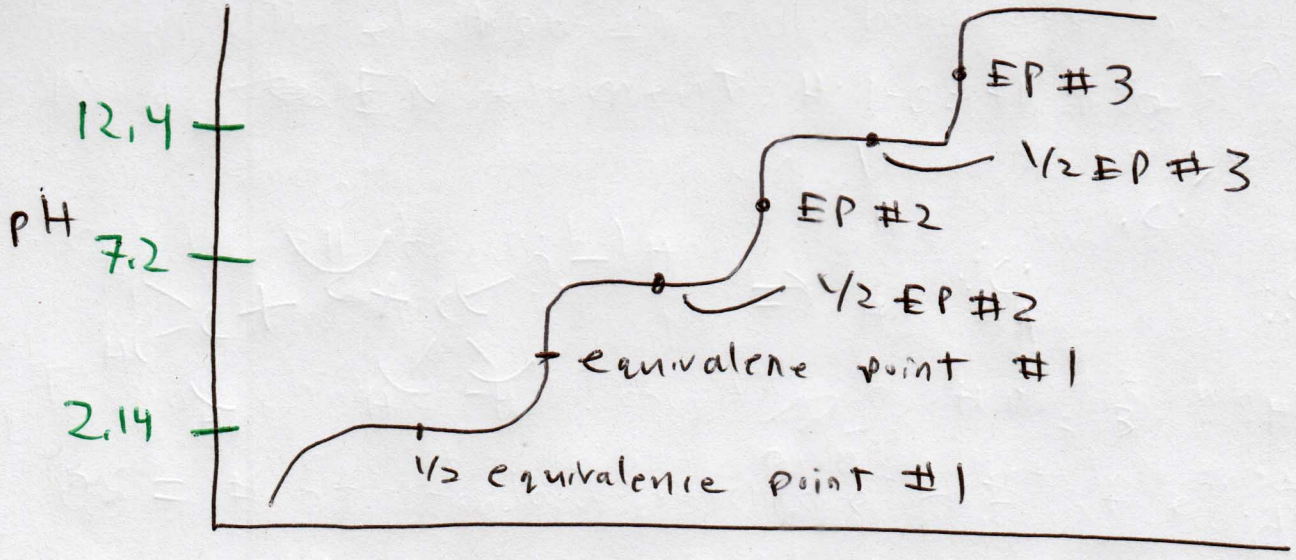
$H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^- \rightleftharpoons 2H^+ + HPO_4^{-2} \rightleftharpoons 3H^+ + PO_4^{-3}$

$K_{a_1} = 7.2 \times 10^{-3}$ $K_{a_2} = 6.3 \times 10^{-8}$ $K_{a_3} = 4.2 \times 10^{-13}$



NaH_2PO_4 + Na_2HPO_4

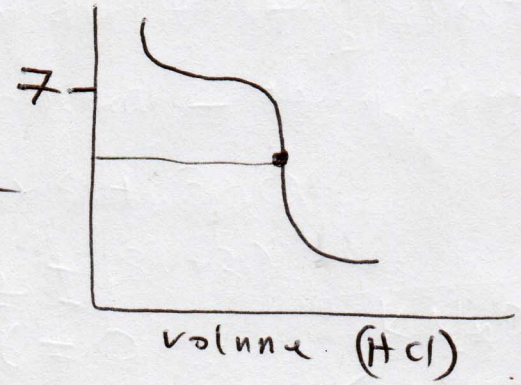
since this is the acid, the Ka value used should be K_{a_2}

K_{a_3} is not used because Na_2HPO_4 is not dissociating

→ bromocresol green $K_a = 1.6 \times 10^{-5}$ pKa 4.8
bromothymol blue 1.0×10^{-7} 7.0
phenolphthalein 5.0×10^{-10} 9.3

Indicators change color when the pH = pKa of the indicator

Since the titration of a weak base with a strong acid produces an acidic solution, an indicator with pKa < 7 is needed.



	Ka	pKa
CH_3COOH	1.76×10^{-5}	4.76
NaH_2PO_4	6.3×10^{-8}	7.2
→ $NaHCO_3$	4.7×10^{-4}	10.3

The ideal pH of a buffer soln is when the pH = pKa of the acid. Since soln pH is 10.00, it is closest to the pKa of $NaHCO_3$, so $NaHCO_3$ is the best choice of soln.

$$pH = pK_a + \log_{10}\frac{[A^-]}{[HA]}$$

$$10.00 = 10.3 + \log_{10}\frac{[A^-]}{[HA]}$$

$$\log_{10}\frac{[A^-]}{[HA]} = -0.3$$

$$\frac{[A^-]}{[HA]} = 10^{-0.3} = 0.501 \approx 0.50$$

$$[A^-] \approx 0.50[HA]$$

$$n_{A^-} = [HA^\bullet](0.5)(0.50) = (1)(0.5)(0.5) = 0.25\ \text{mol}$$

$$\frac{[H^+]}{[HA]} = \frac{\text{mol } A^-}{\text{mol } HA} = 10^{-0.3}$$

$$\log\left(\frac{x}{y}\right) = \log x - \log y$$

$$10^{(\log x - \log y)} = 10^{-0.3} \qquad x - y = 10^{-0.3}$$

$$10^{\log x}\cdot 10^{-\log y} = 10^{\log x} \div 10^{\log y} = x/y$$

HNO_2 $K_a = 7.1\times10^{-4}$ 0.6M HNO_2 + 0.4M $NaNO_2$

$$pH = pK_a + \log_{10}\frac{[A^-]}{[HA]} = 3.15 + \log_{10}\frac{0.4}{0.6}$$

$$= 3.15 - 0.18 = 2.97$$

$$\text{mol } HNO_2 = (0.200\text{L})(0.600\text{M}) + (0.0015\text{L})(12.0\text{M})$$

$$= .12\ \text{mol} + .018\ \text{mol} = .138\ \text{mol } HNO_2$$

$$\text{mol } NaNO_2 = (0.200\text{L})(0.400\text{M}) - (.0015\text{L})(12.0\text{M})$$

$$= .08\ \text{mol} - .018\ \text{mol} = .062\ \text{mol } NO_2$$

$$pH = pK_a + \log_{10}\frac{[A^-]}{[HA]} \Rightarrow pK_a + \log_{10}\frac{\text{mol } A^-}{\text{mol } HA}$$

$$= 3.15 + \log_{10}\frac{.062 \text{ mol } A^-}{.132 \text{ mol } HA}$$

$$= 3.15 + -.35 = 2.80$$

$Cu(NO_3)_2$ $Ni(NO_3)_2$ Na_2S

8×10^{-34} 3×10^{-16}

~~$K_{sp} = [M^{+2}][NO_3^-]^2$~~

CuS NiS

$K_{sp} = [M^{+2}][S^{-2}]$

precipitation occurs when $Q_{sp} > K_{sp}$

$K_{sp}(NiS) >> K_{sp}(CuS)$

$\therefore$ CuS will precipitate first