Limiting Reagents
Sample Problem

① $2\,Cu_{(s)} + S_{(s)} \rightarrow Cu_2S_{(s)}$

80.0 g 25.0 g

What is the limiting reagent when 80.0 g of $Cu_{(s)}$ reacts with 25.0 g of $S_{(s)}$?

I'm going to choose to start with Cu.

$$g\ Cu \xrightarrow{A} mol\ Cu \xrightarrow{B} mol\ S \xrightarrow{C} g\ S$$

(A) $80.0\ \cancel{g\ Cu} \times \frac{1\ mol\ Cu}{63.55\ \cancel{g\ Cu}} = 1.26\ mol\ Cu$

(B) $1.26\ \cancel{mol\ Cu} \times \frac{1\ mol\ S}{2\ \cancel{mol\ Cu}} = 0.63\ mol\ S$

(C) $0.63\ mol\ S \times \frac{32.06\ g\ S}{1\ mol\ S} = 20.20\ g\ S$

Compare the 20.20 g S calculated to the 25.0 g S given in the question.

- calculated amount is <u>less</u> than the given amount ⇒ S is in excess

- if S is in excess, Cu is the limiting reagent

$Cu_{(s)}$ is the limiting reagent

Same reaction, different numbers

② $2\,Cu_{(s)} + S_{(s)} \rightarrow Cu_2S_{(s)}$

What is the limiting reagent when 120.0g of $Cu_{(s)}$ reacts with 25.0g $S_{(s)}$?

Start with $Cu_{(s)}$

$$g\ Cu \xrightarrow{A} mol\ Cu \xrightarrow{B} mol\ S \xrightarrow{C} g\ S$$

(A) $120.0\,\cancel{g}\ Cu \times \frac{1\ mol}{63.55\,\cancel{g}} = 1.89\ mol\ Cu$

(B) $1.89\ \cancel{mol\ Cu} \times \frac{1\ mol\ S}{2\ \cancel{mol\ Cu}} = 0.945\ mol\ S$

(C) $0.945\ \cancel{mol}\ S \times \frac{32.06\ g}{1\ \cancel{mol}} = 30.3\ g\ S$

Compare the 30.3g S calculated to the 25.0g S given in the question.

- calculated amount is <u>greater</u> than the given amount ⇒ S is the limiting reagent
- this means Cu is in excess

$S_{(s)}$ is the limiting reagent