class notes – chemistry Mr Genest, January, 29, 2014

Warmup

A certain recipe for sandwiches calls for:

2 breadslices + 3 anchovies → 1 sandwich

If your kitchen has 35 breadslices and 45 anchovies, how many sandwiches can you make?

#1 $35 \text{ breadslices} \times \left(\frac{1 \text{ sandwich}}{2 \text{ breadslice}}\right) = 17.5 \text{ sandwich}$

#2 $45 \text{ anchovies} \times \left(\frac{1 \text{ sandwich}}{3 \text{ anchovies}}\right) = 15 \text{ sandwiches}$

Definition: "LIMITING REAGENT" is the substance you don't have enough of

Example: IN THE REACTION ABOVE, ANCHOVIES ARE THE LIMITING REAGENT

The 3 Steps of Solving a Limiting Reagent Problem

This acid-base reaction takes place in the stomach when a person takes an antacid.

$$2\,HCl_{(aq)} + Ca(OH)_{2\,(s)} \rightarrow CaCl_{2\,(aq)} + 2\,H_2O_{(l)}$$

How many grams of water are made when 0.656 g *each* of hydrochloric acid (HCl) and calcium hydroxide are mixed?

Step 1) Convert the mass of each reactant into moles of product

#1 $.656 \text{ g } HCl \times \left(\frac{1 \text{ mol } HCl}{36.46 \text{ g } HCl}\right) \times \left(\frac{1 \text{ mol } CaCl_2}{2 \text{ mol } HCl}\right) = 9.00 \times 10^{-3} \text{ mol } CaCl_2$

#2 $.656 \text{ g } Ca(OH)_2 \times \left(\frac{1 \text{ mol } Ca(OH)_2}{74.10 \text{ g } Ca(OH)_2}\right) \times \left(\frac{1 \text{ mol } CaCl_2}{1 \text{ mol } Ca(OH)_2}\right) = 8.85 \times 10^{-3} \text{ mol } CaCl_2$

Step 2) The reaction can't make 0.0180 ***and*** 0.0177 moles of H_2O. One reactant limits how much product can be made. The limiting reactant (reagent) is the one that produces the least product.

the limiting reactant is $Ca(OH)_2$ because it's what makes the least product

Step 3) Calculate the mass of product produced

Since we already know 8.85×10^{-3} moles $CaCl_2$ form

$8.85 \times 10^{-3} \text{ mol } CaCl_2 \times \left(\frac{110.98 \text{ grams } CaCl_2}{1 \text{ mol } CaCl_2}\right) = 0.982 \text{ gram } CaCl_2$

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Stop in for hel[illegible]very day at[illegible]nch and Tues., Weds., &Th[illegible]s after[illegible]ol!

After-hours qu[illegible]tion? Em[illegible] me at home[illegible]eagenest@madison.k12.wi.us

Nam[illegible] _____

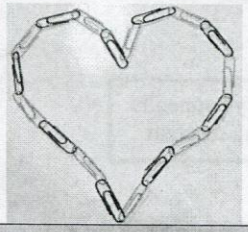
Period _____

HINTS

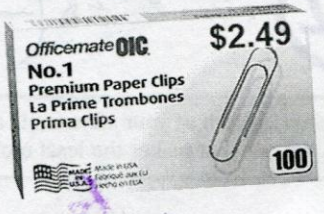
1. Calculate the answer in each case, writing both number and correct UNIT.

a. $\left(\frac{4\ moles\ Fe}{1}\right) x \left(\frac{3\ moles\ H_2\ O}{2\ moles\ Fe}\right) x \left(\frac{18.02\ grams\ H_2\ O}{1\ moles\ H_2\ O}\right) =$

b. $\left(\frac{4\ mL\ Fe}{1}\right) x \left(\frac{11\ grams\ Fe}{2\ mL\ Fe}\right) x \left(\frac{55.85\ grams\ Fe}{1\ mole\ Fe}\right) =$



1 gross paperclips = 144 paperclips
1 paperclip = 3.00 cm long
1 paperclip = 0.977 grams



2. Using only the information above, fill in these conversion factors

1 box of paperclips = ____ dollars
1 box of paperclips = ____ paperclips
1 paperclip heart = ____ paperclips

3. Using only the Equalities above, fill in the missing conversion factors and calculate the answer.

a. $\left(\frac{9\ paperclip\ hearts}{1}\right) x \left(\underline{\qquad\qquad}\right) x \left(\frac{grams}{clips}\right) =$ grams

b. $\left(\frac{33\ clips}{1}\right) x \left(\underline{\qquad\qquad}\right) x \left(\frac{dollars}{boxes\ of\ clips}\right) =$ dollars

add one more step

c. $\left(\frac{53\ boxes\ of\ clips}{1}\right) x \left(\underline{\qquad\qquad}\right) x \left(\frac{meters}{cm}\right) =$ meters

d. $\left(\frac{13\ dollars}{1}\right) x \left(\underline{\qquad\qquad}\right) x \left(\frac{clips}{boxes\ of\ clips}\right) =$ clips

4. Imagine that 100. grams of aluminum and 100 grams of chlorine gas (remember: wacky 7 formula for the chlorine molecule…) react according to the following stoichiometery

$2Al_{(s)} + 3Cl_{2(g)} \rightarrow 2AlCl_{3(s)}$

Which reagent will be the limiting reagent? How many grams of $AlCl_{3(s)}$ will form?

Step 1) Convert the mass of each reactant into moles of product

#1 $100.\text{g Al} \times \left(\frac{\text{mol Al}}{\text{g Al}}\right) \times \left(\frac{\text{mol AlCl}_3}{\text{mol Al}}\right) =$

#2 $100.\text{g Cl}_2 \times \left(\quad\right) \times \left(\quad\right) =$

Step 2) Both of your statements in Step 1 can't be right. The one that will actually happen is the one that makes the least moles of product. Below this box write "The limiting reactant

Step 3) Calculate the mass of product produced

5. Use the same three steps you used on the example from class. Imagine that 67.00 grams of aluminum and 60.50 grams grams of chlorine gas react according to the following stoichiometery

$2Al_{(s)} + 3Cl_{2(g)} \rightarrow 2AlCl_{3(s)}$

Which reagent will be the limiting reagent? How many grams of $AlCl_{3(s)}$ will form?

#1 $67.00\text{g Al} \times \left(\frac{\text{mol Al}}{\text{g Al}}\right) \times \left(\frac{\text{mol AlCl}_3}{\text{mol Al}}\right) =$

#2 $60.50\text{g Cl}_2 \times \left(\frac{\text{mol Cl}_2}{\text{g Cl}_2}\right) \times \left(\frac{\text{mol AlCl}_3}{\text{mol Cl}_2}\right) =$