Limiting Reagents

Warm Up 3/10/2015

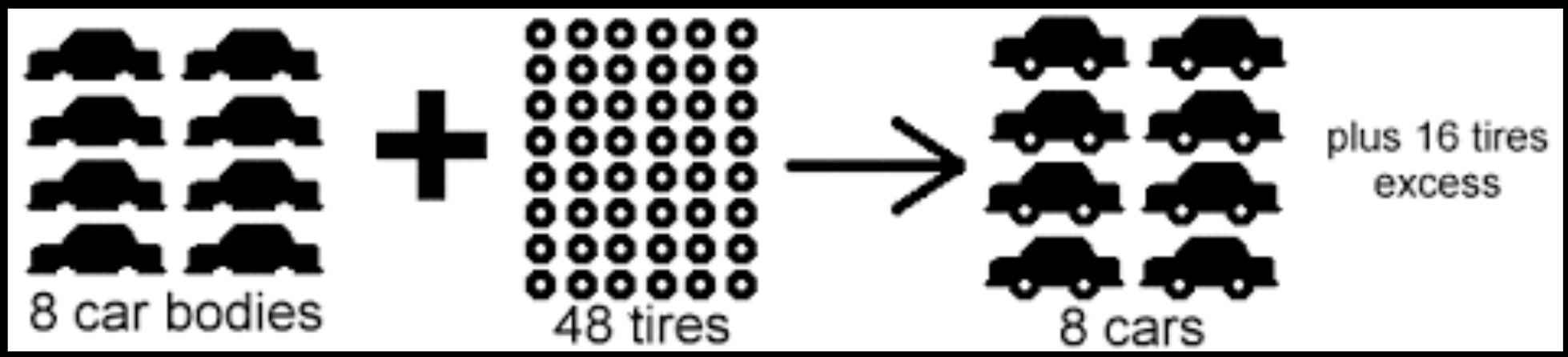
Barium nitrate (reagent A) and sodium sulfate (reagent B) react to form barium sulfate, which will precipitate out of solution. Assuming each solution represents 1 mole, **which combination would you expect to have the greatest amount of precipitate and why?**

Drops Reagent A	1	2	3	4	5	6	7	8	9
Drops Reagent B	10	10	8	8	6	6	4	4	2

Limiting reagents

Most of the time in chemistry we have more of one reagent then the other. That reagent is said to be in excess.

The other reagent limits how much product we get. The reactions stop when it runs out so we call it the limiting reagent.



What is the limiting reagent?

Step 1: Start with a balanced chemical reaction.
Step 2: Calculate amount of a single (and the same) product produced from each of the reagents.
Step 3: Identify the limiting reagent by the least amount of product produced.
Step 4: Identify the excess reagent by the most amount of product produced.

Be sure to pick a single product to compare!

Limiting Reagent Practice

15.0 g of potassium reacts with 15.0 g of iodine.

Start with a balanced equation: $2\ K + I_2 \rightarrow 2\ KI$

Pick a reagent to start: K

$$\frac{15.0\ g\ K}{} \left| \frac{1\ mol\ K}{39.10\ g\ K} \right| \frac{2\ mol\ KI}{2\ mol\ K} \left| \frac{166.0\ g\ KI}{1\ mol\ KI} \right. = 63.68\ g\ KI$$

Try for other reagent: I_2

$$\frac{15.0\ g\ I_2}{} \left| \frac{1\ mol\ I_2}{253.80\ g\ I_2} \right| \frac{2\ mol\ KI}{1\ mol\ I_2} \left| \frac{166.0\ g\ KI}{1\ mol\ KI} \right. = 19.62\ g\ KI$$

10.0g of aluminium reacts with 35.0 grams of chlorine gas to produce aluminium chloride. Which reagent is limiting, which is in excess, and how much product is produced?

