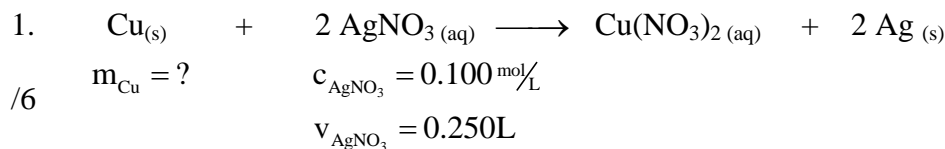


Chemistry 20 – Lesson 21
Solution Stoichiometry

/80



A. calculate moles

$$n_{\text{AgNO}_3} = 0.100 \text{ mol/L} (0.250 \text{ L})$$

$$n_{\text{AgNO}_3} = 0.0250 \text{ mol}$$

B. mole ratio

$$\frac{n_{\text{AgNO}_3}}{2} = \frac{n_{\text{Cu}}}{1}$$

$$\frac{0.0250 \text{ mol}}{2} = \frac{n_{\text{Cu}}}{1}$$

$$n_{\text{Cu}} = 0.0125 \text{ mol}$$

C. calculate mass

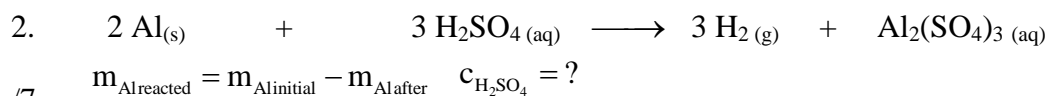
$$m_{\text{Cu}} = 0.0125 \text{ mol} (63.55 \text{ g/mol})$$

$$\boxed{m_{\text{Cu}} = 0.794 \text{ g}}$$

OR

$$m_{\text{Cu}} = \frac{0.100 \text{ mol AgNO}_3}{1 \text{ L}} \times 0.250 \text{ L} \times \frac{1 \text{ mol Cu}}{2 \text{ mol AgNO}_3} \times \frac{63.55 \text{ g Cu}}{1 \text{ mol Cu}}$$

$$\boxed{m_{\text{Cu}} = 0.794 \text{ g}}$$



$$m_{\text{Al}} = 15.14 \text{ g} - 9.74 \text{ g}$$

$$m_{\text{Al}} = 5.40 \text{ g}$$

A. Calculate moles

$$n_{\text{Al}} = \frac{5.40 \text{ g}}{26.98 \text{ g/mol}}$$

$$n_{\text{Al}} = 0.200 \text{ mol}$$

B. Mole ratio

$$\frac{n_{\text{H}_2\text{SO}_4}}{3} = \frac{n_{\text{Al}}}{2}$$

$$\frac{n_{\text{H}_2\text{SO}_4}}{3} = \frac{0.200 \text{ mol}}{2}$$

$$n_{\text{H}_2\text{SO}_4} = 0.300 \text{ mol}$$

C. Calculate concentration

$$c_{\text{H}_2\text{SO}_4} = \frac{0.300 \text{ mol}}{0.500 \text{ L}}$$

$$\boxed{c_{\text{H}_2\text{SO}_4} = 0.600 \text{ mol/L}}$$

OR

$$c_{\text{H}_2\text{SO}_4} = 3.40 \text{ g Al} \times \frac{1 \text{ mol Al}}{26.98 \text{ g Al}} \times \frac{3 \text{ mol H}_2\text{SO}_4}{2 \text{ mol Al}} \times \frac{1}{0.500 \text{ L}}$$

$$\boxed{c_{\text{H}_2\text{SO}_4} = 0.600 \text{ mol/L}}$$



/8 First calculate the mass of magnesium that reacted.

$$m_{\text{Mg}} = ?$$

A. calculate moles

$$n_{\text{HCl}} = 6.00 \text{ mol/L} (2.40\text{L})$$

$$n_{\text{HCl}} = 14.4 \text{ mol}$$

$$c_{\text{HCl}} = 6.00 \text{ mol/L}$$

$$v_{\text{HCl}} = 2.40\text{L}$$

B. mole ratio

$$\frac{n_{\text{Mg}}}{1} = \frac{n_{\text{HCl}}}{2}$$

$$\frac{n_{\text{Mg}}}{1} = \frac{14.4 \text{ mol}}{2}$$

$$n_{\text{Mg}} = 7.20 \text{ mol}$$

C. calculate mass

$$m_{\text{Mg}} = 7.20 \text{ mol} (24.31 \frac{\text{g}}{\text{mol}})$$

$$m_{\text{Mg reacted}} = 175 \text{ g}$$

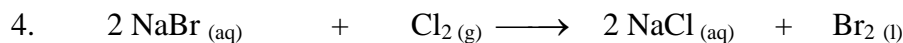
OR

$$m_{\text{Mg}} = \frac{6.00 \text{ mol HCl}}{1\text{L}} \times 2.40\text{L} \times \frac{1 \text{ mol Mg}}{2 \text{ mol HCl}} \times \frac{24.32 \text{ g Mg}}{1 \text{ mol Mg}} = 175 \text{ g}$$

