# Stoichiometry-Activity 2

Goals:
1. To use a balanced chemical equation to calculate molar ratios between reactants and products.
2. To use the molar ratios from the balanced equation to calculate masses of reactants and products.

Model 1: A balanced chemical reaction like the one below describes a chemical change, both in terms of the identity of the reactants and products, and in terms of the relative quantities of each. We can read the equation this way: "Two moles of solid sodium react with one mole of chlorine gas to form two moles of solid sodium chloride."

Reaction 1: $2Na\ (s)\ + Cl_2\ (g) \rightarrow 2\ NaCl\ (s)$
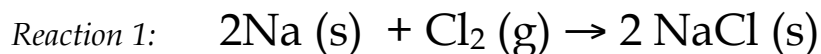
We can use the relative number of moles to develop conversion factors. The following factors relate the quantities of sodium atoms and chlorine molecules in this reaction.

Ratios: $\dfrac{2\text{ moles Na}}{1\text{ mole Cl}_2}$ $\dfrac{1\text{ mole Cl}_2}{2\text{ moles Na}}$

1. Write four other ratios for *Reaction 1.*

2. Which conversion factor would you use to find out how many moles of NaCl are produced per every mole of Cl_2 that is consumed?

3. How many moles of Cl_2 are consumed when 1.35 moles of Na are consumed?

4. How many moles of NaCl are produced when 9.04×10^{-3} moles of Cl_2 are consumed?

5. Write the balanced equation for the reaction of ammonia (NH_3) and oxygen (O_2) to form nitrogen oxide (NO) and water (H_2O).

6. Write two conversion factors that relate moles of H_2O produced to moles of NH_3 consumed.

7. How many moles of H_2O are produced when 4.8 moles of NH_3 are consumed?

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8. Write the balanced equation for the reaction of magnesium (Mg) and oxygen (O_2) to form the ionic compound magnesium oxide (MgO).

9. *How many grams of magnesium oxide are produced by the combustion of 1.02 grams of magnesium?* To answer this question, follow steps a-d below:

   a. What is the molar mass of magnesium (Mg)? (express as a ratio, include units!)

   b. Based on the balanced equation, what conversion factor would convert from moles of magnesium to moles of magnesium oxide?

   c. What is the molar mass of magnesium oxide in grams per mole?

   d. Use the 3 conversion factors above, calculate how many grams of magnesium oxide are produced by the combustion of 1.02 grams of magnesium.

Exercises:
1. Magnesium (Mg) reacts with hydrochloric acid (HCl) to produce magnesium chloride ($MgCl_2$) and hydrogen gas (H_2).
   a. Write the balanced equation for this reaction.

   b. If you start with 25.0 g of magnesium, how many grams of hydrogen gas will form?

   c. If you start with 140.0 g of hydrochloric acid, how many moles of magnesium will react?

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2. Ferric oxide (Fe_2O_3) plus carbon monoxide (CO) gas yields iron metal (Fe) and carbon dioxide (CO_2) gas
   a. Write the balanced equation for this reaction.

   b. How many grams of Fe are made if 0.576 moles of CO_2 are produced?

   c. 100.0 g CO reacted with excess ferric oxide.   How many grams of Fe was produced?

3. Lead(II) oxide (PbO) and oxygen gas (O_2) react to form lead(IV) oxide (PbO_2)
   a. Write the balanced equation for this reaction.

   b. How many moles of lead(IV) oxide will be formed from 334.8 g of PbO ?

4. Nitrogen gas (N_2) and hydrogen gas (H_2) combine to form ammonia (NH_3) gas.
   a. Write the balanced equation for this reaction.

   b. In the above reaction, how many g of ammonia will be produced from 7.2 g of hydrogen gas?

   c. How many grams of nitrogen are needed to produce 460 g of ammonia?

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5. Pentane (C_5H_{12}) combusts in O_2 to form CO_2 and H_2O.
   a. Write the balanced equation for this reaction.

   b. How many grams of carbon dioxide form from 320.0 g of pentane?

   c. How many grams of water are produced if 200.0 g of CO_2 are produced?

   d. You start with 150.0 g of pentane. How many grams of H_2O will you make?

6. In the process of photosynthesis, carbon dioxide (CO_2) and water (H_2O) are transformed using the energy from sunlight into sucrose ($C_{12}O_{11}H_{22}$) and O_2.
   a. Write the balanced equation for this reaction.

   b. How many grams of carbon dioxide are required to produce a sugar cube that has a mass of 4.00 grams?