Unit 8 Stoichiometry
Conversions Requiring Mole Ratios

Name _____

Block # _____

Part A: Mole Ratios

1. How many moles of iron will be produced, if 3 moles of iron III oxide is reacted with excess aluminum?

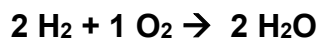   *One way to do this is to use the Cross Multiply and Divide method…*

$$1 \ Fe_2O_3 + 2 \ Al \rightarrow 2 \ Fe + 1 \ Al_2O_3$$

Word Problem   Balanced Coefficients

$$\frac{? \ moles \ Fe}{3 \ moles \ Fe_2O_3} = \frac{2 \ moles \ Fe}{\div \ 1 \ moles \ Fe_2O_3}$$

= 6 moles of Fe are produced

2. How many moles of oxygen are required to produce 10.0 moles of water?
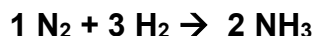
$$2 \ H_2 + 1 \ O_2 \rightarrow 2 \ H_2O$$

Another way to do it is with dimensional analysis…

Word Problem   Balanced Coefficients

$$\frac{10 \ moles \ H_2O}{1} \left| \frac{\times \ 1 \ mole \ O_2}{\div \ 2 \ moles \ H_2O} \right| = \textbf{5 moles } O_2 \textbf{ required}$$

3. How many moles of hydrogen are required to produce 25.0 moles of ammonia?

$$1 \ N_2 + 3 \ H_2 \rightarrow 2 \ NH_3$$

Word Problem   Balanced Coefficients

$$\frac{25 \ moles \ NH_3}{1} \left| \frac{\times \ 3 \ mole \ H_2}{\div \ 2 \ moles \ NH_3} \right| = \textbf{37.5 moles } H_2 \textbf{ required}$$

Part B: Working with Reactants and Products using Liters and Moles

1. How many moles of carbon dioxide will be produced, if 2.0 liters of propane are reacted with excess oxygen?

$$1 \ C_3H_8 + 5 \ O_2 \rightarrow 3 \ CO_2 + 4 \ H_2O$$

Word Problem   Gas Law Conversion   Balanced Coefficients

$$\frac{2.0 \ Liters \ C_3H_8}{1} \left| \frac{1 \ mole \ C_3H_8}{22.4 \ Liters \ C_3H_8} \right| \frac{3 \ mole \ CO_2}{1 \ mole \ C_3H_8} = \textbf{0.27 moles } CO_2$$

2. How many liters of carbon dioxide are required to produce 2.5 moles of lithium carbonate?

$$2 \text{ LiOH} + 1 \text{ CO}_2 \rightarrow 2 \text{ H}_2\text{O} + 1 \text{ Li}_2\text{CO}_3$$

Word Problem   Balanced Coefficients   Gas Law Conversion

$$\frac{2.5 \text{ moles Li}_2\text{CO}_3}{1} \left| \frac{1 \text{ mole CO}_2}{1 \text{ moles Li}_2\text{CO}_3} \right| \frac{22.4 \text{ Liters CO}_2}{1 \text{ mole CO}_2} \right| = \textbf{56 moles CO}_2$$

3. How many moles of iron III chloride will be produced from 30.5 liters of chlorine gas?

$$2 \text{ Fe} + 3 \text{ Cl}_2 \rightarrow 2 \text{ FeCl}_3$$
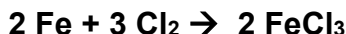
Word Problem   Gas Law Conversion   Balanced Coefficients

$$\frac{30.5 \text{ Liters Cl}_2}{1} \left| \frac{1 \text{ mole Cl}_2}{22.4 \text{ Liters Cl}_2} \right| \frac{2 \text{ mole FeCl}_3}{3 \text{ mole Cl}_2} \right| = \textbf{0.908 mole FeCl}_3$$

Part C: Working with Reactants and Products using Grams and Moles

4. How many moles of calcium are required to produce 5.0 grams of calcium hydroxide?

$$1 \text{ Ca} + 2 \text{ H}_2\text{O} \rightarrow 1 \text{ Ca(OH)}_2 + 2 \text{ H}_2$$

Molar Mass of Ca(OH)$_2$

Ca: 1 x 40 = 40
O: 2 x 16 = 32
H: 2 x 1 = 2
Total Mass = 74 g

Word Problem   Molar Mass   Balanced Coefficients

$$\frac{5.0 \text{ grams Ca(OH)}_2}{1} \left| \frac{1 \text{ mole Ca(OH)}_2}{\textbf{74 grams} \text{ Ca(OH)}_2} \right| \frac{1 \text{ mole Ca}}{1 \text{ mole Ca(OH)}_2} \right| = \textbf{20.3 moles Ca}$$

5. How many grams of potassium chloride will be produced from 0.25 moles of potassium chlorate?

$$2 \text{ KClO}_3 \rightarrow 2 \text{ KCl} + 3 \text{ O}_2$$

Molar Mass of KClO$_3$

K: 1 x 39.1 = 39.1
Cl: 1 x 35.5 = 35.5
Total Mass = 74.5g
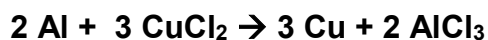
Word Problem   Balanced Coefficients   Molar Mass

$$\frac{0.25 \text{ moles KClO}_3}{1} \left| \frac{2 \text{ mole KCl}}{2 \text{ mole KClO}_3} \right| \frac{74.5 \text{ grams KCl}}{1 \text{mole KCl}} \right| = \textbf{19 grams KCl}$$

Are you confused? I bet you got 533 grams on the calculator. Don't forget that the value of moles in the word problem only contains two sig figs. Therefore, you must round off to 530 grams. The final zero is not significant because there is no decimal.

