Stoichiometry Review Unit 1

1a. $2SO_2 + 2CaCO_3 + O_2 \rightarrow 2CaSO_4 + 2CO_2$

sulfur dioxide, calcium carbonate, oxygen, calcium sulfate, carbon dioxide

b. $2SO_2 + 2CaCO_3 + O_2 \rightarrow 2CaSO_4 + 2CO_2$

155 g, ? g

155 g SO_2	1 mol SO_2 / 64.06 g	2 mol $CaCO_3$ / 2 mol SO_2	100.09 g / 1 mol $CaCO_3$	= **242 g $CaCO_3$**

c.

155 g SO_2	1 mol SO_2 / 64.06 g	2 mol $CaSO_4$ / 2 mol SO_2	136.14 g / 1 mol $CaSO_4$	= **329 g $CaSO_4$**

2a. $S_8 + 4Cl_2 \rightarrow 4S_2Cl_2$

32.0 g, 71.0 g, ? g

32.0 g S_8	1 mol S_8 / 256.48 g	4 mol S_2Cl_2 / 1 mol S_8	135.02 g / 1 mol S_2Cl_2	= 67.4 g S_2Cl_2

71.0 g Cl_2	1 mol Cl_2 / 70.9 g	4 mol S_2Cl_2 / 4 mol Cl_2	135.02 g / 1 mol S_2Cl_2	= 135 g S_2Cl_2

∴ LR = S_8

b. 67.4 g S_2Cl_2 produced (theoretical yield)

c.

32.0 g S_8	1 mol S_8 / 256.48 g	4 mol Cl_2 / 1 mol S_8	70.9 g / 1 mol Cl_2	= 35.4 g Cl_2 consumed

Excess Cl_2 = 71.0 g − 35.4 g = **35.6 g Cl_2 in excess**

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3a. $2NaBH_4 + I_2 \rightarrow B_2H_6 + 2NaI + H_2$

1.203 g excess ? g

$1.203\ g\ NaBH_4 \left| \frac{1\ mol\ NaBH_4}{37.84\ g} \right| \frac{1\ mol\ B_2H_6}{2\ mol\ NaBH_4} \left| \frac{27.68\ g}{1\ mol\ B_2H_6} \right. = \boxed{.4400\ g\ B_2H_6}$

theoretical yield

b. $\% \text{ error} = \frac{.4400\ g - 0.295\ g}{.4400\ g} \times 100 = \boxed{33.0\ \% \text{ error}}$

c. $\% \text{ yield} = \frac{0.295\ g}{.4400\ g} \times 100 = \boxed{67.0\ \% \text{ yield}}$

OR $\% \text{ yield} = 100 - \% \text{ error} = 100 - 33.0\% = \boxed{67.0\% \text{ yield}}$

4. $MgBr_2 \cdot XH_2O$

63% 37%

$63\ g\ MgBr_2 \left| \frac{1\ mol\ MgBr_2}{184.1\ g} \right. = \frac{.3422\ mol\ MgBr_2}{.3422} = 1\ mol\ MgBr_2$

$37\ g\ H_2O \left| \frac{1\ mol\ H_2O}{18.02\ g} \right. = \frac{2.05327\ mol\ H_2O}{.3422} = 6\ mol\ H_2O$

$\boxed{MgBr_2 \cdot 6H_2O}$

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5. $C_xH_yN_z + O_2 \rightarrow CO_2 + H_2O$

5.775 mg 15.666 mg 4.491 mg

$.015666\ g\ CO_2 \left| \frac{1\ mol\ CO_2}{44.01\ g} \right| \frac{1\ mol\ C}{1\ mol\ CO_2} \left| \frac{12.01\ g}{1\ mol\ C} \right. = .0042751\ g\ C$

$.004491\ g\ H_2O \left| \frac{1\ mol\ H_2O}{18.02\ g} \right| \frac{2\ mol\ H}{1\ mol\ H_2O} \left| \frac{1.01\ g}{1\ mol\ H} \right. = 5.0343 \times 10^{-4}\ g\ H$

$g\ N = .005775\ g\ C_xH_yN_z - .0042751\ g\ C - 5.0343 \times 10^{-4}\ g\ H$
$= 9.9647 \times 10^{-4}\ g\ N$

$.0042751\ g\ C \left| \frac{1\ mol\ C}{12.01\ g} \right. = \frac{3.5596 \times 10^{-4}\ mol\ C}{7.11256 \times 10^{-5}} = 5\ mol\ C$

$5.0343 \times 10^{-4}\ g\ H \left| \frac{1\ mol\ H}{1.01\ g} \right. = \frac{4.984455 \times 10^{-4}\ H}{7.11256 \times 10^{-5}} = 7\ mol\ H$

$9.9647 \times 10^{-4}\ g\ N \left| \frac{1\ mol\ N}{14.01\ g} \right. = \frac{7.11256 \times 10^{-5}\ mol\ N}{7.11256 \times 10^{-5}} = 1\ mol\ N$

$\boxed{\text{Emprical Formula} = C_5H_7N}$

$\frac{MM_{MF}}{MM_{EF}} = \frac{162.26\ g/mol}{81.13\ g/mol} = 2$

$\boxed{\text{Molecular Formula} = C_{10}H_{14}N_2}$