Name ANSWERS Hr.

Review Stoichiometry

For the following question there is something wrong. Your job is to find out what is wrong and fix it.

The conversions below are incorrect. Re-write them so that they are correct.

Incorrect	Correct
22.4 moles = 1 liter of gas *(true for gases at S.T.P.)*	1 mole = 22.4 L
1.01 grams H_2 = 1 mole of H_2	2.02 g = 1 mole
$6.02x10^{23}$ moles of copper = 63.55 g copper	6.02×10^{23} atoms of copper = 1 mole copper; 1 mole copper = 63.55g Cu
$6.02x10^{23}$ moles of argon = 1 atom of argon	1 mole Argon = 6.02×10^{23} atoms Ar

Iron can react with steam according to the following reaction:

$$3Fe_{(s)} + 4H_2O_{(g)} \rightarrow 1Fe_3O_{4(s)} + 4H_{2(g)}$$

In the 4 problems below, cross out any incorrect conversion factors and write what the correct conversion factor would be. (The 999 at the beginning of each problem is not a conversion factor so leave it alone.) Assume the temperature and pressure are S.T.P. You do not have to answer the problem.

$$\left(\frac{999\, moles\, Fe}{1}\right) x \left(\frac{\cancel{1}\,4\, moles\, H_2O}{\cancel{1}\,3\, moles\, Fe}\right) x \left(\frac{18.02\, grams\, H_2O}{\cancel{4}\,1\, moles\, H_2O}\right) =$$

$$\left(\frac{999\, liters\, H_2O}{1}\right) x \left(\frac{\cancel{1}\, moles\, H_2O}{\cancel{1}\,22.4L\, liters\, H_2O}\right) x \left(\frac{3\,\cancel{1}\, moles\, Fe}{4\,\cancel{1}\, moles\, H_2O}\right) =$$

$$\left(\frac{999\, grams\, Fe}{1}\right) x \left(\frac{\cancel{1}\, moles\, Fe}{\cancel{1}\,55.85\, grams\, Fe}\right) x \left(\frac{4\,\cancel{1}\, moles\, H_2}{\cancel{1}\,3\, moles\, Fe}\right) =$$

$$\left(\frac{999\, mL\, H_2}{1}\right) x \left(\frac{1\, L\, H_2}{\cancel{1}\,1000\, mL\, H_2}\right) x \left(\frac{1\, moles\, H_2}{\cancel{4}\,22.4\, L\, H_2}\right) =$$

1. Balance the following reaction and answer the other questions:

   a. __2__ $C_2H_{6(g)}$ + __5__ $O_{2(g)}$ → __4__ $CO_{2(g)}$ + __6__ $H_2O_{(g)}$

   b. Write five possible mole ratios.

   c. If 3.00 moles of $C_2H_{6(g)}$ are burned, how many moles of $CO_{2(g)}$ are produced?

$$3.00 \text{ moles } C_2H_6 \times \left(\frac{4 \text{ mol } CO_2}{2 \text{ mol } C_2H_6}\right) = 6.00 \text{ mol } CO_2$$

   d. If 2.34 grams of $C_2H_{6(g)}$ are burned, how many grams of $H_2O_{(g)}$ are produced?

$$\frac{2.34 \text{ g } C_2H_6}{1} \times \left(\frac{1 \text{ mol } C_2H_6}{30.08 \text{ g } C_2H_6}\right) \times \left(\frac{6 \text{ mol } H_2O}{2 \text{ mol } C_2H_6}\right) \times \left(\frac{18.02 \text{ grams } H_2O}{1 \text{ mol } H_2O}\right) = 4.21 \text{ g } H_2O$$

   e. If 2.56 grams of $CO_{2(g)}$ are produced, how many liters of $H_2O_{(g)}$ are made at the same time if at STP?

$$2.56 \text{ g } CO_2 \times \left(\frac{1 \text{ mol } CO_2}{44.01 \text{ g } CO_2}\right) \times \left(\frac{6 \text{ mol } H_2O}{4 \text{ mol } CO_2}\right) \times \left(\frac{22.4 \text{ L } H_2O}{1 \text{ mol } H_2O}\right) = 1.95 \text{ L } H_2O$$

2. Balance the following reaction and answer the questions:

   a. __2__ $H_2O_{(l)}$ + __2__ $SO_{2(g)}$ + __1__ $O_{2(g)}$ → __2__ $H_2SO_{4(l)}$

   b. How many moles of $H_2O_{(l)}$ are needed to completely react 3.7 grams of $SO_{2(g)}$?

$$3.7 \text{ g } SO_2 \times \frac{1 \text{ mol } SO_2}{64.07 \text{ g } SO_2} \times \frac{2 \text{ mol } H_2O}{2 \text{ mol } SO_2} = 0.058 \text{ mol } H_2O$$

   c. How many moles of $O_{2(g)}$ are needed to use up 13.7 moles of $SO_{2(g)}$?

