Stoichiometry Exam Review

Problems: SHOW WORK TO RECEIVE CREDIT

1. According to the reaction below, what is the mole ratio of aluminum sulfate to aluminum chloride?

$$\_\_\_\_\_\ Al_2(SO_4)_3 + \_\_3\_\_\ BaCl_2 \rightarrow \_\_3\_\_\ BaSO_4 + \_\_2\_\_\ AlCl_3$$

a) 2:1 b) 1:2 c) 2:2 d) 3:2

2. From the same equation, what is the mole ratio between barium sulfate and aluminum chloride?

a) 2:1 b) 1:2 c) 2:2 d) 3:2

look at coefficients!

3. What conversion factor from the reaction below would you use to begin converting 4.56g of N_2 to moles of NH_3 produced?

$$\_\_\_\_ N_2 + \_3\_ H_2 \rightarrow \_2\_ NH_3$$

g: 4.56g N_2

w: ? mol NH_3

1 mol N_2 = 2 mol NH_3

$$4.56\text{g } N_2 \times \frac{1\text{ mol } N_2}{28.0\text{ g } N_2} \times \frac{2\text{ mol } NH_3}{1\text{ mol } N_2}$$

1 mol N_2 = 28.0g N_2

4. How many moles of NH_3 may be produced from 1.20 moles of N_2 assuming that hydrogen is excess.

$$\_\_\_\_ N_2 + \_3\_ H_2 \rightarrow \_2\_ NH_3$$

g: 1.20 mol N_2

w: ? mol NH_3

1 mol N_2 = 2 mol NH_3

$$1.20\text{ mol } N_2 \times \frac{2\text{ mol } NH_3}{1\text{ mol } N_2} = 2.40\text{ mol } NH_3$$

5. Calculate the number of moles of H_2 produced from 0.78 moles Ga and 1.92 moles HCl?

R R

$$\_2\_\ Ga + \_6\_\ HCl \rightarrow \_2\_\ GaCl_3 + \_3\_\ H_2$$

g: 0.78 mol Ga
g: 1.92 mol HCl
w: ? mol H_2

2 mol Ga = 3 mol H_2
6 mol HCl = 3 mol H_2

$$0.78\ mol\ Ga \left| \frac{3\ mol\ H_2}{2\ mol\ Ga} \right. = 1.2\ mol\ H_2$$

$$1.92\ mol\ HCl \left| \frac{3\ mol\ H_2}{6\ mol\ HCl} \right. = 0.960\ mol\ H_2$$

6. How many moles of H_2O_2 are required to react with 11.0 g of N_2H_4 according to the following reaction?

$$\_7\_\ H_2O_2 + \_1\_\ N_2H_4 \rightarrow \_2\_\ HNO_3 + \_8\_\ H_2O$$

g: 11.0 g N_2H_4
w: ? mol H_2O_2

7 mol H_2O_2 = 1 mol N_2H_4

$$11.0\ g\ N_2H_4 \left| \frac{1\ mol\ N_2H_4}{32.0\ g\ N_2H_4} \right| \frac{7\ mol\ H_2O_2}{1\ mol\ N_2H_4} = 2.41\ mol\ H_2O_2$$

7. How many grams of S are formed at STP from the reaction of 6.80 g of H_2S and 7.43 L SO_2 according to the following reaction?

P R P

$$\underline{2}\ H_2S + \underline{\quad}\ SO_2 \rightarrow \underline{3}\ S + \underline{2}\ H_2O$$

g: 6.80 g H_2S
g: 7.43 L SO_2
w: ? g S
2 mol H_2S = 3 mol S
1 mol SO_2 = 3 mol S

$$6.80\text{ g } H_2S \left|\frac{1\text{ mol } H_2S}{34.1\text{ g } H_2S}\right.\left|\frac{3\text{ mol S}}{2\text{ mol } H_2S}\right.\left|\frac{32.1\text{ g S}}{1\text{ mol S}}\right. = 9.60\text{ g S}$$

$$7.43\text{ L } SO_2 \left|\frac{1\text{ mol } SO_2}{22.4\text{ L } SO_2}\right.\left|\frac{3\text{ mol S}}{1\text{ mol } SO_2}\right.\left|\frac{32.1\text{ g S}}{1\text{ mol S}}\right. = 31.9\text{ g S}$$

