Chemical Reactions **Name**_____

Combustion Reactions

Read from Lesson 2 Classifying Chemical Reactions in the Chemistry Tutorial Section Chapter 8 of The Physics Classroom: Part b: Combustion Reactions Part e: Predicting Products

A **combustion** reaction is a reaction of an element or a compound (that acts as a fuel) with oxygen gas to release relatively large amounts of energy and oxide products.
The general equation for a combustion reaction is $X + O_2 \rightarrow X_nO_m +$ Energy
If the fuel is a hydrocarbon, the general combustion equation is $C_xH_y + O_2 \rightarrow CO_2 + H_2O +$ Energy

A key tip for balancing combustion equations is to balance oxygen last.

Examples of Combustion:

1. Element Combustion: $4\ Fe\ (s) + 3\ O_2(g) \rightarrow 2\ Fe_2O_3\ (s)$

2. Hydrocarbon Complete Combustion: $2\ C_8H_{18}\ (l) + 25\ O_2(g) \rightarrow 16\ CO_2\ (g) + 18\ H_2O\ (g)$
   Note: in a complete combustion reaction with a hydrocarbon as the fuel, CO_2 and H_2O are <u>always</u> the products. Assume all combustion reactions in these exercises to be complete combustion reactions.

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3. Hydrocarbon Incomplete Combustion: $CH_4\ (g) + O_2(g) \rightarrow CO(g) + H_2O\ (g)$
   An incomplete combustion reaction occurs when there is not sufficient oxygen to allow the fuel to react completely with the oxygen to produce carbon dioxide and water. CO will be produced instead of CO_2.
   Note: When fossil fuels do not burn properly, CO can build up inside of buildings and cause sickness and even death to humans. Carbon monoxide detectors are required in homes to provide early warnings, thus protecting residents from poisoning.

For the following questions, predict the reactants or products of these combustion reactions. Write the skeleton equation (proper formulae, no coefficients). Then add coefficients to balance the chemical equation.

1. Nonane (C_9H_{20}) burns in an excess of oxygen.

2. Benzene (C_6H_6) burns in an excess of oxygen.

3. Write the balanced equation for the combustion of strontium.

4. Sucrose ($C_{12}H_{22}O_{11}(s)$) is burned in a complete combustion reaction.

5. Flo Wrene and Aaron Agin are discussing a demonstration that their teacher performed in the lab. Their teacher took a piece of magnesium strip and placed it in the flame of a Bunsen burner. A bright light was produced as well as a white powder. Aaron said that this reaction was an example of a synthesis reaction. Flo states that the reaction could be considered to be a synthesis reaction and a combustion reaction. Write the balanced equation for the reaction that occurred and explain if Aaron or Flo is correct and why.