Start with a balanced equation: $2\ Al + 3\ Cl_2 \rightarrow 2\ AlCl_3$

Pick a reagent to start: Al

$$\frac{10.0\text{ g Al}}{} \left| \frac{1\text{ mol Al}}{27.0\text{ g Al}} \right| \frac{2\text{ mol } AlCl_3}{2\text{ mol Al}} \left| \frac{133.5\text{ g } AlCl_3}{1\text{ mol } AlCl_3} \right. = 49.4\text{g } AlCl_3$$

Try for other reagent: Cl_2

$$\frac{35.0\text{ g } Cl_2}{} \left| \frac{1\text{ mol } Cl_2}{71.0\text{ g } Cl_2} \right| \frac{2\text{ mol } AlCl_3}{3\text{ mol } Cl_2} \left| \frac{133.5\text{ g } AlCl_3}{1\text{ mol } AlCl_3} \right. = 43.9\text{g } AlCl_3$$

15.0 g of K reacts with 15.0 g of I_2. I_2 limits the reaction and 19.62 g of KI is produced.

$$2\ K + I_2 \rightarrow 2\ KI$$

Finding excess reagent used:

start with limiting reagent

$$\frac{15.0\ g\ I_2}{} \left| \frac{1\ mol\ I_2}{254\ g\ I_2} \right| \frac{2\ mol\ K}{1\ mol\ I_2} \left| \frac{39.1\ g\ K}{1\ mol\ K} \right. = 4.62\ g\ K$$

end with excess reagent

Calculate excess (unused) reagent:

15 g K (have) − 4.62 g K (needed) = 10.38 g K excess (unused)

Calculating Excess Reagent

How much more reagent do you have than what you need?

Amount of reagent have — **Amount of reagent needed** = **Excess Reagent**

1. Using limiting reagent, calculate amount of excess reagent needed - determine using stoichiometry from grams of limiting reagent.
2. Subtract amount reagent needed from amount of reagent you have.

- 30 grams of ammonium nitrate react with 50 grams sodium phosphate
  - Which of the reagents is limiting?
  - How much excess reagent do you actually need?
  - How much excess reagent do you have?

10.0g of aluminium reacts with 35.0 grams of chlorine gas to produce aluminium chloride. Which reagent is limiting, which is in excess, and how much product is produced?

Start with a balanced equation: $2\ Al + 3\ Cl_2 \rightarrow 2\ AlCl_3$

Pick a reagent to start: Al

10.0 g Al | | | | = g $AlCl_3$

Try for other reagent: Cl_2

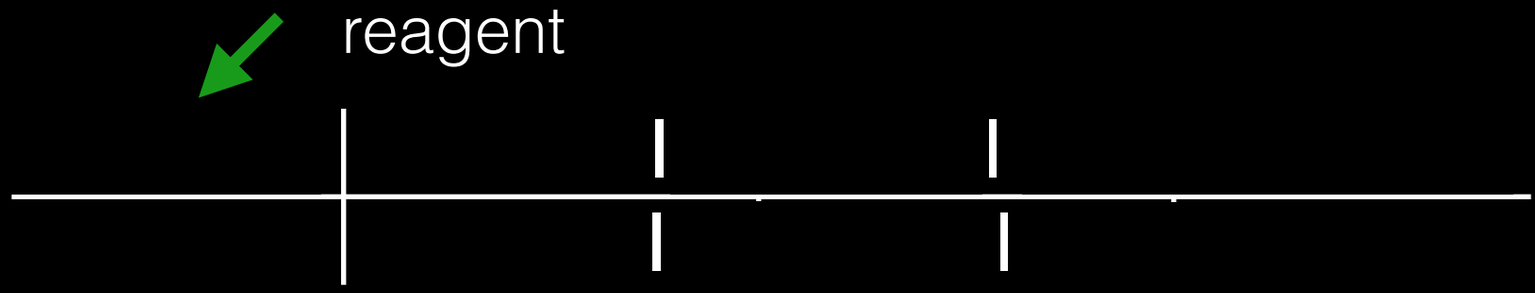
35.0 g Cl_2 | | | | = g $AlCl_3$

15.0 g of K reacts with 15.0 g of I_2. I_2 limits the reaction and 19.62 g of KI is produced.

$$2\ K + I_2 \rightarrow 2\ KI$$

Finding excess reagent used:

start with limiting reagent



= g K

end with excess reagent

Calculate excess (unused) reagent:

15 g K
(have)

Limiting Reagent Practice

15.0 g of potassium reacts with 15.0 g of iodine. Identify the limiting reagent and how much product would be produced.

Start with a balanced equation: $2\ K + I_2 \rightarrow 2\ KI$

Pick a reagent to start: K

15.0 g K | | | = g KI

Try for other reagent: I_2

15.0 g I_2 | | | = g KI