Name(s) _____

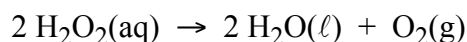## *Chemical Reactions & Balancing Chemical Equations*
Stoichiometry: Conserving Moles, Molecules & Mass

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1. Consider the decomposition of hydrogen peroxide:

 $$2\ H_2O_2(aq)\ \rightarrow\ 2\ H_2O(\ell)\ +\ O_2(g)$$

    How many dozen of each of the products will be formed from the reaction of 2 dozen molecules of H_2O_2? H_2O _____ O_2 _____ 4 dozen molecules of H_2O_2? H_2O _____ O_2 _____

    How many molecules of each of the products will be formed from the reaction of 2 million molecules of H_2O_2? H_2O _____ O_2 _____ 4 million molecules of H_2O_2? H_2O _____ O_2 _____

    How many moles of each of the products will be formed from the reaction of 2 moles of H_2O_2 molecules? H_2O _____ O_2 _____ 4 moles of H_2O_2 molecules? H_2O _____ O_2 _____

    How many grams of each of the products will be formed from the reaction of 68 grams of H_2O_2? H_2O _____ O_2 _____ 136 grams of H_2O_2? H_2O _____ O_2 _____

2. Consider the combustion of ethylene represented in the following balanced equation:
 $$C_2H_4\ +\ 3\ O_2\ \rightarrow\ 2\ CO_2\ +\ 2\ H_2O$$
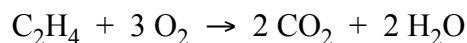
    How many moles of oxygen are needed to react with 3.5 moles of ethylene?

    How many moles of ethylene reacted with excess oxygen if 0.50 mole of water is produced?

    How many moles of carbon dioxide will be produced when 140 grams of ethylene react with excess oxygen? How many grams of CO_2 is this?

3. For each question below, first balance the skeleton (unbalanced) equation and then determine the answer.

    a) _____ $C_2H_5OH(\ell)$ + _____ $O_2(g)$ → _____ $CO_2(g)$ + _____ $H_2O(g)$
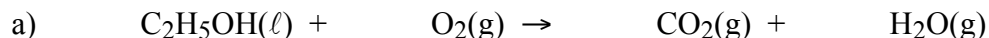
    How many moles of oxygen are needed to react completely with 12 grams of ethanol? *(There are about 12 g in a 12 ounce beer, This is the amount of oxygen that a human will need to completely remove ethanol from the blood stream.)*

    b) _____ $Fe(s)$ + _____ $O_2(g)$ → _____ $Fe_2O_3(s)$
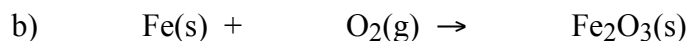
   How grams of iron (III) oxide will be produced from 100. g iron metal and an unlimited amount of oxygen??

4. When water is added to solid calcium carbide, CaC_2, acetylene gas, C_2H_2, and calcium hydroxide, $Ca(OH)_2$, are produced.

   Write a balanced equation for the reaction.

    How many moles of acetylene are produced when 0.50 mole of calcium carbide reacts?

    How many grams of calcium carbide are needed to completely react with 1.2×10^{24} water molecules?

5. Plants produce glucose through photosynthesis, which is the chemical reaction of carbon dioxide, CO_2, and water to yield glucose, $C_6H_{12}O_6$, and oxygen, O_2. Sunlight is the source of energy that drives the reaction. What is the minimum mass of carbon dioxide needed to produce 12.5 g (*a teaspoon*) of glucose through a photosynthesis reaction? How much water would also be required?

    _____ H_2O (ℓ) + _____ CO_2(g) → _____ $C_6H_{12}O_6$ (s) + _____ O_2(g)
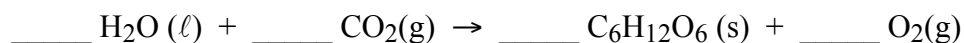
6. Later this semester, you will synthesize aspirin ($C_9H_8O_4$) from the reaction of salicylic acid ($C_7H_6O_3$) and acetic anhydride ($C_4H_6O_3$). An additional product of the reaction is acetic acid ($C_2H_4O_2$). What is the minimum amount of salicylic acid necessary to produce 100 tablets which each contain 325 mg of aspirin?

    _____ $C_7H_6O_3$ (s) + _____ $C_4H_6O_3$ (l) → _____ $C_9H_8O_4$ (s) + _____ $C_2H_4O_2$ (l)
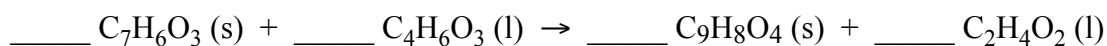
7. The maximum product yield for a large-scale industrial reaction is known to be 375 kg. What is the percent yield if 315 kg is actually produced?