Titration Problems:
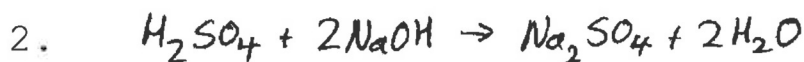
1. $HCl + NaOH \rightarrow NaCl + H_2O$

$$n_A = n_B$$
$$C_A V_A = C_B V_B$$
$$V_B = \frac{C_A V_A}{C_B}$$

$$V_B = \frac{50.0 \text{mL} \times 0.100 \text{ M}}{0.200 \text{ M}}$$

$$V_B = 25 \text{mL}$$

2. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

$$2n_A = n_B$$
$$2C_A V_A = C_B V_B$$
$$C_A = \frac{C_B V_B}{2V_A}$$

$$C_A = \frac{0.100 \text{ M} \times 45.0 \text{mL}}{2 \times 25.0 \text{mL}}$$

$$C_A = 0.09 \text{ M}$$

3. $Ba(OH)_2 + 2HCl \rightarrow BaCl_2 + 2H_2O$
$KOH + HCl \rightarrow KCl + H_2O$

$$n_A = 2n_B^{Ba(OH)_2} + n_B^{KOH}$$

$$C_A V_A = 2n_B^{Ba(OH)_2} + n_B^{KOH}$$
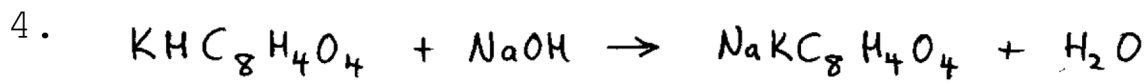
$$V_A = \frac{2n_B^{Ba(OH)_2} + n_B^{KOH}}{C_A}$$

$$V_A = \frac{2(1.080 \times 10^{-4} \text{mol}) + 7.619 \times 10^{-3} \text{mol}}{0.5 \text{ M}}$$

$$V_A = 0.0157 \text{L}$$

$$V_A = 15.7 \text{ mL}$$

$$n_B^{Ba(OH)_2} : \frac{0.0370 g}{2} \times \frac{1 \text{mol}}{171.35 g} = 1.080 \times 10^{-4} \text{ mol}$$

$$n_B^{KOH} : \frac{0.855 g}{2} \times \frac{1 \text{mol}}{56.11 g} = 7.619 \times 10^{-3} \text{ mol}$$

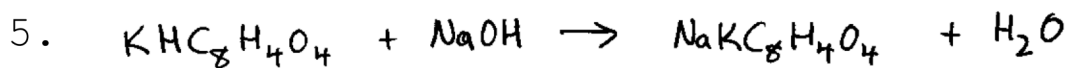4. $KHC_8H_4O_4 + NaOH \rightarrow NaKC_8H_4O_4 + H_2O$

$$n_A = n_B$$

$$n_A = C_B V_B$$

$$C_B = \frac{n_A}{V_B}$$

$$C_B = \frac{0.00539 \text{ mol}}{0.0322 \text{ L}}$$

$$C_B = 0.167 \text{ M}$$

$$n_A: \quad 1.10g \times \frac{1 \text{ mol}}{204.23 g} = 0.00539 \text{ mol}$$
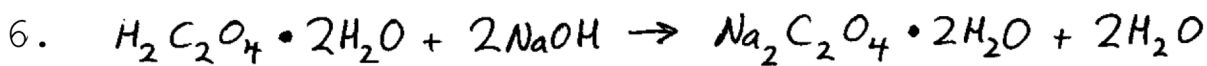

5. $KHC_8H_4O_4 + NaOH \rightarrow NaKC_8H_4O_4 + H_2O$

$$n_A = n_B$$

$$n_A = C_B V_B$$

$$n_A = 0.1 M \times 0.025 L$$

$$n_A = 0.0025 \text{ mol}$$

$$0.0025 \text{ mol} \times \frac{204.23 g}{1 \text{ mol}} = 0.511g$$

$$\frac{0.511g}{1.00g} \times 100\% = 51.1\%$$

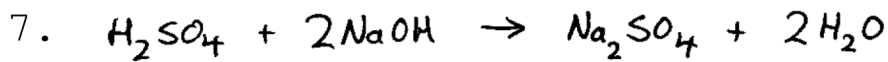6. $H_2C_2O_4 \cdot 2H_2O + 2NaOH \rightarrow Na_2C_2O_4 \cdot 2H_2O + 2H_2O$

$$2n_A = n_B$$

$$2n_A = C_B V_B$$

$$V_B = \frac{2n_A}{C_B}$$

$$V_B = \frac{2 \times 3.172 \times 10^{-3} \text{ mol}}{0.1 M}$$

$$V_B = 0.0634 L$$

$$V_B = 63.4 mL$$

$$n_A: \quad 0.400g \times \frac{1 \text{ mol}}{126.10 g} = 3.172 \times 10^{-3} \text{ mol}$$

7. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

$$2n_A = n_B$$

$$2C_A V_A = n_B$$

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

$$V_A = \frac{0.8\,mol}{2 \times 1.5\,M}$$

$$V_A = 0.266.\dot{6}\,L$$

$$V_A = 267\,mL$$

$$n_B: \quad 32.0g \times \frac{1\,mol}{40.00g} = 0.8\,mol$$

8. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$
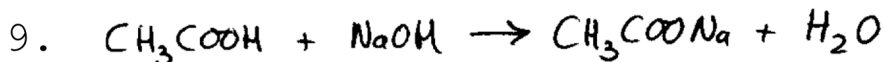
$$2n_A = n_B$$

$$2C_A V_A = C_B V_B$$

$$V_A = \frac{C_B V_B}{2C_A}$$

$$V_A = \frac{0.04\,M \times 20.0\,mL}{2 \times 0.02\,M}$$

$$V_A = 20\,mL$$

9. $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

$$n_A = n_B$$

$$n_A = C_B V_B$$

$$n_A = 0.3460\,M \times 0.04240\,L$$

$$n_A = 0.01467\,mol$$

$$0.01467\,mol \times \frac{60.06g}{1\,mol} = 0.8811g \quad (mass\ of\ CH_3COOH)$$

$$15.20\,mL \times \frac{1.060g}{1\,ml} = 16.112g \quad (mass\ of\ 15.20\,ml\ of\ solution)$$

$$\frac{0.8811g}{16.112g} \times 100\% = 5.469\%$$