KEY

Chemistry I (1) Review Chapter 9

Name:

Ideal Stoichiometry (No limiting reactants) & Percent Yield

1. The *unbalanced* chemical equation for the formation of water is:

   2 H_2 + ____ O_2 → 2 H_2O

   a. If 3.3 mol O_2 are used, how many liters of H_2 are needed?

   $3.3\ mol\ O_2 \left| \frac{2\ H_2}{1\ O_2} \right| \frac{22.4\ L\ H_2}{1\ mol\ H_2} = 147.84\ L \rightarrow 150\ L\ H_2$ or $1.5 \times 10^2\ L\ H_2$

   b. How many grams O_2 must react with excess H_2 to form 6.72 grams H_2O?

   $6.72\ g\ H_2O \left| \frac{1\ mol\ H_2O}{18.02\ g\ H_2O} \right| \frac{1\ O_2}{2\ H_2O} \left| \frac{32.0\ g\ O_2}{1\ mol\ O_2} \right. = 5.96\ g\ O_2$

   c. If you wanted to make 8.12 grams H_2O, how many molecules of H_2 would you need?

   $8.12\ g\ H_2O \left| \frac{1\ mol\ H_2O}{18.02\ g\ H_2O} \right| \frac{2\ H_2}{2\ H_2O} \left| \frac{6.02 \times 10^{23}\ molec\ H_2}{1\ mol\ H_2} \right. = 2.71 \times 10^{23}\ molec\ H_2$

2. Aluminum reacts with oxygen to form aluminum oxide.

   a. Write the complete balanced equation.

   $4Al + 3O_2 \rightarrow 2Al_2O_3$

   b. How many moles of O_2 are needed to react with 1.44 mol of aluminum?

   $1.44\ mol\ Al \left| \frac{3\ O_2}{4\ Al} \right. = 1.08\ mol\ O_2$

   c. How many grams of aluminum oxide can be made if 5.23 grams Al completely react?

   $5.23\ g\ Al \left| \frac{1\ mol\ Al}{26.98\ g\ Al} \right| \frac{2\ Al_2O_3}{4\ Al} \left| \frac{101.96\ g\ Al_2O_3}{1\ mol\ Al_2O_3} \right. = 9.88\ g\ Al_2O_3$

   d. How many grams of aluminum oxide can be formed by the reaction of 38.8 L of oxygen gas?

   $38.8\ L\ O_2 \left| \frac{1\ mol\ O_2}{22.4\ L\ O_2} \right| \frac{2\ Al_2O_3}{3\ O_2} \left| \frac{101.96\ g\ Al_2O_3}{1\ mol\ Al_2O_3} \right. = 117.74\ g \rightarrow 118\ g\ Al_2O_3$

3. Calcium carbide, CaC_2, reacts with water to form acetylene.

   ____ CaC_2 + 2 H_2O → ____ C_2H_2 + ____ $Ca(OH)_2$

   a. How many grams of water are needed to react with 485 g of calcium carbide?

   $485\ g\ CaC_2 \left| \frac{1\ mol\ CaC_2}{64.1\ g\ CaC_2} \right| \frac{2\ H_2O}{1\ CaC_2} \left| \frac{18.02\ g\ H_2O}{1\ mol\ H_2O} \right. = 272.69\ g \rightarrow 273\ g\ H_2O$

   b. How many grams of CaC_2 could make 23.6 g C_2H_2?

   $23.6\ g\ C_2H_2 \left| \frac{1\ mol\ C_2H_2}{26.02\ g\ C_2H_2} \right| \frac{1\ CaC_2}{1\ C_2H_2} \left| \frac{64.1\ g\ CaC_2}{1\ mol\ CaC_2} \right. = 58.14\ g \rightarrow 58.1\ g\ CaC_2$

   c. If 55.3 g $Ca(OH)_2$ are formed, how many grams of water reacted?

   $55.3\ g\ Ca(OH)_2 \left| \frac{1\ mol\ Ca(OH)_2}{74.02\ g\ Ca(OH)_2} \right| \frac{2\ H_2O}{1\ Ca(OH)_2} \left| \frac{18.02\ g\ H_2O}{1\ mol\ H_2O} \right. = 26.93\ g \rightarrow 26.9\ g\ H_2O$

4. If 156 g of sodium nitrate react, what is the theoretical yield of sodium nitrite?

   2 $NaNO_3$ → 2 $NaNO_2$ + ____ O_2

   $156\ g\ NaNO_3 \left| \frac{1\ mol\ NaNO_3}{85\ g\ NaNO_3} \right| \frac{2\ NaNO_2}{2\ NaNO_3} \left| \frac{69.01\ g\ NaNO_2}{1\ mol\ NaNO_2} \right. = 126.65\ g \rightarrow 127\ g\ NaNO_2$

5. If the actual yield of sodium nitrite from problem number 5 is 112 g, what is the percent yield?

   $\frac{112}{127} \times 100 = 88.2\%$

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Limiting Reactant/Excess Reactant/ Theoretical Yield

6. _____ CaC_2 + _2_ H_2O → _____ C_2H_2 + _____ $Ca(OH)_2$

If 64 g CaC_2 is reacted with 64 g H_2O,

What is the limiting reactant? What is the excess reactant? H_2O

CaC_2 ← $64\,g\,CaC_2 \mid 1\,mol\,CaC_2 \mid 1\,C_2H_2 \mid 26.04\,g\,C_2H_2 \;/\; 64.1\,g\,CaC_2 \mid 1\,CaC_2 \mid 1\,mol\,C_2H_2 = 25.99 \rightarrow 26\,g\,C_2H_2$

$64\,g\,H_2O \mid 1\,mol\,H_2O \mid 1\,C_2H_2 \mid 26.04\,g\,C_2H_2 \;/\; 18.02\,g\,H_2O \mid 2\,H_2O \mid 1\,mol\,C_2H_2 = 46.$

How many grams of C_2H_2 is formed?

$26\,g\,C_2H_2$

7. In the reaction shown below, 28 g of nitrogen are reacted with 28 g of hydrogen.
_____ N_2 + _3_ H_2 → _2_ NH_3

N_2 What is the limiting reactant? What is the excess reactant? H_2

$28\,g\,N_2 \mid 1\,mol\,N_2 \mid 2\,NH_3 \mid 17.04\,g\,NH_3 \;/\; 28.02\,g\,N_2 \mid 1\,N_2 \mid 1\,mol\,NH_3 = 34.06\,g\,NH_3$

$28\,g\,H_2 \mid 1\,mol\,H_2 \mid 2\,NH_3 \mid 17.04\,g\,NH_3 \;/\; 2.02\,g\,H_2 \mid 3\,H_2 \mid 1\,mol\,NH_3 = 157.4 \rightarrow 160\,g\,NH_3$

$34\,g\,NH_3$

How many grams of NH_3 can be produced?

$34\,g\,NH_3$

How much excess reactant remains?

$28\,g\,N_2 \mid 1\,mol\,N_2 \mid 3\,H_2 \mid 2.02\,g\,H_2 \;/\; 28.02\,g\,N_2 \mid 1\,N_2 \mid 1\,mol\,H_2 = 6.06\,g\,H_2$ ← used

$28\,g - 6.06 = 21.94\,g \rightarrow 22\,g\,H_2$ excess

have − used = excess

Do you know:

-The difference between the limiting reactant and the excess reactant? Why is it important to know which is which for a reaction?

-The difference between the theoretical yield and actual yield? Is the TY usually = to the AY? Why or why not? If not how do they usually compare?

-Where do mole ratios come from? What do we use them for?