Key (Sturman)

12.3 Practice Problems (from handout) evens only

~~(0)~~ $O_2 + 2H_2 \rightarrow 2H_2O$

$$\frac{1.22\text{g } O_2}{1} \cdot \frac{1\text{ mole } O_2}{32.00\text{g } O_2} \cdot \frac{2\text{ moles } H_2O}{1\text{ mole } O_2} \cdot \frac{18.02\text{g } H_2O}{1\text{ mole } H_2O} = 1.37\text{g } H_2O$$

∴ O_2 limiting reactant

$$\frac{1.05\text{g } H_2}{1} \cdot \frac{1\text{ mole } H_2}{2.02\text{g } H_2} \cdot \frac{2\text{ moles } H_2O}{2\text{ mole } H_2} \cdot \frac{18.02\text{g } H_2O}{1\text{ mole } H_2O} = 9.37\text{g } H_2O$$

(2) $Fe + S = FeS$ $\quad \mu_{FeS} = 55.85 + 32.07 = 87.92$ g/m

$$\frac{4.68\text{g Fe}}{1} \cdot \frac{1\text{ mole Fe}}{55.85\text{g Fe}} \cdot \frac{1\text{ mole FeS}}{1\text{ mole Fe}} \cdot \frac{87.92\text{g FeS}}{1\text{ mole FeS}} = 7.37\text{g FeS}$$

∴ Fe limiting reactant

$$\frac{2.88\text{g S}}{1} \cdot \frac{1\text{ mole S}}{32.07\text{g S}} \cdot \frac{1\text{ mole FeS}}{1\text{ mole S}} \cdot \frac{87.92\text{g FeS}}{1\text{ mole FeS}} = 7.90\text{ FeS}$$

(4) $AgNO_3 + NaCl \rightarrow NaNO_3 + AgCl$ $\quad \mu_{AgCl} = 107.87 + 35.45 = 143.32$ $\quad \mu_{AgNO_3} = 107.87 + 14.01 + 3(16.00) = 169.88$

$$\frac{6.25\text{g } AgNO_3}{1} \cdot \frac{1\text{ mole } AgNO_3}{169.88\text{g } AgNO_3} \cdot \frac{1\text{ mol AgCl}}{1\text{ mol } AgNO_3} \cdot \frac{143.32\text{g AgCl}}{1\text{ mol AgCl}} = 5.27\text{g AgCl}$$

∴ $AgNO_3$ limiting reactant

$$\frac{4.12\text{g NaCl}}{1} \cdot \frac{1\text{ mole NaCl}}{58.44\text{g NaCl}} \cdot \frac{1\text{ mole AgCl}}{1\text{ mole NaCl}} \cdot \frac{143.32\text{g AgCl}}{1\text{ mol AgCl}} = 10.10\text{g AgCl}$$

(6) $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$ $\quad \mu_{H_2SO_4} = 2.02 + 32.07 + 4(16.00) = 98.09$ g/mol $\quad \mu_{NaOH} = 22.99 + 16.00 + 1.01 = 40.00$ g/mol

$$\frac{6.33\text{g } H_2SO_4}{1} \cdot \frac{1\text{ mol } H_2SO_4}{98.09\text{g } H_2SO_4} \cdot \frac{2\text{ mol } H_2O}{1\text{ mol } H_2SO_4} \cdot \frac{18.02\text{g } H_2O}{1\text{ mol } H_2O} = 2.33\text{g } H_2O$$

∴ H_2SO_4 limiting reactant

$$\frac{5.92\text{g NaOH}}{1} \cdot \frac{1\text{ mol NaOH}}{40.00\text{g NaOH}} \cdot \frac{2\text{ mol } H_2O}{2\text{ mol NaOH}} \cdot \frac{18.02\text{g } H_2O}{1\text{ mol } H_2O} = 2.67\text{g } H_2O$$

$\mathcal{M}_{Na_2CO_3} = 2(22.99) + 12.01 + 3(16.00) = 105.9$

$\mathcal{M}_{NaCl} = 22.99 + 35.45 = 58.44\ g/mol$

(8) $CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + 2NaCl$ $\quad \mathcal{M}_{CaCl_2} = 40.08\ g/mol + 2(35.45\ g/mol) = 110.9$ g/

$$\frac{65.14\ g\ CaCl_2}{1} \cdot \frac{1\ mol\ CaCl_2}{110.98\ g\ CaCl_2} \cdot \frac{2\ mol\ NaCl}{1\ mol\ CaCl_2} \cdot \frac{58.44\ g\ NaCl}{1\ mol\ NaCl} = 68.60\ g\ NaCl$$

