

Mole Conversion

$$1) 9.54 \times 10^{23} \text{ Fe atoms} \times \frac{1 \text{ mol Fe atoms}}{6.02 \times 10^{23} \text{ Fe atoms}} =$$

$$2) 7.54 \text{ mol gas} \times \frac{22.4 \text{ L}}{1 \text{ mol gas}} =$$

$$3) 654.3 \text{ L XeF}_2 \times \frac{1 \text{ mol XeF}_2}{22.4 \text{ L XeF}_2} \times \frac{169.29 \text{ g XeF}_2}{1 \text{ mol XeF}_2} = 4945 \text{ g XeF}_2$$

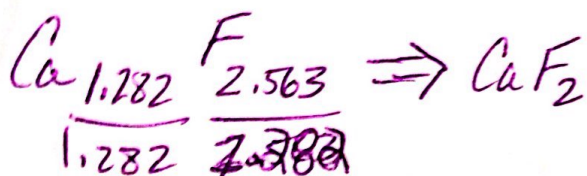
Empirical and Molecular Formulas

100g sample...

1) 48.7% F \rightarrow 48.7g F
 51.3% Ca \rightarrow 51.3g Ca

$$48.7\text{g F} \times \frac{1\text{mol F}}{19.0\text{g F}} = 2.563\text{mol F}$$

$$51.3\text{g Ca} \times \frac{1\text{mol Ca}}{40.01\text{g Ca}} = 1.282\text{mol Ca}$$



2) $\frac{5.18\text{g C}}{12.01\text{g C}} = 0.4313\text{mol C}$

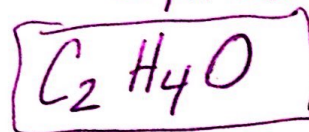
$$\begin{array}{ccc} \text{C} & \text{H} & \text{O} \\ \frac{0.4313}{0.2163} & \frac{0.8515}{0.2163} & \frac{0.2163}{0.2163} \end{array}$$

$$\frac{0.86\text{g H}}{1.01\text{g H}} = 0.8515\text{mol H}$$



Empirical Formula...

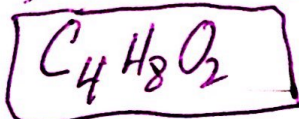
$$M_{\text{oxygen}} = 9.50\text{g} - 5.18\text{g} - 0.86\text{g} = 3.46\text{g O}$$



$$\frac{3.46\text{g O}}{16.00\text{g O}} = 0.2163\text{mol O}$$

$$\frac{M_{\text{MF}}}{M_{\text{EF}}} = \frac{88.0\text{g/mol}}{44.06\text{g/mol}} \approx 2$$

Molecular Formula...



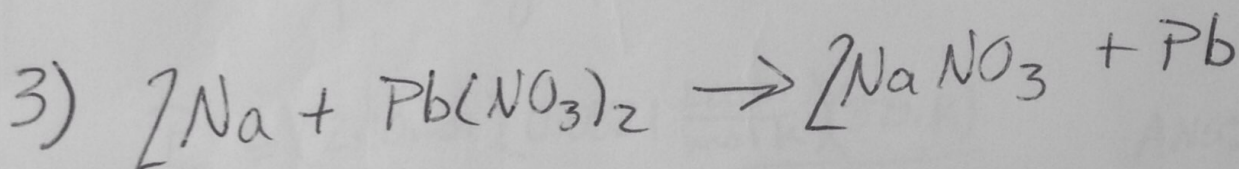
BASIC STOICHIOMETRY

$$1) \frac{78.9 \text{ g CaCl}_2}{111.0 \text{ g CaCl}_2} \left| \frac{1 \text{ mol CaCl}_2}{1 \text{ mol CaCl}_2} \right| \frac{2 \text{ mol AgCl}}{1 \text{ mol AgCl}} \left| \frac{143.32 \text{ g AgCl}}{1 \text{ mol AgCl}} \right|$$