8. Thin films of silicon, used in fabrication of electronic components, may be prepared by the decomposition of silane.

What mass (in g) of SiH_4 is required to prepare 0.2173 g of silicon?

$$\underline{\quad}\ SiH_4 \rightarrow \underline{\quad}\ Si + \underline{2}\ H_2$$

g: 0.2173 g Si
w: ? g SiH_4
1 mol Si = 1 mol SiH_4

$$0.2173\text{ g Si} \left|\frac{1\text{ mol Si}}{28.1\text{ g Si}}\right.\left|\frac{1\text{ mol } SiH_4}{1\text{ mol Si}}\right.\left|\frac{32.1\text{ g } SiH_4}{1\text{ mol } SiH_4}\right.$$

$$= 0.2482\text{ g } SiH_4$$

9. The reaction of 0.68 g of NH_3 with excess O_2 according to the following reaction yields 0.98 g of NO. What is the percent yield?

$$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$$

$2 + 3 = 5$

R g: 0.68 g NH_3

W: ? g NO

P actual: 0.98 g NO

4 mol NH_3 = 4 mol NO

0.68 g NH_3	1 mol NH_3	4 mol NO	30.0 g NO
	17.0 g NH_3	4 mol NH_3	1 mol NO

theor. → 1.2 g NO

$$\%\ yield = \frac{A}{T} \times 100$$

$$\frac{0.98\ g\ NO}{1.2\ g\ NO} \times 100 = \boxed{82\%\ yield}$$

10. A chemist combines 6.32 g of C_2H_2 and 12.2 g of oxygen. How many grams of carbon dioxide are produced?

R R

5 mol O_2 = 4 mol CO_2

2 mol C_2H_2 = 4 mol CO_2

$$\underline{2}\ C_2H_2(g) + \underline{5}\ O_2(g) \rightarrow \underline{4}\ CO_2(g) + \underline{2}\ H_2O(l)$$

4 + 1 = 5

g: 6.32 g C_2H_2

g: 12.2 g O_2

w: ? g CO_2

$$6.32\text{g}\,C_2H_2 \left|\frac{1\text{mol}\,C_2H_2}{26.0\text{g}\,C_2H_2}\right|\frac{4\text{mol}\,CO_2}{2\text{mol}\,C_2H_2}\left|\frac{44\text{g}\,CO_2}{1\text{mol}\,CO_2}\right| = 21.4\text{g}\,CO_2$$

$$12.2\text{g}\,O_2 \left|\frac{1\text{mol}\,O_2}{32.0\text{g}\,O_2}\right|\frac{4\text{mol}\,CO_2}{5\text{mol}\,O_2}\left|\frac{44\text{g}\,CO_2}{1\text{mol}\,CO_2}\right| = \boxed{13.4\text{g}\,CO_2}$$

What is the limiting reactant? O_2

How many grams excess reagent remain after the previous reaction? 2.35 g C_2H_2

g: 12.2 g O_2 LR

w: ? g C_2H_2 ER

2 mol C_2H_2 = 5 mol O_2

$$12.2\text{g}\,O_2 \left|\frac{1\text{mol}\,O_2}{32.0\text{g}\,O_2}\right|\frac{2\text{mol}\,C_2H_2}{5\text{mol}\,O_2}\left|\frac{26.0\text{g}\,C_2H_2}{1\text{mol}\,C_2H_2}\right|$$

avail − used = remain

6.32 g C_2H_2 − 3.97 g C_2H_2 = 2.35 g C_2H_2 remain

3.97 g C_2H_2 used

Know the following terms:

stoichiometry the relationship between the quantities of substances taking part in a reaction. Always use mol ratios!

percent yield $\frac{\text{actual}}{\text{theoretical}} \times 100 = \%\ \text{yield}$

actual yield amount of product actually obtained in an experiment (measured or given in problem)

theoretical yield amount of product that should have been obtained in an experiment. (calculated)

gram formula mass also known as molar mass. The mass (in grams) of one mole of a substance.

Law of Conservation of Mass mass & # of atoms are always conserved in a reaction.

Excess reagent also known as "excess reactant". The reactant that is NOT used up in an experiment.

Limiting reagent also known as "limiting reactant!" The reactant that is used up in a reaction.

Mol-mol ratio ratio of moles of one substance to moles of another. Found using coefficients from balanced chemical equations.

Good luck on your test! :)