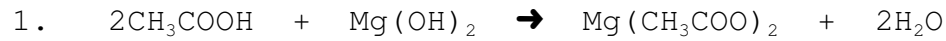


Answers:



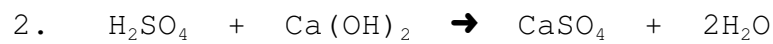
$$n_A = 2n_B$$

$$C_A V_A = 2C_B V_B$$

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

$$C_A = \frac{2 \times 0.468 \text{ mol/L} \times 67.0 \text{ mL}}{50.0 \text{ mL}}$$

$$C_A = 1.25 \text{ M CH}_3\text{COOH}$$



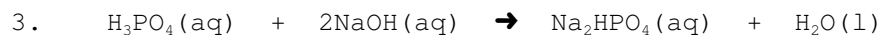
$$2n_A = 2n_B$$

$$2C_A V_A = 2C_B V_B$$

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

$$C_A = \frac{2 \times 0.560 \text{ mol/L} \times 24.5 \text{ mL}}{2 \times 10.0 \text{ mL}}$$

$$C_A = 1.372 \text{ M H}_2\text{SO}_4$$



Note that "to achieve the second endpoint means that the first and second proton only have been removed from the acid. The third proton remains intact. When titrating any polyprotic substance the proton removal, etc. is always sequential. This means that the phosphoric acid is treated as diprotic in this case!

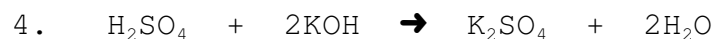
$$2n_A = n_B$$

$$2C_A V_A = C_B V_B$$

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

$$V_B = \frac{2 \times 0.075 \text{ mol/L} \times 25.0 \text{ mL}}{0.060 \text{ mol/L}}$$

$$V_B = 62.5 \text{ mL NaOH}$$



First determine the average volume of KOH required for titration of 20.0 mL aliquots.

$$V_T = \frac{V_1 + V_2 + V_3}{3}$$

$$V_T = \frac{23.0 \text{ mL} + 24.0 \text{ mL} + 23.5 \text{ mL}}{3}$$

$$V_T = 23.5 \text{ mL NaOH}$$

Then!!

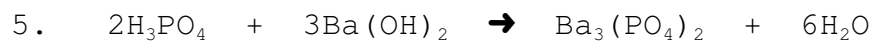
$$2n_A = n_B$$

$$2C_A V_A = C_B V_B$$

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

$$C_A = \frac{0.100 \text{ mol/L} \times 23.5 \text{ mL}}{2 \times 20.0 \text{ mL}}$$

$$C_A = 0.05875 \text{ M H}_2\text{SO}_4$$



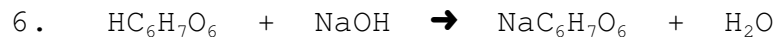
$$3n_A = 2n_B$$

$$3C_A V_A = 2C_B V_B$$

$$C_A = \frac{2C_B V_B}{3V_A}$$

$$C_A = \frac{2 \times 0.560 \text{ mol/L} \times 76.00 \text{ mL}}{3 \times 25.0 \text{ mL}}$$

$$C_A = 1.135 \text{ M H}_3\text{PO}_4$$



$$n_A = n_B$$

$$n_A = C_B V_B$$

$$n_A = 0.200 \text{ mol/L} \times 0.046 \text{ L}$$

$$n_A = 0.00920 \text{ mol HC}_6\text{H}_7\text{O}_6$$

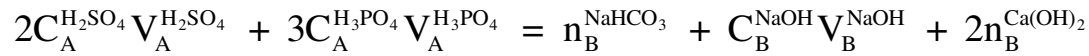
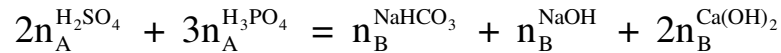
$$0.00920 \text{ mol HC}_6\text{H}_7\text{O}_6 \times \frac{176.13 \text{ g HC}_6\text{H}_7\text{O}_6}{1 \text{ mol HC}_6\text{H}_7\text{O}_6} = 1.62 \text{ g HC}_6\text{H}_7\text{O}_6$$

$$\% \text{ purity} = \frac{\text{pure mass}}{\text{impure sample mass}} \times 100 \%$$

$$\% \text{ purity} = \frac{1.62 \text{ g}}{2.06 \text{ g}} \times 100 \%$$

$$\% \text{ purity} = 78.6 \%$$

7. Cannot write a neutralization reaction for a multi-component problem!



$$n_B^{\text{NaHCO}_3} = [2C_A^{\text{H}_2\text{SO}_4} V_A^{\text{H}_2\text{SO}_4} + 3C_A^{\text{H}_3\text{PO}_4} V_A^{\text{H}_3\text{PO}_4}] - [C_B^{\text{NaOH}} V_B^{\text{NaOH}} + 2n_B^{\text{Ca(OH)}_2}]$$

$$n_B^{\text{NaHCO}_3} = 2C_A^{\text{H}_2\text{SO}_4} V_A^{\text{H}_2\text{SO}_4} + 3C_A^{\text{H}_3\text{PO}_4} V_A^{\text{H}_3\text{PO}_4} - C_B^{\text{NaOH}} V_B^{\text{NaOH}} - 2n_B^{\text{Ca(OH)}_2}$$

$$\begin{aligned} n_B^{\text{NaHCO}_3} &= (2 \times 18.0 \text{ mol/L} \times 0.025 \text{ L}) + (3 \times 14.8 \text{ mol/L} \times 0.050 \text{ L}) \\ &\quad - (6.0 \text{ mol/L} \times 0.125 \text{ L}) - \left(2 \times 12.5 \text{ g Ca(OH)}_2 \times \frac{1 \text{ mol Ca(OH)}_2}{74.09 \text{ g Ca(OH)}_2} \right) \end{aligned}$$

$$n_B^{\text{NaHCO}_3} = 2.033 \text{ mol NaHCO}_3$$

$$2.033 \text{ mol NaHCO}_3 \times \frac{84.01 \text{ g NaHCO}_3}{1 \text{ mol NaHCO}_3} = 171 \text{ g NaHCO}_3$$