ANS: 204 g AgCl

$$2) \frac{45 \text{ mol C}_4\text{H}_{10}}{2 \text{ mol C}_4\text{H}_{10}} \left| \frac{8 \text{ mol CO}_2}{1 \text{ mol CO}_2} \right| \frac{22.4 \text{ L CO}_2}{1 \text{ mol CO}_2}$$

ANS: $4.0 \times 10^3 \text{ L CO}_2$



$$\frac{75.5 \text{ g Na}}{22.99 \text{ g Na}} \left| \frac{1 \text{ mol Na}}{2 \text{ mol Na}} \right| \frac{1 \text{ mol Pb}}{1 \text{ mol Pb}} \left| \frac{207.2 \text{ g Pb}}{1 \text{ mol Pb}} \right|$$

ANS: 340. g Pb
or $3.40 \times 10^2 \text{ g Pb}$

Stoichiometry with Molarity and IDEAL Gas Law

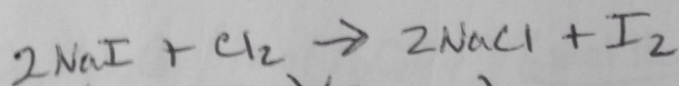
$$1) \frac{0.6500L}{1L} \times \frac{0.78 \text{ mol HCl}}{1 \text{ mol HCl}} \times \frac{1 \text{ mol H}_2\text{O}}{1 \text{ mol HCl}} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}}$$

ANS: 9.1g H₂O

$$2) \frac{67.3 \text{ g S}}{32.06 \text{ g S}} \times \frac{1 \text{ mol S}}{2 \text{ mol S}} \times \frac{2 \text{ mol SO}_3}{2 \text{ mol S}} = 2.10 \text{ mol SO}_3$$

$$P_{\text{SO}_3} = \frac{(2.10 \text{ mol}) \left(0.0821 \frac{\text{Latm}}{\text{molK}} \right) (370. \text{K})}{23.5 \text{ L}}$$

ANS: 2.71 atm

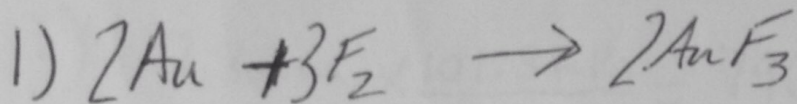


$$3) n_{\text{Cl}_2} = \frac{(6.87 \text{ kPa}) (9.08 \text{ L})}{(8.31 \frac{\text{LkPa}}{\text{molK}}) (349.3 \text{ K})} = 0.0215 \text{ mol}$$

$$0.0215 \text{ mol Cl}_2 \times \frac{2 \text{ mol NaI}}{1 \text{ mol Cl}_2} \times \frac{1 \text{ L}}{1.32 \text{ mol NaI}} = 0.0326 \text{ L}$$

ANS:
or
32.6 mL

● Limiting & Excess Reactant Stoichiometry



$$\frac{98\text{g Au}}{196.97\text{g Au}} \left| \frac{1\text{mol Au}}{2\text{mol AuF}_3} \right| = 0.498\text{mol AuF}_3$$

$$\frac{15\text{g F}_2}{38.00\text{g F}_2} \left| \frac{1\text{mol F}_2}{3\text{mol F}_2} \right| \left| \frac{2\text{mol AuF}_3}{3\text{mol F}_2} \right| = 0.263\text{mol AuF}_3$$

a) F_2 is the LR b) $0.263\text{mol AuF}_3 \cdot \frac{253.91\text{g AuF}_3}{1\text{mol AuF}_3} = 66.8\text{g AuF}_3$

c) $(0.498\text{mol AuF}_3 - 0.263\text{mol AuF}_3) \cdot \frac{1\text{mol Au}}{1\text{mol AuF}_3} \cdot \frac{196.97\text{g Au}}{1\text{mol Au}} = 46.3\text{g Au}$

