## Worksheet: Endothermic and exothermic reactions and thermochemical equations

1. In an exothermic reaction, is heat gained or lost in the system? Draw a diagram that shows the transfer of heat energy in an endothermic reaction.

2. In an endothermic reaction, is heat gained or lost in the system? Draw a diagram to illustrate the transfer of energy in an exothermic reaction.

3. Is ΔH positive or negative in an exothermic reaction?

4. Is ΔH positive or negative in an endothermic reaction?

5. Predict the sign of ΔH for the burning of a candle. Is this reaction endothermic or exothermic?

6. List three examples of an exothermic reaction.

7. List two examples of an endothermic reaction.

8. Determine the quantity of energy (heat) involved in the following reactions:

    a. When hydrogen peroxide is placed on a cut knee it decomposes to form water and oxygen gas. How much energy will be released when 34.0 g of $H_2O_2$ decomposes according to the following equation?

    $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g) + 200kJ$

    b. Manganese will react with hydrochloric acid to produce hydrogen gas according to the following equation:

    $Mn(s) + 2\ HCl(aq) \rightarrow MnCl_2(aq) + H_2(g) + 221\ kJ$

    How much energy will be released when 5.494 g of manganese reacts completely?

    c. How many kilojoules of energy will be needed to decompose 10.8 grams of $N_2O_5$ gas?

    $2\ N_2O_5\ (g) + 110\ kJ \rightarrow 4NO_2(g) + O_2(g)$

    d. Phosphorous burns in air to produce dense white clouds of $P_4O_{10}$ gas. When this gas is dissolved in rain water, phosphoric acid is produced. How much energy is released when 14.2 g of $P_4O_{10}$ reacts?

    $P_4O_{10}(g) + 6H_2O(l) \rightarrow 4\ H_3PO_4(aq) + 424\ kJ$

9. Methane ($CH_4$) gas is used as a fuel for heating hot water in many of our homes. In addition it is the gas used to fuel the Bunsen burners in our lab. Write the thermochemical equation for the combustion of methane gas. The ΔH for methane is –890 kJ/mol.