$$m_{\text{Mg remaining}} = m_{\text{Mg initial}} - m_{\text{Mg reacted}}$$

$$m_{\text{Mg remaining}} = 200 \text{ g} - 175 \text{ g}$$

$$\boxed{m_{\text{Mg remaining}} = 25 \text{ g}}$$



/5 $c_{\text{NaBr}} = 0.300 \text{ mol/L}$ $n_{\text{Cl}_2} = ?$

$$v_{\text{NaBr}} = 0.120\text{L}$$

A. calculate moles

$$n_{\text{NaBr}} = 0.300 \text{ mol/L} (0.120\text{L})$$

$$n_{\text{NaBr}} = 0.0360 \text{ mol}$$

B. mole ratio

$$\frac{n_{\text{Cl}_2}}{1} = \frac{n_{\text{NaBr}}}{2}$$

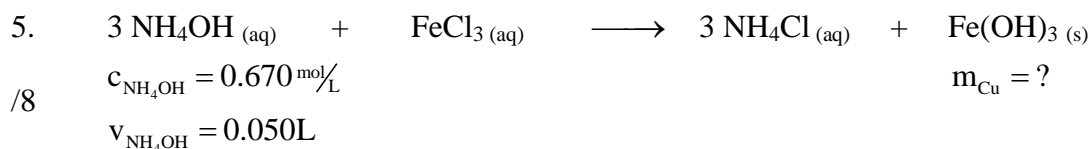
$$\frac{n_{\text{Cl}_2}}{1} = \frac{0.0360 \text{ mol}}{2}$$

$$\boxed{n_{\text{Cl}_2} = 0.0180 \text{ mol}}$$

OR

$$n_{\text{Cl}_2} = \frac{0.300 \text{ mol NaBr}}{1\text{L}} \times 0.120\text{L} \times \frac{1 \text{ mol Cl}_2}{2 \text{ mol NaBr}}$$

$$\boxed{n_{\text{Cl}_2} = 0.0180 \text{ mol}}$$



A. calculate moles

$$n_{\text{NH}_4\text{OH}} = 0.670 \text{ mol/L} (0.050 \text{ L})$$

$$n_{\text{NH}_4\text{OH}} = 0.0335 \text{ mol}$$

B. mole ratio

$$\frac{n_{\text{Fe}(\text{OH})_3}}{1} = \frac{n_{\text{NH}_4\text{OH}}}{3}$$

$$\frac{n_{\text{Fe}(\text{OH})_3}}{1} = \frac{0.0335 \text{ mol}}{3}$$

$$n_{\text{Fe}(\text{OH})_3} = 0.0112 \text{ mol}$$

C. calculate mass

$$m_{\text{Fe}(\text{OH})_3} = 0.0112 \text{ mol} (106.88 \text{ g/mol})$$

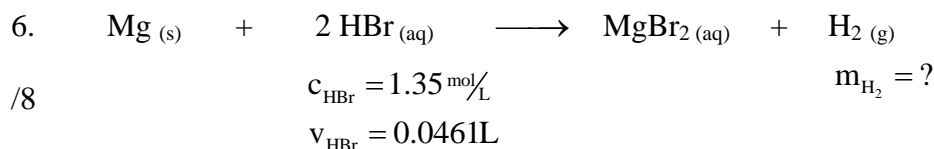
$$m_{\text{Fe}(\text{OH})_3} = 1.193 \text{ g}$$

D. calculate % error

$$\% \text{ error} = \frac{m_{\text{exp yield}} - m_{\text{theo yield}}}{m_{\text{theo yield}}} \times 100\%$$

$$\% \text{ error} = \frac{1.135 \text{ g} - 1.193 \text{ g}}{1.193 \text{ g}} \times 100\%$$

