Follow along as you view the video, "Stoichiometry: Limiting Reactants" on edpzzle.com and fill in the blanks as you go. (Also available at https://youtu.be/_B556kf4g1g)

- What is a limiting reactant?
  - Reactant that gets used up ("depleted") first
    - Limits the amount of product formed because reaction stops when the reactant is gone
      - recall combustion of ethyl alcohol from reactions lab—used up alcohol, but plenty of O_2 remained
  - *Excess Reactant* is reactant that is left over when reaction stops
- How to identify the **limiting reactant**
  - For the reaction $N_2\ (g) + 3\ H_2\ (g) \rightarrow 2\ NH_3\ (g)$,
    - If you have 1 mol N_2 and 3 mol H_2, then both get used up (neither is limiting)
    - But if mole amounts are different from coefficients, need to compare *equivalents*:
      - e.g. if there are 1 mol N_2 and 2 mol H_2, divide *actual* moles by *coefficient* moles to get *equivalents*:

$$\text{Equiv. } N_2 = \frac{1 \text{ mol } N_2}{1 \text{ mol } N_2} = 1; \quad \text{Equiv. } H_2 = \frac{2 \text{ mol } H_2}{3 \text{ mol } H_2} = 0.67$$

      - Since $0.67 < 1$, H_2 gets used up first, and is limiting reactant
    - Slightly harder example:
      - If there are 2.3 mol N_2 and 7.6 mol H_2, which reactant is limiting?

$$\text{Equiv. } N_2 = \frac{2.3 \text{ mol } N_2}{1 \text{ mol } N_2} = 2.3; \quad \text{Equiv. } H_2 = \frac{7.6 \text{ mol } H_2}{3 \text{ mol } H_2} = 2.5$$

      - $2.3 < 2.5$, so N_2 gets used up first and is the limiting reactant
  - Mass-Mass problems
    - For the same reaction, determine the limiting reactant if there are 20.0 g N_2 and 10.0 g H_2:
      - First we must determine the number of moles of each reactant:

$$20.0 \text{ g } N_2 \times \frac{1 \text{ mol } N_2}{28.02 \text{ g } N_2} = 0.714 \text{ mol } N_2; \quad 10.0 \text{ g } H_2 \times \frac{1 \text{ mol } H_2}{2.016 \text{ g } H_2} = 4.96 \text{ mol } H_2$$

      - Next determine equivalents, as before:

$$\text{Equiv. } N_2 = \frac{0.714 \text{ mol } N_2}{1 \text{ mol } N_2} = 0.714; \quad \text{Equiv. } H_2 = \frac{4.96 \text{ mol } H_2}{3 \text{ mol } H_2} = 1.65$$

      - $0.714 < 1.65$, so N_2 is limiting.
    - You try it:
      - For the reaction, $4\ FeS(s) + 7\ O_2(g) \rightarrow 2\ Fe_2O_3(s) + 4\ SO_2(g)$, what is the limiting reactant if 84.9 g FeS reacts with 64.9 g O_2?
        - First, determine the moles of each reactant:

$$84.9 \text{ g FeS} \times \frac{1 \text{ mol FeS}}{87.92 \text{ g FeS}} = 0.966 \text{ mol FeS}; \quad 64.9 \text{ g } O_2 \times \frac{1 \text{ mol } O_2}{32.00 \text{ g } O_2} = 2.03 \text{ mol } O_2$$

      - Next determine equivalents:

$$\text{Equiv. FeS} = \frac{0.966 \text{ mol FeS}}{4 \text{ mol FeS}} = 0.242; \quad \text{Equiv. } O_2 = \frac{2.03 \text{ mol } O_2}{7 \text{ mol } O_2} = 0.290$$

      - Since $0.242 < 0.290$, FeS is limiting.