$$13.7 \text{ mol } SO_2 \times \left(\frac{1 \text{ mol } O_2}{2 \text{ mol } SO_2}\right) = 6.85 \text{ mol } O_2$$

   d. How many moles of $H_2SO_{4(l)}$ will be produced if 13.7 moles of $SO_{2(g)}$ are used up?

$$13.7 \text{ mol } SO_2 \times \left(\frac{2 \text{ mol } H_2SO_4}{2 \text{ mol } SO_2}\right) = 13.7 \text{ mol } H_2SO_4$$

3. How many grams of $H_{2(g)}$ are made when 3.45 moles of Na react according to the following equation?

$$2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$$

$$3.45 \text{ mol Na} \times \left(\frac{1 \text{ mol } H_2}{2 \text{ mol Na}}\right) \times \left(\frac{2.02 \text{ grams } H_2}{1 \text{ mol } H_2}\right) = 3.48 \text{ g } H_2$$

Inventing appropriate conversion factors

CλeMis+ry: http://genest.weebly.com

Stop in for help every day at lunch and Tues, Weds., &Thurs after school!

After-hours question? Email me at home: eagenest@madison.k12.wi.us

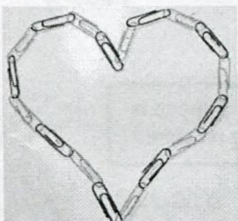
Name ANSWERS

Period ______

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

a. $\left(\frac{4\ moles\ Fe}{1}\right) x \left(\frac{3\ moles\ H_2O}{2\ moles\ Fe}\right) x \left(\frac{18.02\ grams\ H_2O}{1\ moles\ H_2O}\right) =$ 108 g H_2O

b. $\left(\frac{4\ mL\ Fe}{1}\right) x \left(\frac{11\ grams\ Fe}{2\ mL\ Fe}\right) x \left(\frac{55.85\ grams\ Fe}{1\ mole\ Fe}\right) =$ 1228 $\frac{grams^2}{moles}$



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 = 2.49 dollars
   1 box of paperclips = 100 paperclips
   1 paperclip heart = 18 paperclips

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

a. $\left(\frac{9\ paperclip\ hearts}{1}\right) x \left(\frac{18\ clips}{1\ hearts}\right) x \left(\frac{0.977\ grams}{1\ clips}\right) =$ grams

b. $\left(\frac{33\ clips}{1}\right) x \left(\frac{1\ boxes}{100\ clips}\right) x \left(\frac{2.49\ dollars}{1\ boxes\ of\ clips}\right) =$ dollars

c. $\left(\frac{53\ boxes\ of\ clips}{1}\right) x \left(\frac{100\ clip}{1\ box}\right)\left(\frac{3.00\ cm}{1\ clip}\right) x \left(\frac{1\ meters}{100\ cm}\right) =$ meters

d. $\left(\frac{13\ dollars}{1}\right) x \left(\frac{1\ box}{2.49\ dollars}\right) x \left(\frac{100\ clips}{1\ boxes\ of\ clips}\right) =$ 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 $100.\text{ grams Al} \times \left(\frac{1 \text{ mol Al}}{26.98 \text{ g Al}}\right) \times \left(\frac{2 \text{ mol } AlCl_3}{2 \text{ mol Al}}\right) = 3.71 \text{ mol } AlCl_3$

#2 $100.\text{ grams } Cl_2 \times \left(\frac{1 \text{ mol } Cl_2}{70.90 \text{ g } Cl_2}\right) \times \left(\frac{2 \text{ mol } AlCl_3}{3 \text{ mol } Cl_2}\right) = 0.940 \text{ mol } AlCl_3$

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

The limiting reactant is chlorine because it makes the least product.

Step 3) Calculate the mass of product produced

Because we just found that 0.940 mol $AlCl_3$ can form, we use that in our calculation:

$\frac{0.940 \text{ mol } AlCl_3}{1} \times \left(\frac{133.33 \text{ grams } AlCl_3}{1 \text{ mol } AlCl_3}\right) = 125 \text{ grams } AlCl_3$

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 $\frac{67.00 \text{ grams Al}}{1} \times \left(\frac{1 \text{ mol Al}}{26.98 \text{ g Al}}\right) \times \left(\frac{2 \text{ mol } AlCl_3}{2 \text{ mol Al}}\right) = 2.48 \text{ mol } AlCl_3$ would form

#2 $60.50 \text{ g } Cl_2 \times \left(\frac{1 \text{ mol } Cl_2}{70.90 \text{ g } Cl_2}\right) \times \left(\frac{2 \text{ mol } AlCl_3}{3 \text{ mol } Cl_2}\right) = 0.569 \text{ mol } AlCl_3$ would form

Both can't be right; Cl_2 will run out first. Cl_2 is the "LIMITING REAGENT":

$\frac{0.569 \text{ mol } AlCl_3 \text{ (from above answer)}}{1} \times \left(\frac{133.33 \text{ grams } AlCl_3}{1 \text{ mol } AlCl_3}\right) = 75.9 \text{ grams } AlCl_3$ will form