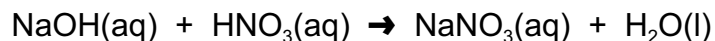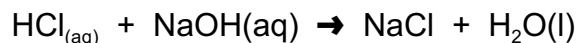## Acid-Base Stoichiometry

1. 17.85 mL of nitric acid is needed to neutralize 25.00 mL of 0.150 mol/L NaOH(aq). Calculate the concentration of the nitric acid? *(0.210 mol/L)*
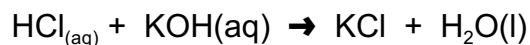
    $NaOH(aq)$ + $HNO_3(aq)$ → $NaNO_3(aq)$ + $H_2O(l)$

2. What volume of 0.150 mol/L $HCl_{(aq)}$ is needed to neutralize each solution below?

a) 25.0 mL of 0.135 mol/L sodium hydroxide *(22.5 mL)*

    $HCl_{(aq)}$ + $NaOH(aq)$ → $NaCl$ + $H_2O(l)$

b) 20.0 mL of 0.185 mol/L KOH solution *(24.7 mL)*

    $HCl_{(aq)}$ + $KOH(aq)$ → KCl + $H_2O(l)$

c) 80 mL of 0.0045 mol/L calcium hydroxide *(4.8 mL)*

    $2\ HCl_{(aq)}$ + $Ca(OH)_2(aq)$ → $CaCl_2(aq)$ + $2\ H_2O(l)$
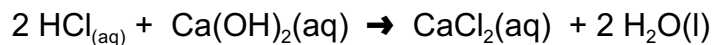
3.   What volume of 1.015 mol/L magnesium hydroxide is needed to neutralize 40.0 mL of 1.60 mol/L hydrochloric acid? *(31.5 mL)*

2 $HCl_{(aq)}$ + $Mg(OH)_2(aq)$ ➜ $MgCl_2(aq)$ + 2 $H_2O(l)$
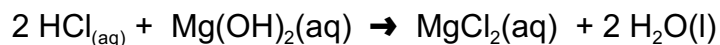
4.   What concentration of $NaOH_{(aq)}$ solution is needed for each neutralization reaction?

a)   37.82 mL of sodium hydroxide neutralizes 15.00 mL of 0.250 mol/L hydrofluoric acid.

$NaOH(aq)$ + $HF(aq)$ ➜ $NaF(aq)$ + $H_2O(l)$ *(0.0992 mol/L)*

b)   21.56 mL of sodium hydroxide neutralizes 20.00 mL of 0.145 mol/L sulfuric acid.

                                                                                (0.268 mol/L)

$H_2SO_4(aq)$ + 2 $NaOH(aq)$ ➜ $Na_2SO_4(aq)$ + 2 $H_2O(l)$

c)   14.27 mL of sodium hydroxide neutralizes 25.00 mL of 0.105 mol/L phosphoric acid.

                                                                                (0.552 mol/L)

$H_3PO_4(aq)$ + 3 $NaOH$ ➜ 3 $H_2O(l)$ + $Na_3PO_4(aq)$