Name:________________

Titration Test

1. Determine the concentration of 500 mL of HCl solution if neutralization can be achieved by 43.2 mL of 0.5 M KOH

$HCl + KOH \rightarrow KCl + H_2O$

$n_A = n_B$ $C_A = 0.0432$ M

$C_AV_A = C_BV_B$

$C_A = \frac{C_BV_B}{V_A}$

$C_A = \frac{0.5 \text{ mol/L} \times 0.0432 \text{ L}}{0.500 \text{ L}}$

2. Determine the concentration of 250 mL of H_3BO_3 solution if neutralization can be achieved by the addition of 2.22 g of Na_2CO_3 (s).

$2H_3BO_3 + 3Na_2CO_3 \rightarrow 2Na_3BO_3 + 3H_2CO_3$

$3n_A = 2n_B$ $2.22 \text{ g} \times \frac{1 \text{ mol}}{105.99 \text{ g}} = 0.02095 \text{ mol } Na_2CO_3$

$3C_AV_A = 2n_B$

$C_A = \frac{2n_B}{3V_A}$

$C_A = \frac{2 \times 0.02095 \text{ mol}}{3 \times 0.250 \text{ L}}$

$C_A = 0.05585$ M

3. What is the difference between the endpoint of a titration and the equivalence point of a titration.

endpoint - indicator changes colour (observation)

equivalence point - stoichiometric point of neutrality (calculation)

careful choice of indicator will result in good agreement

4. 20.0 g of a diprotic base is carefully neutralized by acetic acid (CH_3COOH). 298.5 mL of 1.0 M acetic acid is required to achieve neutralization. Use this information to determine the molar mass of the base. Now given your answer, which of the following bases could be the base in this question. (Na_2SO_4, K_2CO_3, $Na_2C_2O_4$, $Ba(OH)_2$, $Al(OH_3)$)

$$n_A = 2n_B$$

$$C_AV_A = 2n_B$$

$$n_B = \frac{C_AV_A}{2}$$

$$n_B = \frac{1.0\text{ mol/L} \times 0.2985\text{ L}}{2}$$

$$n_B = 0.14925\text{ mol}$$

$$\frac{20.0\text{ g}}{0.14925\text{ mol}} = 134.00\text{ g/mol}$$

therefore $Na_2C_2O_4$ is the base

5. Grayden and Jerry are messing about in the lab one day and accidentally brake a full bottle (2.5 L) of 18.0 M concentrated sulphuric acid (H_2SO_4). Not quite sure what to do, Grayden quickly stirs in a 5.75 kg bag of potassium hydroxide (KOH) in the hopes of neutralizing this mess. According to Jerry's calculations, this is to much base, so he quickly adds 2.5 L of concentrated 12.1 M HCl. After the fire department and the ambulance have left, you are now faced with the job of neutralization. What mass in kg of $NaHCO_3$ (a monoprotic base) must be added to achieve true neutralization.

$$2n_A^{H_2SO_4} + n_A^{HCl} = n_B^{KOH} + n_B^{NaHCO_3}$$

$$2C_A^{H_2SO_4}V_A^{H_2SO_4} + C_A^{HCl}V_A^{HCl} = n_B^{KOH} + n_B^{NaHCO_3}$$

$$n_B^{NaHCO_3} = 2C_A^{H_2SO_4}V_A^{H_2SO_4} + C_A^{HCl}V_A^{HCl} - n_B^{KOH}$$

$$n_B^{NaHCO_3} = 2 \times 18.0\ \text{mol}/\text{L} \times 2.5\text{ L} + 12.1\ \text{mol}/\text{L} \times 2.5\text{ L} - 5750\text{ g} \times \frac{1\text{ mol}}{56.11\text{ g}}$$

$$n_B^{NaHCO_3} = 17.77\text{ mol}$$

$$17.77\text{ mol} \times \frac{84.01\text{ g}}{1\text{ mol}} = 1493.09\text{ g or } 1.493\text{ kg}$$