

Group Quiz#2, (given on 2/11/05) Titration problem:

It takes 23.50 mLs of .025 M NaOH to completely neutralize 50.0 mL of phosphoric acid,  $\text{H}_3\text{PO}_4$ , of unknown concentration.

First of all, write the balanced equation:



a) What is the concentration of  $\text{H}_3\text{PO}_4$  ?  **$3.92 \times 10^{-3} \text{M}$**

solution: (refer to balanced equation)

at equivalence point: # mol  $\text{H}^+$  = # mol  $\text{OH}^-$

or,  $3 \times \text{#mol } \text{H}_3\text{PO}_4 = \text{#mol NaOH}$

or,  $3 M_1 V_1 = M_2 V_2$  (where "1" =  $\text{H}_3\text{PO}_4$  and "2" = NaOH)

or,  $M_1 = (1/3)(M_2 V_2 / V_1) = (1/3)(.025\text{M})(23.50\text{mL}) / (50.00\text{mL}) = \mathbf{3.92 \times 10^{-3} \text{M } \text{H}_3\text{PO}_4}$ .

b) What is the concentration of NaOH in the resulting solution if you added a total of 30.0 mLs of NaOH to the solution?  **$2.03 \times 10^{-3} \text{M}$**

Solution: Note that an excess amount of NaOH has been added. To get [NaOH], need to determine the excess moles of NaOH and divide that by the total volume. (the total volume =  $50.0\text{mL} + 30.0 \text{mL}$ ).

excess moles NaOH = Total mol NaOH added – mol NaOH used up  
(note that mol NaOH used = mol NaOH at equivalence. )

x's mmol NaOH =  $M_{\text{NaOH}} V_{\text{NaOH}} = (.025\text{M})(30.0\text{mL}) - (.025\text{M})(23.5\text{mL}) = 0.1625 \text{ mmol NaOH}$

$[\text{NaOH}] = 0.1625 \text{ mmol NaOH} / (50.0 \text{ mL} + 30.0 \text{ mL}) = 0.00203 \text{ mmol/mL} = \mathbf{2.03 \times 10^{-3} \text{M NaOH}}$ .