Mole Conversion

1) 9.54×10^{25} 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 → 48.7g F

51.3% Ca → 51.3g Ca

$48.7\text{g F} \times \frac{1\text{mol F}}{19.00\text{g F}} = 2.563\text{mol F}$

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

$Ca_{\frac{1.282}{1.282}} F_{\frac{2.563}{1.282}} \Rightarrow CaF_2$

2) $\frac{5.18\text{g C}}{} \Big| \frac{1\text{mol C}}{12.01\text{g C}} = 0.4313\text{mol C}$

$\frac{0.86\text{g H}}{} \Big| \frac{1\text{mol H}}{1.01\text{g H}} = 0.8515\text{mol H}$

$m_{Oxygen} = 9.50\text{g} - 5.18\text{g} - 0.86\text{g} = 3.46\text{g O}$

$\frac{3.46\text{g O}}{} \Big| \frac{1\text{mol}}{16.00\text{g O}} = 0.2163\text{mol O}$

$C_{\frac{0.4313}{0.2163}} H_{\frac{0.8515}{0.2163}} O_{\frac{0.2163}{0.2163}}$

⇓

Empirical Formula...

C_2H_4O

$\frac{M_{MF}}{M_{EF}} = \frac{88.1\text{g/mol}}{44.06\text{g/mol}} \cong 2$

Molecular Formula...

$C_4H_8O_2$

BASIC STOICHIOMETRY

1) $\frac{78.9\,g\,CaCl_2}{} \Big| \frac{1\,mol\,CaCl_2}{111.0\,g\,CaCl_2} \Big| \frac{2\,mol\,AgCl}{1\,mol\,CaCl_2} \Big| \frac{143.32\,g\,AgCl}{1\,mol\,AgCl}$

ANS: 204 g AgCl

2) $\frac{45\,mol\,C_4H_{10}}{} \Big| \frac{8\,mol\,CO_2}{2\,mol\,C_4H_{10}} \Big| \frac{22.4\,L\,CO_2}{1\,mol\,CO_2}$

ANS: 4.0×10^3 L CO_2

3) $2Na + Pb(NO_3)_2 \rightarrow 2NaNO_3 + Pb$

$\frac{75.5\,g\,Na}{} \Big| \frac{1\,mol\,Na}{22.99\,g\,Na} \Big| \frac{1\,mol\,Pb}{2\,mol\,Na} \Big| \frac{207.2\,g\,Pb}{1\,mol\,Pb}$

ANS: 340. g Pb
or 3.40×10^2 g Pb

Stoichiometry With Molarity and IDEAL Gas Law

1) $\frac{0.6500\,L}{} \Big| \frac{0.78\,mol\,HCl}{1\,L} \Big| \frac{1\,mol\,H_2O}{1\,mol\,HCl} \Big| \frac{18.02\,g\,H_2O}{1\,mol\,H_2O}$

ANS: $9.1\,g\,H_2O$

2) $\frac{67.3\,g\,S}{} \Big| \frac{1\,mol\,S}{32.06\,g\,S} \Big| \frac{2\,mol\,SO_3}{2\,mol\,S} = 2.10\,mol\,SO_3$

$P_{SO_3} = \frac{(2.10\,mol)(0.0821\,\frac{L\,atm}{mol\,K})(370.\,K)}{23.5\,L}$ ANS: 2.71 atm

$2NaI + Cl_2 \rightarrow 2NaCl + I_2$

3) $n_{Cl_2} = \frac{(6.87\,kPa)(9.08\,L)}{(8.31\,\frac{L\,kPa}{mol\,K})(349.3\,K)} = 0.0215\,mol$

$\frac{0.0215\,mol\,Cl_2}{} \Big| \frac{2\,mol\,NaI}{1\,mol\,Cl_2} \Big| \frac{1\,L}{1.32\,mol\,NaI} =$ ANS: 0.0326 L or 32.6 mL

Limiting & Excess Reactant Stoichiometry

1) $2Au + 3F_2 \rightarrow 2AuF_3$

$$\frac{98g\ Au}{} \left| \frac{1mol\ Au}{196.97g\ Au} \right| \frac{2mol\ AuF_3}{2mol\ Au} = 0.498mol\ AuF_3$$

$$\frac{15g\ F_2}{} \left| \frac{1mol\ F_2}{38.00g\ F_2} \right| \frac{2mol\ AuF_3}{3mol\ F_2} = 0.263mol\ AuF_3$$

a) F_2 is the LR

b) $0.263mol\ AuF_3 \cdot \frac{253.97g\ AuF_3}{1mol\ AuF_3} = 66.8g\ AuF_3$

c) $(0.498mol\ AuF_3 - 0.263mol\ AuF_3) \cdot \frac{1mol\ Au}{1mol\ AuF_3} \cdot \frac{196.97g\ Au}{1mol\ Au} = 46.3g\ Au$

2) $0.5000L \left(\frac{0.897mol\ [Ag(CN)_6]^{3-}}{1L}\right)\left(\frac{6mol\ HCN}{1mol\ [Ag(CN)_6]^{3-}}\right) = 2.69mol\ HCN$

$$100.0g\ H_2C_2O_4 \left(\frac{1mol\ H_2C_2O_4}{90.04g\ H_2C_2O_4}\right)\left(\frac{6mol\ HCN}{3mol\ H_2C_2O_4}\right) = 2.22mol\ HCN$$

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

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

GAS LAWS & KMT

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

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

2) $P_{H_2O} = 18.134$ torr

$P_{CO_2} = 800.0$ torr $- 18.134$ torr $= 781.9$ torr
DALTON'S LAW

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

- 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) $n_{O_2} = \frac{(0.98 atm)(0.8943L)}{(0.0821 \frac{L atm}{mol K})(423K)} = 0.02524... mol\ O_2$

$0.02524... mol\ O_2 \times \frac{32 g\ O_2}{1 mol\ O_2} = 0.808 g\ O_2$

Solutions

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

$M_1V_1 = M_2V_2$

$.175L \cdot 1.6M = M_2 \cdot 1.0L$

$\boxed{M_2 = .28M}$

2. $4.49g\ CuCl_2 \times \frac{1mol\ CuCl_2}{134.35g} = .0334mol\ Cu$

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

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

$M_1V_1 = M_2V_2$

$133mL \cdot 7.90M = .64M \cdot V_2$

$V_2 = 1641mL$ or $1.64L$

Solutions

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

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

4. $2.45 g H_2SO_4 \times \frac{1 mol}{98g} \times \frac{1L}{18.0 mol} \times \frac{1000 mL}{1L}$

$= 1.38 mL$