NAME _KEY_

CHEM1301 Stoichiometry Homework #11

Due: Friday, October 31

Show your work!

1. For the reaction shown, find the limiting reactant for each of the initial quantities of reactants.

$$4\ Cr(s) + 3\ O_2(g) \rightarrow 2\ Cr_2O_3(s)$$
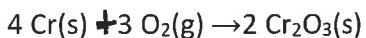
a) 1 mol Cr; 1 mol O_2

$$\frac{1\ mol\ Cr}{} \left(\frac{2\ mol\ Cr_2O}{4\ mol\ Cr}\right) = .5\ mol\ Cr_2O_3 \leftarrow Theor.\ Yield$$

LR!

$$1\ mol\ O_2 \left(\frac{2\ mol\ Cr_2O_3}{3\ mol\ O_2}\right) = .67\ mol\ Cr_2O_3$$

b) 4 mol Cr; 5 mol O_2

LR

$$\boxed{4\ mol\ Cr} \left(\frac{2\ mol\ Cr_2O_3}{4\ mol\ Cr}\right) = \underline{2\ mol\ Cr_2O_3}\ \nwarrow TY$$

$$5\ mol\ O_2 \left(\frac{2\ mol\ Cr_2O_3}{3\ mol\ O_2}\right) = 3.3\ mol\ Cr_2O_3$$

c) 12.4 mol Cr; 10.3 mol O_2

LR

$$\frac{12.4\ mol\ Cr}{} \left(\frac{2\ mol\ Cr_2O_3}{4\ mol\ Cr}\right) = \underline{6.2\ mol\ Cr_2O_3}\ \nwarrow TY$$

$$10.3\ mol\ O_2 \left(\frac{2\ mol\ Cr_2O_3}{3\ mol\ O_2}\right) = 6.9\ mol\ Cr_2O_3$$

2. Consider the reaction below.

$$4 \ HCl \ (g) + O_2 \ (g) \rightarrow 2 \ H_2O \ (g) + 2 \ Cl_2 \ (g)$$

5.76g   4.32g   ?
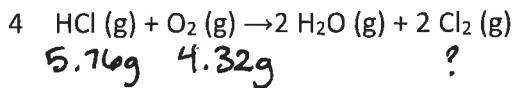
a) If 5.76 g HCl and 4.32g O_2 react, what is the theoretical yield of Cl_2 and which is the limiting reactant?

$$\dfrac{5.76g \ HCl}{LR} \left(\dfrac{1 mol \ HCl}{36.46g \ HCl}\right)\left(\dfrac{2 mol \ Cl_2}{4 mol \ HCl}\right)\left(\dfrac{70.9g \ Cl_2}{1 mol \ Cl_2}\right) = \boxed{5.60g \ Cl_2}$$

TY r

.079 mol Cl₂

$$4.32g \ O_2 \left(\dfrac{1 mol \ O_2}{32.00g \ O_2}\right)\left(\dfrac{2 mol \ Cl_2}{1 mol \ O_2}\right)\left(\dfrac{70.9g \ Cl_2}{1 mol \ Cl_2}\right) = 19.1g \ Cl_2$$

I put these → .27 mol Cl₂
here in case you
stopped at mol Cl₂.
Still gives the same
answer!

b) You run the experiment with the masses given in part a). If the percent yield for Cl_2 is 55.4% for the reaction above, how much Cl_2 would you expect to recover in the lab?

$$\% \ y = \dfrac{AY}{TY} \times 100\%$$

$$.544 = \dfrac{AY}{5.60g \ Cl_2}$$

$$AY = 3.05g \ Cl_2$$

3. Consider the reaction below:

$$2NiS_2 + 5 O_2 \rightarrow 2 NiO + 4 SO_2$$

11.2g   5.43g $\underset{4.86g \text{ Recovered } (AY)}{\curvearrowleft}$
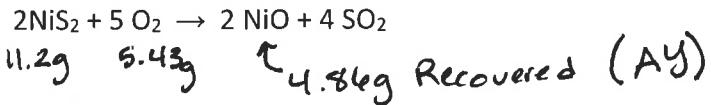
When 11.2 g of NiS_2 react with 5.43 g of O_2, 4.86 g of NiO are recovered. Determine the limiting reactant, the theoretical yield, and the percent yield for the reaction.

$$11.2g \; NiS_2 \left(\frac{1 mol\, NiS_2}{122.81g\, NiS_2}\right)\left(\frac{2 mol\, NiO}{2 mol\, NiS_2}\right)\left(\frac{74.69g\, NiO}{1 mol\, NiO}\right) = 6.81g \; NiO$$

LR

$\rightarrow$ $\boxed{5.43g \; O_2}\left(\dfrac{1 mol\, O_2}{32.00g\, O_2}\right)\left(\dfrac{2 mol\, NiO}{5 mol\, O_2}\right)\left(\dfrac{74.69g\, NiO}{1 mol\, NiO}\right) = \overset{\downarrow TY}{\boxed{5.07g \; NiO}}$
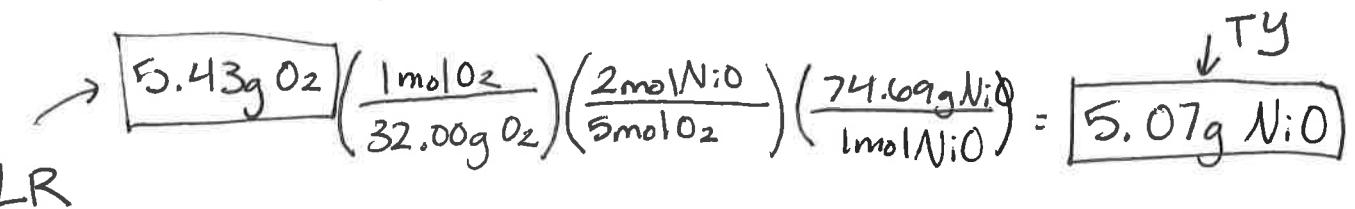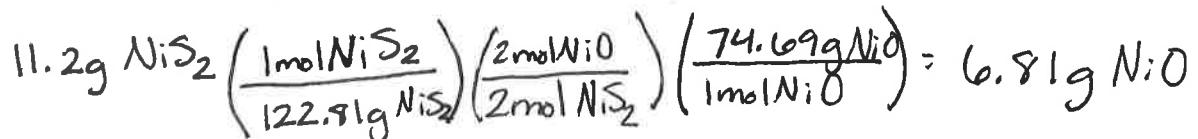
$$\% y = \frac{4.86g}{5.07g} \times 100\% = \boxed{95.9\%}$$

4. Sodium peroxide ($\overset{\curvearrowleft Na\, !}{N_2O_2}$) reacts with water to form sodium hydroxide and oxygen gas. Write the balanced equation for the reaction. Determine how much oxygen in grams is formed when 32.09 g Na_2O_2 are reacted completely.

$$2 Na_2O_2 + 2 H_2O \longrightarrow 4 NaOH + O_2$$

32.09g   ?g

$$32.09g \; Na_2O_2 \left(\frac{1 mol\, Na_2O_2}{77.98g\, Na_2O_2}\right)\left(\frac{1 mol\, O_2}{2 mol\, Na_2O_2}\right)\left(\frac{32.00g\, O_2}{1 mol\, O_2}\right)$$

$$= \boxed{6.58g \; O_2}$$