2) $0.5000\text{L} \left(\frac{0.899\text{mol} [\text{Ag}(\text{CN})_6]^{3-}}{1\text{L}} \right) \left(\frac{6\text{mol HCN}}{1\text{mol} [\text{Ag}(\text{CN})_6]^{3-}} \right) = 2.698\text{mol HCN}$

$$100.0\text{g H}_2\text{C}_2\text{O}_4 \left(\frac{1\text{mol H}_2\text{C}_2\text{O}_4}{90.04\text{g H}_2\text{C}_2\text{O}_4} \right) \left(\frac{6\text{mol HCN}}{3\text{mol H}_2\text{C}_2\text{O}_4} \right) = 2.22\text{mol HCN}$$

$$V_{\text{HCN}} = \frac{(2.22\text{mol}) \left(0.0821 \frac{\text{L atm}}{\text{mol K}} \right) (308.2)}{2.45\text{ atm}} = 22.9\text{L}$$

$$V_{\text{HCN, actual}} = (22.9\text{L}) (0.457) = 10.5\text{L}$$

GAS LAWS & KMT

$$1) 7.8 \text{ atm} \times \frac{101.3 \text{ kPa}}{1 \text{ atm}} = 790.1 \text{ kPa}$$

$$V_2 = \frac{(790.1 \text{ kPa})(5.3 \text{ L})}{(110 \text{ kPa})} = 38 \text{ L}, \text{ Boyle's LAW}$$

$$2) P_{\text{H}_2\text{O}} = 18.134 \text{ torr}$$

$$P_{\text{CO}_2} = 800.0 \text{ torr} - 18.134 \text{ torr} = 781.9 \text{ torr}$$

DALTON'S LAW

$$3) V_2 = \left(\frac{450 \text{ mL}}{295 \text{ K}} \right) (338 \text{ K}) = 516 \text{ mL}$$

• The higher T is the more KE the gas particles have. This means they move more rapidly and collide with the container walls more frequently and more forcefully. The bag, being flexible (to an extent) will increase in volume due to these faster and more frequent collisions.

$$4) n_{\text{O}_2} = \frac{(0.98 \text{ atm})(0.8943 \text{ L})}{(0.0821 \frac{\text{L atm}}{\text{mol K}})(423 \text{ K})} = 0.02524 \dots \text{ mol O}_2$$

$$0.02524 \dots \text{ mol O}_2 \times \frac{32 \text{ g O}_2}{1 \text{ mol O}_2} = 0.808 \text{ g O}_2$$

Solutions

$$1. \quad 175 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = .175 \text{ L}$$

$$M_1 V_1 = M_2 V_2$$

$$.175 \text{ L} \cdot 1.6 \text{ M} = M_2 \cdot 1.0 \text{ L}$$

$$\boxed{M_2 = .28 \text{ M}}$$

$$2. \quad 4.49 \text{ g CuCl}_2 \times \frac{1 \text{ mol CuCl}_2}{134.35 \text{ g}} = .0334 \text{ mol Cu}$$

$$51.5 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = .0515 \text{ L}$$

$$M = \frac{.0334 \text{ mol}}{.0515 \text{ L}} = .64 \text{ M} = M_2$$

$$M_1 V_1 = M_2 V_2$$

$$133 \text{ mL} \cdot 7.90 \text{ M} = .64 \text{ M} \cdot V_2$$

$$V_2 = 1641 \text{ mL or } 1.64 \text{ L}$$

Solutions

$$3. \quad 5.00\text{g} \times \frac{1\text{mol}}{40\text{g}} = \frac{.125\text{ mol NaOH}}{.750\text{ L}}$$

$$M = .166 \frac{\text{mol}}{\text{L}}$$

$$4. \quad 2.45\text{g H}_2\text{SO}_4 \times \frac{1\text{mol}}{98\text{g}} \times \frac{1\text{L}}{18.0\text{mol}} \times \frac{1000\text{mL}}{1\text{L}}$$

$$= 1.38\text{ mL}$$