH = pK_b + \log\left(\frac{S}{b}\right) = 4.75 + \log\left(\frac{5}{5}\right) = 4.75$$

$$pH = 14 - 4.75 = 9.25$$

(15)  $\text{CH}_3\text{COOK}$  is most basic because it is salt of strong base with weak acid.

(16) Methyl orange is yellow in basic medium while pinkish red in acidic medium.

(17)  $\text{H}_2\text{S}(\text{aq.}) \rightleftharpoons 2\text{H}^+(\text{aq.}) + \text{S}^{2-}(\text{aq.}) : K_{eq} = K_1 \times K_2$

$$K_1 \times K_2 = \frac{[\text{H}^+]^2 [\text{S}^{2-}]}{[\text{H}_2\text{S}]}$$

$$1 \times 10^{-7} \times 1.2 \times 10^{-13} = \frac{(0.2)^2 [\text{S}^{2-}]}{0.1}$$

$$[\text{S}^{2-}] = 3 \times 10^{-20} \text{ M}$$

(18) Let initial concn. of  $\text{Ba}^{+2}$  is  $C_1$  & Volume = 500-50 = 450 ml

when ppt. just begin to form

$$K_{sp} = 1 \times 10^{-10} = [\text{Ba}^{+2}] [\text{SO}_4^{2-}]$$

$$1 \times 10^{-10} = \left[ \frac{C_1 \times 450}{500} \right] \left[ \frac{1 \times 50}{500} \right]$$

$$C_1 = 1.1 \times 10^{-9} \text{ M}$$

$$(19) \quad (i) \quad [H^+] = \frac{\frac{1}{5} \times 75 - \frac{1}{5} \times 25}{100} = 10^{-1} \Rightarrow pH = 1$$

$$(ii) \quad [H^+] = [OH^-] \Rightarrow pH = 7$$

$$(iii) \quad [H^+] = \frac{\frac{1}{10} \times 55 - \frac{1}{10} \times 45}{100} = 10^{-2} \Rightarrow pH = 2$$

$$(iv) \quad [H^+] = \frac{\frac{1}{10} \times 60 - \frac{1}{10} \times 40}{100} = \frac{2}{100} = 2 \times 10^{-2}$$

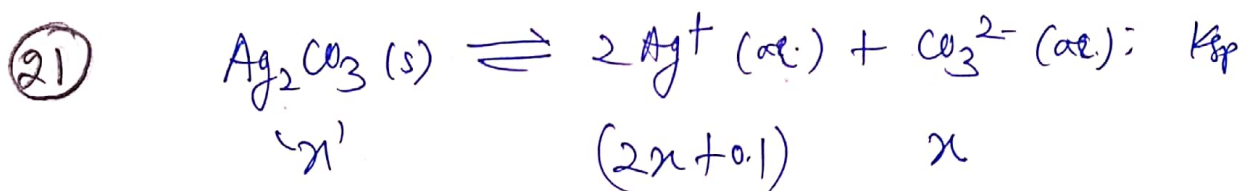
$$pH = 2 - \log 2 = 1.7$$

$$(20) \quad K_{sp} = 4s^3 \Rightarrow s = \left( \frac{K_{sp}}{4} \right)^{1/3} = \left( \frac{3.2 \times 10^{-8}}{4} \right)^{1/3}$$

$$s = 2 \times 10^{-3} \text{ mol/L}$$

$$2 \times 10^{-3} = \frac{\text{moles of PbCl}_2}{V(L)} = \frac{(0.1/278)}{V}$$

$$V = 0.18 L$$



$$\approx 0.1$$

$$K_{sp} = 8 \times 10^{-12} = (0.1)^2 (x)$$

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

(22)

gm equivalent of  $\text{HCl} \equiv \text{Na}_2\text{CO}_3$

$$M \times 25 \times 1 = 30 \times 0.1 \times 2$$

$$M = \frac{6}{25}$$

gm equi. of  $\text{HCl} \equiv \text{NaOH}$

$$\frac{6}{25} \times V = 30 \times 0.2$$

$$V = 25 \text{ ml}$$

(23)



f20 moles

$$\frac{100}{1000} = 0.1$$

(Ppt.)

as  $K_{sp}$  given

$$\frac{2}{143} = 1.4 \times 10^{-2}$$

(L.R.)

(Ppt.)

— ( $K_{sp}$  given) —

finally

x

$1.4 \times 10^{-2}$  moles

$2.8 \times 10^{-2}$  moles

$$\text{mass of } \text{CaSO}_4 = 1.4 \times 10^{-2} \times 136 = 1.9 \text{ gm}$$

$$(\text{OH}^-) = \frac{2.8 \times 10^{-2}}{(100/1000)} = 0.28 \text{ mol/L}$$

(24)

OH<sup>-</sup> are only due to NaOH, as  $\text{Ca(OH)}_2$  is ppt.

(24)

Theory based

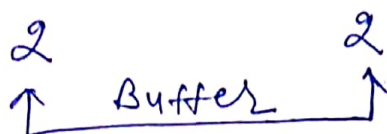




$$20 \times 0.1 = 2 \quad 30 \times 0.2 = 6$$

(L.R.)

X



$$\text{NH}_4^+ = 2 \times (\text{NH}_4)_2\text{SO}_4$$

$$\text{pOH} = \text{pK}_b + \log \left( \frac{\text{S/B}}{2} \right) = 4.7 + \log \left( \frac{2 \times 2}{2} \right) = 5$$

$$\text{pH} = 14 - \text{pOH} = 14 - 5 = 9$$

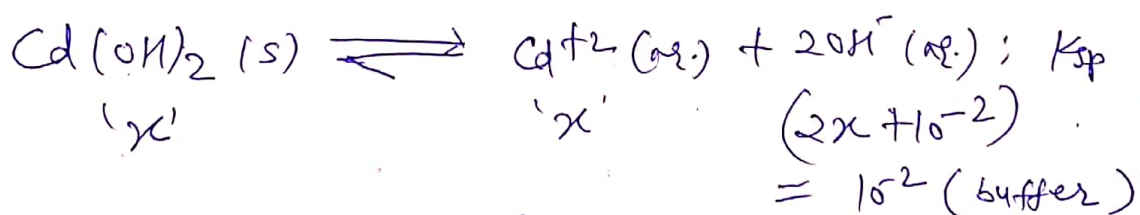
(26)  $K_{sp} = (3)^3 (4)^4 5^7 = 6912 5^7$

(27) When HCl is added to NaOH, first pH decrease slowly but near the equivalence point sudden change (decrease) is observed.

(28) 
$$\text{pH} = 7 - \frac{1}{2} \text{pK}_b - \frac{1}{2} \log c$$

$$= 7 - \frac{1}{2} \times 5 - \frac{1}{2} \log (2 \times 10^{-2}) = 5.35$$

(29)  $K_{sp} = 4s^3 = 4 \times (1.84 \times 10^{-5})^3$



$$K_{sp} = 4 \times (1.84 \times 10^{-3})^3 = x (10^{-2})^2$$

$$x = 2.49 \times 10^{-10} \text{ M}$$