$$\% \text{ error} = -4.90\%$$



A. calculate moles

$$n_{\text{HBr}} = 1.35 \text{ mol/L} (0.0461 \text{ L})$$

$$n_{\text{HBr}} = 0.0622 \text{ mol}$$

B. mole ratio

$$\frac{n_{\text{H}_2}}{1} = \frac{n_{\text{HBr}}}{3}$$

$$\frac{n_{\text{H}_2}}{1} = \frac{0.0622 \text{ mol}}{3}$$

$$n_{\text{H}_2} = 0.0207 \text{ mol}$$

C. calculate mass

$$m_{\text{H}_2} = 0.0207 \text{ mol} (2.02 \text{ g/mol})$$

$$m_{\text{H}_2} = 0.0418 \text{ g}$$

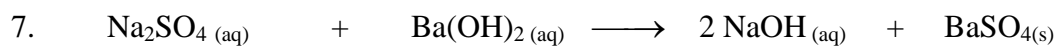
D. calculate % error

$$\% \text{ error} = \frac{m_{\text{exp yield}} - m_{\text{theo yield}}}{m_{\text{theo yield}}} \times 100\%$$

$$\% \text{ error} = \frac{0.0556 \text{ g} - 0.0418 \text{ g}}{0.0418 \text{ g}} \times 100\%$$

$$\% \text{ error} = -11.5\%$$





$$/8 \quad c_{\text{Na}_2\text{SO}_4} = 1.75 \text{ mol/L} \quad m_{\text{H}_2} = ?$$

$$v_{\text{Na}_2\text{SO}_4} = 0.0200 \text{ L}$$

A. calculate moles

$$n_{\text{Na}_2\text{SO}_4} = 1.75 \text{ mol/L} (0.0200 \text{ L})$$

$$n_{\text{Na}_2\text{SO}_4} = 0.0350 \text{ mol}$$

B. mole ratio

$$\frac{n_{\text{BaSO}_4}}{1} = \frac{n_{\text{Na}_2\text{SO}_4}}{1}$$

$$\frac{n_{\text{BaSO}_4}}{1} = \frac{0.0350 \text{ mol}}{1}$$

$$n_{\text{BaSO}_4} = 0.0350 \text{ mol}$$

C. calculate mass

$$m_{\text{BaSO}_4} = 0.0350 \text{ mol} (233.40 \text{ g/mol})$$

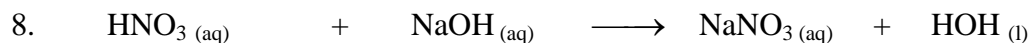
$$m_{\text{BaSO}_4} = 8.17 \text{ g}$$

D. calculate % yield

$$\% \text{ yield} = \frac{m_{\text{exp yield}}}{m_{\text{theo yield}}} \times 100\%$$

$$\% \text{ yield} = \frac{6.17 \text{ g}}{8.17 \text{ g}} \times 100\%$$

$$\boxed{\% \text{ yield} = 75.5\%}$$



$$/6 \quad c_{\text{HNO}_3} = 3.00 \text{ mol/L} \quad c_{\text{NaOH}} = 0.10 \text{ mol/L} \quad m_{\text{H}_2} = ?$$

$$v_{\text{HNO}_3} = ?$$

$$v_{\text{NaOH}} = 0.0600 \text{ L}$$

A. calculate moles

$$n_{\text{NaOH}} = 0.10 \text{ mol/L} (0.0600 \text{ L})$$

$$n_{\text{NaOH}} = 0.00600 \text{ mol}$$

B. mole ratio

$$\frac{n_{\text{HNO}_3}}{1} = \frac{n_{\text{NaOH}}}{1}$$

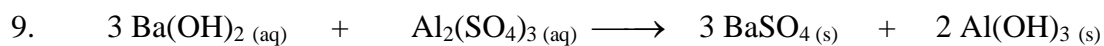
$$\frac{n_{\text{HNO}_3}}{1} = \frac{0.00600 \text{ mol}}{1}$$

$$n_{\text{HNO}_3} = 0.00600 \text{ mol}$$

C. calculate volume

$$v_{\text{HNO}_3} = \frac{0.00600 \text{ mol}}{3.00 \text{ mol/L}}$$

$$\boxed{v_{\text{HNO}_3} = 2.00 \text{ mL}}$$



$$/8 \quad c_{\text{Ba(OH)}_2} = 0.0450 \text{ mol/L} \quad m_{\text{BaSO}_4} = ? \quad m_{\text{Al(OH)}_3} = ?$$