$\therefore$ $CaCl_2$ limiting reactant

$$\frac{74.68\ g\ Na_2CO_3}{1} \cdot \frac{1\ mol\ Na_2CO_3}{105.99\ g\ Na_2CO_3} \cdot \frac{2\ mol\ NaCl}{1\ mol\ Na_2CO_3} \cdot \frac{58.44\ g\ NaCl}{1\ mol\ NaCl} = 83.35\ g\ NaCl$$

(10) $2Cr + 3Cl_2 \rightarrow 2CrCl_3$

$$\frac{4.1\ g\ Cr}{1} \cdot \frac{1\ mol\ Cr}{52.00\ g\ Cr} \cdot \frac{2\ mol\ CrCl_3}{2\ mol\ Cr} \cdot \frac{158.35\ g\ CrCl_3}{1\ mol\ CrCl_3} = 12\ g\ CrCl_3$$

$\therefore$ Chromium limiting reactant

$$\frac{9.3\ g\ Cl_2}{1} \cdot \frac{1\ mol\ Cl_2}{70.9\ g\ Cl_2} \cdot \frac{2\ mol\ CrCl_3}{3\ mol\ Cl_2} \cdot \frac{158.35\ g\ CrCl_3}{1\ mol\ CrCl_3} = 13.8\ g\ CrCl_3$$

(12) $2SO_2 + O_2 \rightarrow 2SO_3$ $\quad \mathcal{M}_{SO_2} = 32.07 + 2(16.00) = 64.07\ g/mol$ $\quad \mathcal{M}_{SO_3} = 80.07\ g/m$

$$\frac{12.4\ g\ SO_2}{1} \cdot \frac{1\ mol\ SO_2}{64.07\ g\ SO_2} \cdot \frac{2\ mol\ SO_3}{2\ mol\ SO_2} \cdot \frac{80.07\ g\ SO_3}{1\ mol\ SO_3} = 15.5\ g\ SO_3$$

$\therefore$ SO_2 limiting reactant

$$\frac{3.45\ g\ O_2}{1} \cdot \frac{1\ mol\ O_2}{32.00\ g\ O_2} \cdot \frac{2\ mol\ SO_3}{1\ mol\ O_2} \cdot \frac{80.07\ g\ SO_3}{1\ mol\ SO_3} = 17.27\ g\ SO_3$$

(14) $Cd + S \rightarrow CdS$ $\quad \mathcal{M}_{CdS} = 112.41\ g/mol + 32.07\ g/mol = 144.48\ g/mol$

$$\frac{8.47\ g\ Cd}{1} \cdot \frac{1\ mol\ Cd}{112.41\ g\ Cd} \cdot \frac{1\ mol\ CdS}{1\ mol\ Cd} \cdot \frac{144.48\ g\ CdS}{1\ mol\ CdS} = 10.89\ g\ CdS \rightarrow 10.9\ g\ CdS$$

$$\frac{2.51\ g\ S}{1} \cdot \frac{1\ mol\ S}{32.07\ g\ S} \cdot \frac{1\ mol\ CdS}{1\ mol\ S} \cdot \frac{144.48\ g\ CdS}{1\ mol\ CdS} = 11.31\ g\ CdS$$

$\mathcal{M}_{N_2O_4} = 2(14.01)+4(16.00) = 92.02\ g/mol$

(16) $N_2O_4 + 2N_2H_4 \rightarrow 3N_2 + 4H_2O$ $\quad \mathcal{M}_{N_2H_4} = 2(14.01)+4.04 = 32.06\ g/mol$

$$\frac{41.6\ g\ N_2O_4}{1} \cdot \frac{1\ mol\ N_2O_4}{92.02\ g\ N_2O_4} \cdot \frac{4\ mol\ H_2O}{1\ mol\ N_2O_4} \cdot \frac{18.02\ g\ H_2O}{1\ mol\ H_2O} = 32.6\ g\ H_2O$$

$$\frac{20.8\ g\ N_2H_4}{1} \cdot \frac{1\ mol\ N_2H_4}{32.06\ g\ N_2H_4} \cdot \frac{4\ mol\ H_2O}{2\ mol\ N_2H_4} \cdot \frac{18.02\ g\ H_2O}{1\ mol\ H_2O} = \boxed{23.4\ g\ H_2O}$$

