Stoichiometry Practice Problems

① $N_2 + 3H_2 \longrightarrow 2NH_3$

$3.45 \text{ moles } N_2 \times \frac{2 \text{ mol } NH_3}{1 \text{ mol } N_2} = \boxed{6.9 \text{ mol } NH_3}$ N_2: Excess Reactant

$4.85 \text{ mol } H_2 \times \frac{2 \text{ mol } NH_3}{3 \text{ mol } H_2} = \boxed{3.23 \text{ mol } NH_3}$ H_2: Limiting Reactant

② $2KClO_3 \longrightarrow 2KCl + 3O_2$

$6.45 \text{ g } KClO_3 \times \frac{1 \text{ mol } KClO_3}{122.6 \text{ g } KClO_3} \times \frac{2 \text{ mol } KCl}{2 \text{ mol } KClO_3} \times \frac{74.6 \text{ g } KCl}{1 \text{ mol } KCl} = \boxed{3.92 \text{ g } KCl}$

③ $2NaNO_3 \longrightarrow 2NaNO_2 + O_2$

$156 \text{ g } NaNO_3 \times \frac{1 \text{ mol } NaNO_3}{85 \text{ g } NaNO_3} \times \frac{2 \text{ mol } NaNO_2}{2 \text{ mol } NaNO_3} \times \frac{69.0 \text{ g } NaNO_2}{1 \text{ mol } NaNO_2} = \boxed{126.6 \text{ g } NaNO_2}$

↑ theoretical

$\% \text{ Yield} = \frac{\text{actual}}{\text{theoretical}} \times 100$ $\frac{112 \text{ g } NaNO_2}{126.6 \text{ g } NaNO_2} \times 100 = \boxed{88.5\%}$

↑ % Yield

④ $Al_2O_3 + 3C \longrightarrow 2Al + 3CO$

$$9.73_g\ Al_2O_3 \times \frac{1\text{mol } Al_2O_3}{102.0_g\ Al_2O_3} \times \frac{2\text{mol } Al}{1\text{mol } Al_2O_3} \times \frac{27.0_g\ Al}{1\text{mol } Al} = \boxed{5.15_g\ Al}$$

↑ theoretical

$$\%\ Yield = \frac{actual}{theoretical} \times 100$$

$$91\% = \frac{actual}{5.15_g\ Al} \times 100 \qquad 0.91 = \frac{actual}{5.15_g\ Al} \qquad \boxed{actual = 4.69_g\ Al}$$

⑤ $Mg + Cu(NO_3)_2 \longrightarrow Cu + Mg(NO_3)_2$

$$25.3_g\ Mg \times \frac{1\text{mol } Mg}{24.3_g\ Mg} \times \frac{1\text{mol } Cu}{1\text{mol } Mg} \times \frac{63.5_g\ Cu}{1\text{mol } Cu} = \boxed{66.1_g\ Cu}$$

Excess Reactant: Mg

~~14.3 g Cu ×~~

$$44.3_g\ Cu(NO_3)_2 \times \frac{1\text{mol } Cu(NO_3)_2}{187.5_g\ Cu(NO_3)_2} \times \frac{1\text{mol } Cu}{1\text{mol } Cu(NO_3)_2} \times \frac{63.5_g\ Cu}{1\text{mol } Cu} = \boxed{15.0_g\ Cu}$$

theoretical ↓

$$\%\ Yield = \frac{14.3_g\ Cu}{15.0_g\ Cu} \times 100 = \boxed{95.3\%}$$

Limiting Reactant = $Cu(NO_3)_2$

⑥ $2Al + 3Cl_2 \longrightarrow 2AlCl_3$

$$34.0_g\ Al \times \frac{1\text{mol } Al}{27.0_g\ Al} \times \frac{2\text{mol } AlCl_3}{2\text{mol } Al} \times \frac{133.5_g\ AlCl_3}{1\text{mol } AlCl_3} = \boxed{168.1_g\ AlCl_3}$$

Excess = Al

$$39.0_g\ Cl_2 \times \frac{1\text{mol } Cl_2}{71.0_g\ Cl_2} \times \frac{2\text{mol } Cl_2}{3\text{mol } Cl_2} \times \frac{133.5_g\ AlCl_3}{1\text{mol } AlCl_3} = \boxed{48.9_g\ AlCl_3}$$

Limiting Cl_2

$$39.0_g\ Cl_2 \times \frac{1\text{mol } Cl_2}{71.0_g\ Cl_2} \times \frac{2\text{mol } Al}{3\text{mol } Cl_2} \times \frac{27.0_g\ Al}{1\text{mol } Al} = 9.89_g\ Al\ used$$

Left over: $34.0 - 9.89 = \boxed{24.11_g\ Al}$