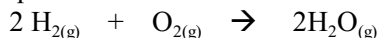# Mass to Mass Problems: II

1. The main engines of the US Space Shuttle are powered by liquid hydrogen and liquid oxygen. If 1.02 x 105 kg of liquid hydrogen are carried on a particular launch, what mass of liquid oxygen will be needed to burn all the hydrogen? The equation for the reaction is:

$$2 \; H_{2(g)} \;\; + \;\; O_{2(g)} \;\; \rightarrow \;\; 2H_2O_{(g)}$$

2. Ethanol may be added to gasoline to produce a fuel called gasohol. Some race car engines are actually designed to operate on pure ethanol, which bums according to the following equation:

$$C_2H_5OH_{(aq)} + 3 \; O_{2(g)} \;\; \rightarrow \;\; 2 \; CO_{2(g)} + 3 \; H_2O_{(g)}$$
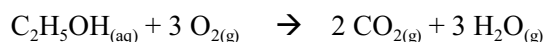
a) What mass of oxygen would be required to react with 1200 g of ethanol?

b)If 655 g of water is produced, what mass of ethanol would be burned?

3. Sodium hydroxide is used in many household drain cleaners. It can be prepared from the reaction of calcium hydroxide with sodium carbonate. Calcium carbonate is also formed.

a) Write the balanced equation for this reaction.

b) What mass of sodium hydroxide can be prepared by the reaction of 225 g of calcium hydroxide with excess sodium carbonate?

4. One of the steps in obtaining a metal from its sulfide ore involves changing the sulfide into an oxide by healing it strongly in air. This process is called 'roasting'. The balanced equation for the reaction of iron (II) sulfide with oxygen is:

$$4 \; FeS_{(s)} + 7 \; O_{2(g)} \;\; \rightarrow \;\; 2 \; Fe2O_{3(s)} \;\; + \;\; 4 \; SO_{2(g)}$$
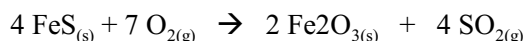
a) What mass of iron (II) oxide can be obtained by the roasting of 774 g of iron (II) sulfide?

b) What mass of sulfur dioxide is produced in the same reaction?

5. The first step in the industrial production of nitric acid is the reaction between ammonia and oxygen to produce nitrogen dioxide and water in the reaction:

$$4 \; NH_{3(g)} \;\; + \;\; 5 \; O_{2(g)} \;\; \rightarrow \;\; 4NO_{2(g)} \;\; + \;\; 6 \; H_2O_{(g)}$$
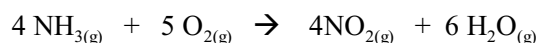
a) How many moles of oxygen would be required to produce 14.7 mol of water?

b) What mass of oxygen is required to react completely with 1.22 kg of ammonia?

c) What mass of nitrogen dioxide is produced in the same reaction?