$\mathcal{M}_{NaI} = 22.99+126.90 = 149.89$

(18) $2NaI + Cl_2 \rightarrow 2NaCl + I_2$

$$\frac{58.7\ g\ NaI}{1} \cdot \frac{1\ mol\ NaI}{149.89\ g\ NaI} \cdot \frac{2\ mol\ NaCl}{2\ mol\ NaI} \cdot \frac{58.44\ NaCl}{1\ mol\ NaCl} = \boxed{22.9\ g\ NaCl}$$

$$\frac{29.4\ g\ Cl_2}{1} \cdot \frac{1\ mol\ Cl_2}{70.9\ g\ Cl_2} \cdot \frac{2\ mol\ NaCl}{1\ mol\ Cl_2} \cdot \frac{58.44\ NaCl}{1\ mol\ NaCl} = 48.5\ g\ NaCl$$

(20) $4K + O_2 \rightarrow 2K_2O$

$$\frac{6.92\ g\ K}{1} \cdot \frac{1\ mol\ K}{39.10\ g\ K} \cdot \frac{2\ mol\ K_2O}{4\ mol\ K} \cdot \frac{94.2\ g\ K_2O}{1\ mol\ K_2O} = 8.34\ g\ K_2O$$

Percent Yield $= \frac{7.36}{8.34} \times 100\% = \boxed{88.2\%}$

(22) $4Cs + O_2 \rightarrow 2Cs_2O$

$$\frac{46.1\ g\ Cs}{1} \cdot \frac{1\ mol\ Cs}{132.91\ g\ Cs} \cdot \frac{2\ mol\ Cs_2O}{4\ mol\ Cs} \cdot \frac{281.82\ g\ Cs_2O}{1\ mol\ Cs_2O} = 48.9\ g\ Cs_2O$$

$\therefore \frac{28.3\ g}{48.9\ g} \times 100\% = \boxed{57.9\%}$

$$\frac{13.4\ g\ O_2}{1} \cdot \frac{1\ mol\ O_2}{32.00\ g\ O_2} \cdot \frac{2\ mol\ Cs_2O}{1\ mol\ O_2} \cdot \frac{281.82\ g\ Cs_2O}{1\ mol\ Cs_2O} = 236\ g\ Cs_2O$$

$\mathcal{M}_{NaCl} = 22.99 + 35.45 = 58.44\ g/mol$

(24) $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$ $\quad \mathcal{M}_{NaBr} = 22.99 + 79.90 = 102.89\ g/mol$

$$\frac{45.9\ g\ NaBr}{1} \cdot \frac{1\ mol\ NaBr}{102.89\ g\ NaBr} \cdot \frac{2\ mol\ NaCl}{2\ mol\ NaBr} \cdot \frac{58.44\ g\ NaCl}{1\ mol\ NaCl} = 26.1\ g\ NaCl$$

$$\text{Percent Yield} = \frac{12.8\ g\ NaCl}{26.1\ g\ NaCl} \times 100\% = \boxed{49.0\%}$$

$\mathcal{M}_{Sb_2S_3} = 2(121.76) + 3(32.07) = 339.73\ g/mol$

(26) $2Sb_2S_3 + 9O_2 \rightarrow Sb_4O_6 + 6SO_2$ $\quad \mathcal{M}_{Sb_4O_6} = 4(121.76) + 6(16.00) = 583.04\ g/mol$

$$\frac{98.7\ g\ Sb_2S_3}{1} \cdot \frac{1\ mol\ Sb_2S_3}{339.73\ g\ Sb_2S_3} \cdot \frac{1\ mol\ Sb_4O_6}{2\ mol\ Sb_2S_3} \cdot \frac{583.04\ g\ Sb_4O_6}{1\ mol\ Sb_4O_6} = 84.7\ g\ Sb_4O_6$$

$$\text{Percent Yield} = \frac{72.4\ g\ Sb_4O_6}{84.7\ g\ Sb_4O_6} \times 100\% = \boxed{85.5\%}$$

(27) [illegible]