

$$1. \quad (a) \quad \text{mol of FeCl}_3 = 11.4 \text{ g FeCl}_3 \times \frac{1 \text{ mol FeCl}_3}{162.2 \text{ g FeCl}_3} = 0.07028 \text{ mol FeCl}_3$$

$$\text{mL of soln} = 0.07028 \text{ mol FeCl}_3 \times \frac{1000 \text{ mL}}{1.025 \text{ mol FeCl}_3} = 68.6 \text{ mL}$$

$$(b) \quad \text{mol FeCl}_3 = 555 \text{ mL} \times \frac{1.025 \text{ mol FeCl}_3}{1000 \text{ mL}} = 0.569 \text{ mol FeCl}_3$$

$$(c) \quad \text{mol FeCl}_3 = 125 \text{ mL} \times \frac{1.025 \text{ mol FeCl}_3}{1000 \text{ mL}} = 0.1281 \text{ mol FeCl}_3$$

$$\text{mol Cl}^- = 0.1281 \text{ mol FeCl}_3 \times \frac{3 \text{ mol Cl}^-}{1 \text{ mol FeCl}_3} = 0.384 \text{ mol Cl}^-$$

$$(d) \quad \text{mol FeCl}_3 = 1.65 \text{ L} \times \frac{1.025 \text{ mol FeCl}_3}{1 \text{ L}} = 1.691 \text{ mol FeCl}_3$$

$$\text{grams FeCl}_3 = 1.691 \text{ mol FeCl}_3 \times \frac{162.2 \text{ g FeCl}_3}{1 \text{ mol FeCl}_3} = 274 \text{ g FeCl}_3$$

$$(e) \quad M_o V_o = M_d V_d \quad V_d = (25.0 + 125.0) \text{ mL} = 150.0 \text{ mL}$$

$$M_d = \frac{1.025 \text{ M} \times 25.0 \text{ mL}}{150.0 \text{ mL}} = 0.171 \text{ M}$$

$$(f) \quad V_o = \frac{0.0925 \text{ M} \times 500.0 \text{ mL}}{1.025 \text{ M}} = 45.1 \text{ mL}$$

$$(g) \quad M_{\text{resulting solution}} = \frac{n_{\text{total}}}{V_{\text{total}}(\text{L})}$$

$$n_{\text{total}} = n_{\text{solution 1}} + n_{\text{solution 2}}$$

$$= 75.0 \text{ mL} \times \frac{1.025 \text{ mol}}{1000 \text{ mL}} + 50.0 \text{ mL} \times \frac{1.875 \text{ mol}}{1000 \text{ mL}}$$

$$= (0.076875 + 0.09375) \text{ mol} = 0.17063 \text{ mol}$$

$$V_{\text{total}} = 75.0 \text{ mL} + 50.0 \text{ mL} = 125.0 \text{ mL} = 0.1250 \text{ L}$$

$$M_{\text{resulting solution}} = \frac{0.17063 \text{ mol}}{0.1250 \text{ L}} = 1.365 \text{ M}$$

2. (a) $\text{mol Fe(OH)}_3 = 1.38 \text{ g Fe(OH)}_3 \times \frac{1 \text{ mol Fe(OH)}_3}{106.9 \text{ g Fe(OH)}_3} = 0.01291 \text{ mol Fe(OH)}_3$

$$\text{mol FeCl}_3 = \text{mol Fe(OH)}_3 = 0.01291 \text{ mol}$$

$$\text{mL FeCl}_3 = 0.01291 \text{ mol FeCl}_3 \times \frac{1000 \text{ mL FeCl}_3}{0.1189 \text{ mol FeCl}_3} = 109 \text{ mL FeCl}_3$$

(b) $\text{mol FeCl}_3 = 25.0 \text{ mL} \times \frac{0.1189 \text{ mol FeCl}_3}{1000 \text{ mL FeCl}_3} = 0.002973 \text{ mol FeCl}_3$

$$\text{mol KOH} = 0.002973 \text{ mol FeCl}_3 \times \frac{3 \text{ mol KOH}}{1 \text{ mol FeCl}_3} = 0.008919 \text{ mol KOH}$$

$$\text{mL KOH} = 0.008919 \text{ mol KOH} \times \frac{1000 \text{ mL KOH}}{0.205 \text{ mol KOH}} = 43.5 \text{ mL KOH}$$

(c) $\text{mol KOH} = 0.184 \text{ g KOH} \times \frac{1 \text{ mol KOH}}{56.1 \text{ g KOH}} = 0.003280 \text{ mol KOH}$

$$\text{mol FeCl}_3 = 0.003280 \text{ mol KOH} \times \frac{1 \text{ mol FeCl}_3}{3 \text{ mol KOH}} = 0.001093 \text{ mol FeCl}_3$$

$$\text{mL FeCl}_3 = 0.001093 \text{ mol FeCl}_3 \times \frac{1000 \text{ mL FeCl}_3}{0.1189 \text{ mol FeCl}_3} = 9.19 \text{ mL FeCl}_3$$

(d) $\text{g of KOH} = 0.265 \text{ g imp KOH} \times \frac{85.0 \text{ g KOH}}{100 \text{ g imp KOH}} = 0.2253 \text{ g KOH}$

$$\text{mol KOH} = 0.2253 \text{ g KOH} \times \frac{1 \text{ mol KOH}}{56.1 \text{ g KOH}} = 0.004016 \text{ mol KOH}$$

$$\text{mol FeCl}_3 = 0.004016 \text{ mol KOH} \times \frac{1 \text{ mol FeCl}_3}{3 \text{ mol KOH}} = 0.001339 \text{ mol FeCl}_3$$

$$\text{mL FeCl}_3 = 0.001339 \text{ mol FeCl}_3 \times \frac{1000 \text{ mL FeCl}_3}{0.1189 \text{ mol FeCl}_3} = 11.3 \text{ mL FeCl}_3$$

3. (a) $\text{mol NaNO}_3 = 1.38 \text{ g NaNO}_3 \times \frac{1 \text{ mol NaNO}_3}{85.0 \text{ g NaNO}_3} = 0.01624 \text{ mol NaNO}_3$

$$\text{molarity} = \frac{0.01624 \text{ mol}}{0.875 \text{ L}} = 0.0186 \text{ M}$$

(b) For 1 L of solution:

$$\text{mass of solution} = 1000 \text{ mL} \times 1.00 \text{ g/mL} = 1000 \text{ g}$$

$$\text{mass of NaNO}_3 = 0.235 \text{ mol NaNO}_3 \times \frac{85.0 \text{ g NaNO}_3}{1 \text{ mol NaNO}_3} = 19.98 \text{ g NaNO}_3$$

$$\% \text{ of NaNO}_3 \text{ in the solution} = \frac{19.98 \times 100}{1000} = 2.00\%$$

4. (a) $M_a V_a = M_b V_b$ since HCl and KOH react in a 1:1 molar ratio

$$M_{\text{HCl}} = \frac{0.08652 \text{ M} \times 23.4 \text{ mL}}{25.0 \text{ mL}} = 0.0810 \text{ M}$$

(b) $\text{mL KOH} = \frac{25.0 \text{ mL} \times 0.1007 \text{ M}}{0.09785 \text{ M}} = 25.7 \text{ mL}$