Limiting Excess Reagent Calculations

When information is given about two or more reactants, the amount of products formed will depend on which ever reactant runs out first.

Step #1   Consider the first reactant (available and required)

Step #2   Consider the second reactant (available and required)

Step #3   Determine the limiting reagent

Step #4   Complete the questions using the **limiting reagent amount** as the starting point

eg   Determine the mass of $FeCl_3$ produced when 50.0 g of iron(III) oxide reacts with 20.0 L of chlorine gas at S.T.P.

$$2Fe_2O_3 \ + \ 6Cl_2 \ \rightarrow \ 4FeCl_3 \ + \ 3O_2$$
$$50.0 \text{ g} \qquad 20.0 \text{ L} \qquad \text{? mass g}$$
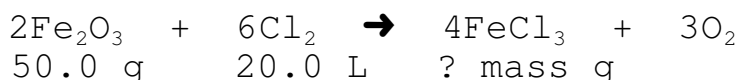
Consider Fe_2O_3:

$$50.0 \text{ g Fe}_2O_3 \text{ x } \frac{1 \text{ mol Fe}_2O_3}{159.70 \text{ g Fe}_2O_3} = 0.313 \text{ mol Fe}_2O_3 \text{ (available)}$$

excess

$$0.313 \text{ mol Fe}_2O_3 \text{ x } \frac{6 \text{ mol Cl}_2}{2 \text{ mol Fe}_2O_3} = 0.939 \text{ mol Cl}_2 \text{ (required)}$$

Consider Cl_2:

$$20.0 \text{ L Cl}_2 \text{ x } \frac{1 \text{ mol Cl}_2}{22.414 \text{ L Cl}_2} = \boxed{0.892 \text{ mol Cl}_2 \text{ (available)}}$$

limiting**

$$0.892 \text{ mol Cl}_2 \text{ x } \frac{2 \text{ mol Fe}_2O_3}{6 \text{ mol Cl}_2} = 0.297 \text{ mol Fe}_2O_3 \text{ (required)}$$

Therefore Cl_2 is the limiting reagent and **0.892 mol Cl_2 is the limiting amount.**

Complete the problem:

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$$0.892 \text{ mol } Cl_2 \text{ x } \frac{4 \text{ mol } FeCl_3}{6 \text{ mol } Cl_2} \text{ x } \frac{162.20 \text{ g } FeCl_3}{1 \text{ mol } FeCl_3} = 96.5 \text{ g } FeCl_3$$