6. How many moles of copper will be produced from 3.75 grams of aluminum?

$$2\ Al + \ 3\ CuCl_2 \rightarrow 3\ Cu + 2\ AlCl_3$$

Molar Mass of Aluminum

26.98154

Al

13

Aluminum

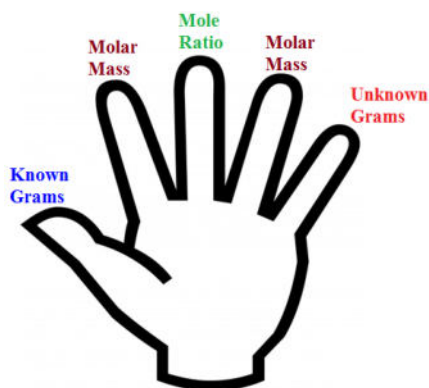Word Problem   Molar Mass   Balanced Coefficients

$$\frac{3.75\ grams\ Al}{1} \left|\frac{1\ mole\ Al}{26.98\ grams\ Al}\right|\frac{3\ mole\ Cu}{2\ mole\ Al}\right| = \mathbf{0.208\ moles\ Cu}$$

Part D: Working with Reactants and Products using Grams and Grams

*When you see gram to gram problems, remember to give yourself a big **HIGH FIVE**!*

Molar Mass   Mole Ratio   Molar Mass   Unknown Grams

Known Grams

1   2   3   4   5

$$\frac{known\ grams}{1} \left|\frac{1\ mole}{\#\ grams}\right|\frac{\#\ moles\ of\ unknown}{\#\ mole\ of\ known}\right|\frac{\#\ grams}{1\ mole}\right| = grams\ unknown$$

Where to find it…

word problem   balanced coefficients   calculator

periodic table   periodic table

7. How many grams of oxygen will be produced from 0.873 grams of sulfur trioxide?

$$2\ SO_3 \rightarrow \ 2\ SO_2 + 1\ O_2$$

Molar Mass of SO_3

S: 1 x 32 = 32
O: 3 x16 = 48
Total Mass = 80 g

$$\frac{0.873\ grams\ SO_3}{1} \left|\frac{1\ mole\ SO_3}{80\ grams\ SO_3}\right|\frac{1\ moles\ O_2}{2\ mole\ SO_3}\right|\frac{32\ grams\ O_2}{1\ mole\ O_2}\right| = \mathbf{0.175\ grams\ O_2}$$

Molar Mass of O_2
O: 2 x16 = **32g**

8. Assuming there is excess hydrochloric acid present, how many grams of barium hydroxide are required to produce 10.00 grams of barium chloride?

$$2\ HCl + 1\ Ba(OH)_2 \rightarrow 1\ BaCl_2 + 2\ H_2O$$
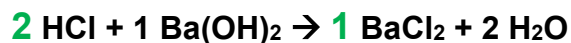
Molar Mass of $BaCl_2$

Ba: 1 x 137.3 = 137.3
Cl: 2 x 35.5 = 71.0
Total Mass = 208.3 g

$$\frac{10.00\ \text{grams BaCl}_2}{1}\left|\frac{1\ \text{mole BaCl}_2}{208.3\ \text{grams BaCl}_2}\right|\frac{1\ \text{moles Ba(OH)}_2}{1\ \text{mole BaCl}_2}\left|\frac{171.3\ \text{grams Ba(OH)}_2}{1\ \text{mole Ba(OH)}_2}\right| = 8.224\ \text{grams Ba(OH)}_2$$

Molar Mass of $Ba(OH)_2$

Ba: 1 x 137.3 = 137.3
O: 2 x 16.0 = 32.0
H: 2 x   1.0 =   2.0
Total Mass = 171.3 g

9. How many grams of sodium are required to react with 5.00 grams of chlorine gas?

$$2\ Na + 1\ Cl_2 \rightarrow 2\ NaCl$$

Molar Mass of Cl_2

Cl: 2 x 35.5 = **71.0 g**

$$\frac{5.00\ \text{grams Cl}_2}{1}\left|\frac{1\ \text{mole Cl}_2}{71.0\ \text{grams Cl}_2}\right|\frac{2\ \text{moles Na}}{1\ \text{mole Cl}_2}\left|\frac{23.0\ \text{grams Na}}{1\ \text{mole Na}}\right| = 3.24\ \text{g Na}$$

Molar Mass of Na:

22.98977
Na
11
Sodium