Stoichiometry

Mrs. Brown's Chemistry

What is stoichiometry?

- Stoichiometry is a ratio-based method chemists use to determine the relationship between the products and the reactants in a chemical reaction.
- Stoichiometry uses molar masses and mole ratios from balanced reactions to determine the masses of unknown reactants and products.
- This allows chemists to use something we can measure (mass in grams) to control chemical reactions and make accurate predictions about what will be produced in a reaction.

Let's Review Molar Mass

- **Molar Mass** (found on periodic table) – We use this to create a **conversion factor**!

- Example: 1 mole of carbon = 12.01 grams SO $\frac{\textbf{1 mol carbon}}{\textbf{12.01 grams}}$ OR $\frac{\textbf{12.01 grams}}{\textbf{1 mol carbon}}$

For compounds we sum all the element's molar masses multiplied by their subscript.

Example: **Molar mass of CO_2 (carbon dioxide)** = (1)12.01g + (2)16.00g = **44.01 grams**

$\frac{1 \text{ mol } CO_2}{44.01 \text{ grams}}$ OR $\frac{44.01 \text{ grams}}{1 \text{ mol } CO_2}$

- Practice: **Calculate the molar mass of sodium sulfide AND determine the conversion factors.**

MM of Na_2S = _____ = _____ g $\frac{\quad}{\quad}$ **OR** $\frac{\quad}{\quad}$

Let's Review Molar Ratios

- **Mole Ratio** (found from balanced equation)

  Example: $\_2\_ H_2O \rightarrow \_2\_ H_2 + \_1\_ O_2$

$\frac{2 \text{ mol } H_2O}{2 \text{ mol } H_2}$	**OR**	$\frac{2 \text{ mol } H_2}{2 \text{ mol } H_2O}$	←**Ratio between H_2 and H_2O**
$\frac{2 \text{ mol } H_2O}{1 \text{ mol } O_2}$	**OR**	$\frac{1 \text{ mol } O_2}{2 \text{ mol } H_2O}$	←**Ratio between O_2 and H_2O**
$\frac{2 \text{ mol } H_2}{1 \text{ mol } O_2}$	**OR**	$\frac{1 \text{ mol } O_2}{2 \text{ mol } H_2}$	←**Ratio between H_2 and O_2**

- **Practice: Using the following balanced equation what is the mole ratio between sodium chloride and barium chloride?**

  1. **First balance the equation!** $\_\_\_\_ NaCl + \_\_\_\_ Ba \rightarrow \_\_\_\_\_ BaCl_2 + \_\_\_\_\_ Na$

  2. Mole Ratios: $\frac{\qquad}{\qquad}$ OR $\frac{\qquad}{\qquad}$

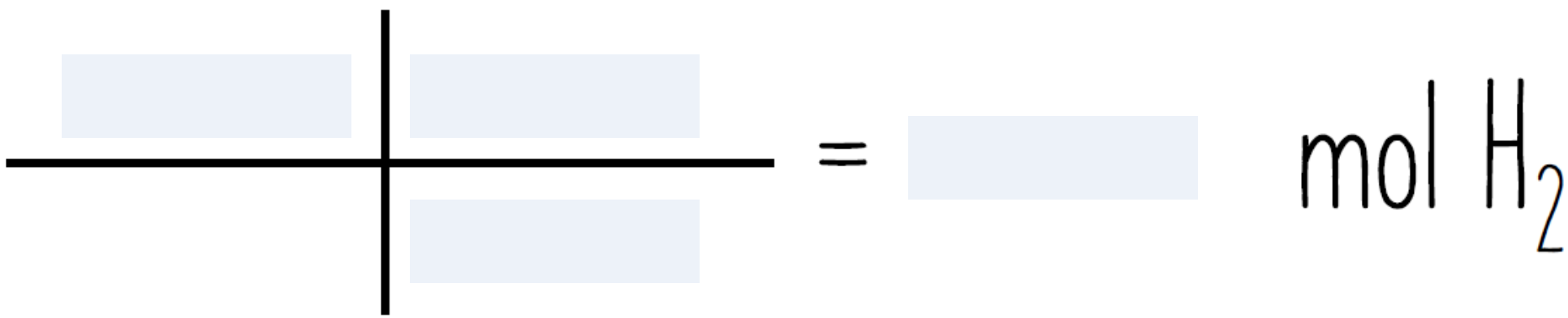
Types of Stoichiometry Problems

$\underline{2}\ H_2O \rightarrow \underline{2}\ H_2 + \underline{1}\ O_2$

Use the equation above to answer the following questions.

- **Mole to Mole (1 ratio/step problem)**
  If **35 moles** of water completely decomposed how many **moles** of hydrogen gas were produced?

