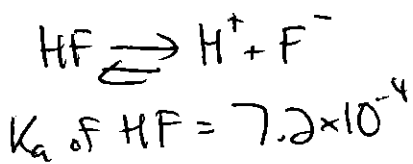


p. 397 #14, 17, 20, 25

$$K_a = \frac{[H^+][F^-]}{[HF]}$$

- (14) .037 mol KF = mol F⁻
135 mL of 0.037 M HF
pH = ?



$$[H^+] = K_a \left(\frac{[HF]}{[F^-]} \right) = (7.2 \times 10^{-4}) \left(\frac{.135 L \times .037 M}{.037 \text{ mol}} \right) = 6.23 \times 10^{-5}$$

$$pH = -\log(6.23 \times 10^{-5}) = \boxed{4.21}$$

- (17) NaHCO₃ / Na₂CO₃ buffer pH = 9.40

K_a of HCO₃⁻ = 5.6 × 10⁻¹¹

$$[H^+] = 10^{-9.40} = 3.98 \times 10^{-10} \text{ M}$$

a) $[H^+] = K_a \left(\frac{[HCO_3^-]}{[CO_3^{2-}]} \right)$ $\left(\frac{[HCO_3^-]}{[CO_3^{2-}]} \right) = \frac{[H^+]}{K_a} = \frac{3.98 \times 10^{-10} \text{ M}}{5.6 \times 10^{-11}} = \boxed{\frac{7.11}{1}}$

b) .225 M Na₂CO₃ × 1 L = .225 mol Na₂CO₃ = .225 mol CO₃²⁻

$$[HCO_3^-] = (7.11) \times .225 \text{ moles} = \boxed{1.60 \text{ moles HCO}_3^- \text{ is needed}}$$

c) .475 L × .336 M NaHCO₃ = .1596 moles NaHCO₃ = .1596 moles HCO₃⁻

$$\frac{.1596 \text{ moles HCO}_3^-}{x \text{ moles CO}_3^{2-}} = 7.11$$

$$.0224 \text{ moles CO}_3^{2-} = .0224 \text{ moles} \times \left(\frac{106 \text{ g}}{\text{mole}} \right) = \boxed{2.48 \text{ g Na}_2\text{CO}_3}$$

d) .735 L of .139 M Na₂CO₃ = .102 moles Na₂CO₃ = .102 mol CO₃²⁻

$$\frac{x \text{ moles HCO}_3^-}{.102 \text{ mol CO}_3^{2-}} = 7.11$$

$$.726 \text{ moles HCO}_3^- \left(\frac{1 \text{ L}}{.200 \text{ mol}} \right) = 3.63 \text{ L CO}_3^-$$

20 a) 5.50 g NH_4Cl
 .0188 mol NH_3
 .155 L of Solution



$$K_a = 5.6 \times 10^{-10}$$

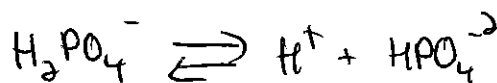
$$5.50 \text{ g } \text{NH}_4\text{Cl} \left(\frac{1 \text{ mole } \text{NH}_4^+}{53.5 \text{ g}} \right) \left(\frac{1 \text{ mole } \text{NH}_4^+}{1 \text{ mole } \text{NH}_4\text{Cl}} \right) = .103 \text{ mol } \text{NH}_4^+$$

$$[\text{H}^+] = K_a \left(\frac{[\text{NH}_4^+]}{[\text{NH}_3]} \right) = 5.6 \times 10^{-10} \left(\frac{.103 \text{ mol}}{.0188 \text{ mol}} \right) = 3.06 \times 10^{-9}$$

$$\boxed{\text{pH} = 8.51}$$

b) Buffer would have same pH as in (a) because Buffers do not rely on the volume of solution.

25 .500 M KH_2PO_4
 .317 M K_2HPO_4
 $K_a = 6.2 \times 10^{-8}$



$$K_a = \frac{[\text{H}^+][\text{HPO}_4^{2-}]}{[\text{H}_2\text{PO}_4^-]}$$

$$[\text{H}^+] = K_a \left(\frac{[\text{H}_2\text{PO}_4^-]}{[\text{HPO}_4^{2-}]} \right)$$

$$\text{a) } [\text{H}^+] = 6.2 \times 10^{-8} \left(\frac{.500 \text{ M}}{.317 \text{ M}} \right) = 9.78 \times 10^{-8} \quad \boxed{\text{pH} = 7.00}$$

b) moles acid = .500 M + .0833 M = .5833 M HA
 $\frac{.05}{.60} = \frac{.0833 \text{ M}}{.0833 \text{ M}}$ moles base = .317 - .0833 M = .2336 M B

$$[\text{H}^+] = 6.2 \times 10^{-8} \left(\frac{.5833}{.2336} \right) = 1.55 \times 10^{-7}$$

$$\boxed{\text{pH} = 6.81}$$

c) $\frac{.05 \text{ mol}}{.6 \text{ L}} = .0833 \text{ M}$

moles acid = .500 M - .0833 M = .4167 M
 moles base = .317 + .0833 M = .4003 M

$$[\text{H}^+] = 6.2 \times 10^{-8} \left(\frac{.4167 \text{ M}}{.4003 \text{ M}} \right) = 6.45 \times 10^{-8}$$

$$\boxed{\text{pH} = 7.19}$$