$$v_{\text{Ba(OH)}_2} = 0.0250 \text{ L}$$

A. calculate moles

$$n_{\text{Ba(OH)}_2} = 0.0450 \text{ mol/L} (0.0250 \text{ L})$$

$$n_{\text{Ba(OH)}_2} = 0.001125 \text{ mol}$$

B. mole ratios

for BaSO_4

$$\frac{n_{\text{BaSO}_4}}{3} = \frac{n_{\text{Ba(OH)}_2}}{3}$$

$$\frac{n_{\text{BaSO}_4}}{3} = \frac{0.001125 \text{ mol}}{3}$$

$$n_{\text{BaSO}_4} = 0.001125 \text{ mol}$$

for Al(OH)_3

$$\frac{n_{\text{Al(OH)}_3}}{2} = \frac{n_{\text{Ba(OH)}_2}}{3}$$

$$\frac{n_{\text{Al(OH)}_3}}{2} = \frac{0.001125 \text{ mol}}{3}$$

$$n_{\text{Al(OH)}_3} = 0.000750 \text{ mol}$$

C. calculate masses

$$m_{\text{BaSO}_4} = 0.001125 \text{ mol} (233.40 \text{ g/mol})$$

$$m_{\text{BaSO}_4} = 0.2626 \text{ g}$$

$$m_{\text{Al(OH)}_3} = 0.00075 \text{ mol} (78.01 \text{ g/mol})$$

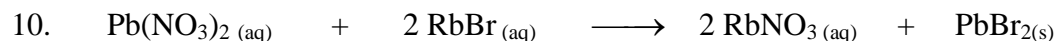
$$m_{\text{Al(OH)}_3} = 0.0585 \text{ g}$$

D. calculate % error

$$\% \text{ error} = \frac{m_{\text{exp yield}} - m_{\text{theo yield}}}{m_{\text{theo yield}}} \times 100\%$$

$$\% \text{ error} = \frac{0.31 \text{ g} - (0.2626 \text{ g} + 0.0585 \text{ g})}{(0.2626 \text{ g} + 0.0585 \text{ g})} \times 100\%$$

$$\% \text{ error} = -3.46\%$$



$$/6 \quad m_{\text{RbBr}} = ? \quad m_{\text{PbBr}_2} = m_{\text{product+filter paper}} - m_{\text{filter paper}}$$

$$m_{\text{PbBr}_2} = 6.83 \text{ g} - 0.21 \text{ g}$$

$$m_{\text{PbBr}_2} = 6.62 \text{ g}$$

A. calculate moles

$$n_{\text{PbBr}_2} = \frac{6.62 \text{ g}}{378.13 \text{ g/mol}}$$

$$n_{\text{PbBr}_2} = 0.0175 \text{ mol}$$

B. mole ratio

$$\frac{n_{\text{RbBr}}}{2} = \frac{n_{\text{PbBr}_2}}{1}$$

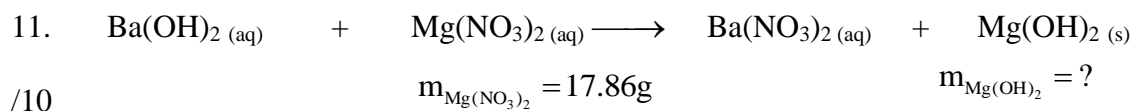
$$\frac{n_{\text{RbBr}}}{2} = \frac{0.0175 \text{ mol}}{1}$$

$$n_{\text{RbBr}} = 0.0350 \text{ mol}$$

C. calculate mass

$$m_{\text{RbBr}} = 0.0350 \text{ mol} (165.37 \text{ g/mol})$$

$$m_{\text{RbBr}} = 5.79 \text{ g}$$



A. calculate moles

$$n_{\text{Mg(NO}_3)_2} = \frac{17.86\text{g}}{148.33\text{g/mol}}$$

$$n_{\text{Mg(NO}_3)_2} = 0.1204\text{mol}$$

B. mole ratio

$$\frac{n_{\text{Mg(OH)}_2}}{1} = \frac{n_{\text{Mg(NO}_3)_2}}{1}$$

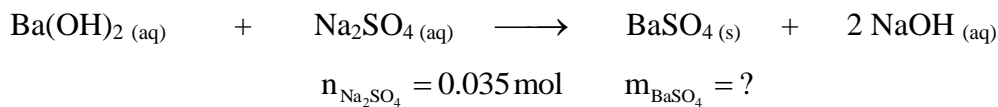
$$\frac{n_{\text{Mg(OH)}_2}}{1} = \frac{0.1204\text{mol}}{1}$$

$$n_{\text{Mg(OH)}_2} = 0.1204\text{mol}$$

C. calculate mass

$$m_{\text{Mg(OH)}_2} = 0.1204\text{mol}(58.33\text{g/mol})$$

$$m_{\text{Mg(OH)}_2} = 7.023\text{g}$$



A. mole ratio

$$\frac{n_{\text{BaSO}_4}}{1} = \frac{n_{\text{Na}_2\text{SO}_4}}{1}$$

$$\frac{n_{\text{BaSO}_4}}{1} = \frac{0.035\text{mol}}{1}$$

$$n_{\text{BaSO}_4} = 0.035\text{mol}$$

B. calculate mass

$$m_{\text{BaSO}_4} = 0.035\text{mol}(233.40\text{g/mol})$$

$$m_{\text{BaSO}_4} = 8.2\text{g}$$