? mol H_2 → 35 mol H_2O



Types of Stoichiometry Problems

$\underline{2}\ H_2O \rightarrow \underline{2}\ H_2 + \underline{1}\ O_2$

Use the equation above to answer the following questions.

- **Mole to Mass (2 ratio/step problem)**

  If **62 moles** of water completely decomposed how many **grams** of oxygen gas were produced?

  ? grams O_2 → 62 mol H_2O

You will need the molar mass of O_2! MM O_2 = _____ = _____ g

Types of Stoichiometry Problems

$\underline{2}\ H_2O \rightarrow \underline{2}\ H_2 + \underline{1}\ O_2$

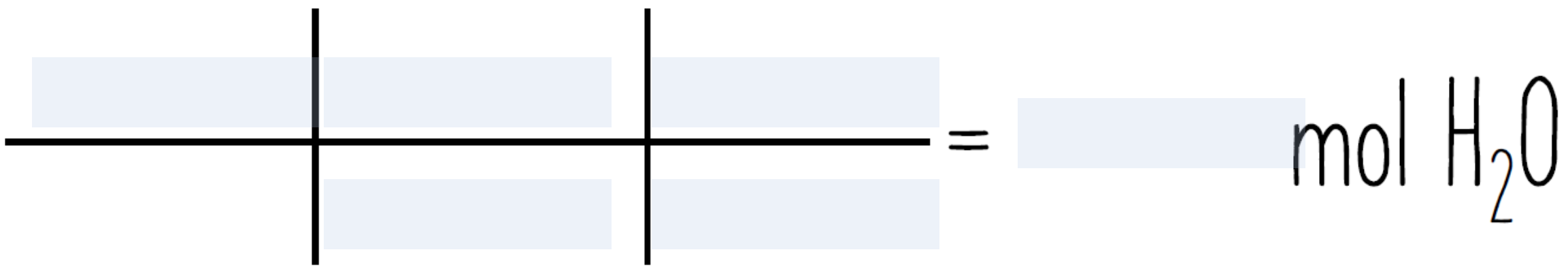
Use the equation above to answer the following questions.

- **Mass to Mole (2 ratio/step problem)**

  If **990 g** of oxygen gas was produced how many **moles** of water decomposed?

? moles H_2O → 990 grams O_2

You will need the molar mass of O_2! MM O_2 = _____ = _____ g



Types of Stoichiometry Problems

$\underline{2}\ H_2O \rightarrow \underline{2}\ H_2 + \underline{1}\ O_2$

Use the equation above to answer the following questions.

- **Mass to Mass (3 ratio/step problem)**

  If **325 grams** of oxygen were produced how many **grams** of hydrogen were also produced? ? grams O_2 → 62 mol H_2O

  You will need the molar mass of H_2! MM H_2 = _____ = g

  AND

  You will need the molar mass of O_2! MM O_2 = _____ = g

= g H_2

Now you Practice...

Balance the equation if necessary then choose the appropriate steps and ratios to calculate the unknown. Use your draw/text/shapes tools to show your work!

Using the following UNBALANCED equation:

$$\_\_\_\ NaOH + \_\_\_\ H_2SO_4 \rightarrow \_\_\_\ H_2O + \_\_\_\ Na_2SO_4$$

How many grams of sodium sulfate will be formed if you start with 200 grams of sodium hydroxide?

Now you Practice...

Balance the equation if necessary then choose the appropriate steps and ratios to calculate the unknown. Use your draw/text/shapes tools to show your work!

Using the following balanced equation:

$$Pb(NO_3)_4 + 2\ Li_2SO_4 \rightarrow Pb(SO_4)_2 + 4\ LiNO_3$$

How many moles of lead (IV) nitrate will be needed to produce 175 grams of lithium nitrate?

Now you Practice...

Balance the equation if necessary then choose the appropriate steps and ratios to calculate the unknown. Use your draw/text/shapes tools to show your work!

Use the following UNBALANCED equation:

$$\_\_\_\_\ C_2H_4 + \_\_\_\_\ O_2 \rightarrow \_\_\_\_\ CO_2 + \_\_\_\_\ H_2O$$

How many moles of oxygen are needed to produce 1.5 moles of carbon dioxide?

Now you Practice...

Balance the equation if necessary then choose the appropriate steps and ratios to calculate the unknown. Use your draw/text/shapes tools to show your work!

Use the following UNBALANCED equation:

$$\_\_\_\_\ N_2 + \_\_\_\_\ F_2 \rightarrow \_\_\_\_\ NF_3$$

How many grams of nitrogen would be required to react with 3.67 moles of fluorine completely?