LO: Students will be able to use Hess's law to determine heat of reactions.

DOL: Students will successfully answer at least 4/5 Hess's Law questions.

Enthalpy change

the amount of energy absorbed by a system as heat during a process at constant pressure

Enthalpy of reaction

the quantity of energy transferred as heat during a chemical reaction

May 5-1:11 PM

Exothermic

energy is a product

Endothermic

energy is a reactant

Thermochemical equation

an equation that includes the quantity of energy released or absorbed

$$4H_2(g) + 2O_2(g) \longrightarrow 4H_2O(g) + 967.2kJ$$

May 5-1:12 PM

Molar enthalpy of formation

the enthalpy change that occurs when one mole of a compound is formed from its elements in their standard state at 298 K and 1 atm

Enthalpy of Combustion

the enthalpy that occurs during the complete combustion of one mol of a substance

May 5-1:15 PM

Hess's Law

the overall enthalpy change in a reaction is equal to the sum of the enthalpy changes for the individual steps in the process

May 5-1:21 PM

Hess's Law can be solved exactly like using the addition / subtraction method used in solving systems of equations in Algebra.

$$\begin{array}{r} 3x + 2y = 10 \\ x - 2y = 6 \\ \hline 4x \qquad = 16 \\ x = 4 \end{array}$$

$$\begin{array}{r} 2x + y = 10 \\ x + 2y = -1 \end{array}$$

Example of Hess's Law

$C(s) + 2H_2(g) \longrightarrow CH_4(g) \quad +/- \; H^0_f$

To determine this H^0_f we can use the combustion enthalpies of C and H

$C(s) + O_2(g) \longrightarrow CO_2(g)$	$H^0_c = -393.5$ kJ
$H_2(g) + 1/2\ O_2(g) \longrightarrow H_2O(l)$	$H^0_c = -285.5$ kJ
$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$	$H^0_c = -890.8$ kJ

May 5-1:22 PM

Reverse reactions will have a reverse amount of energy, as well we can multiply equations by any positive factor (such as 2). Chemical equations are additive, so we can cancel anything that is the same on both sides and add the rest together vertically......

$C(s) + O_2(g) \longrightarrow CO_2(g)$	$H^0_c = -393.5$ kJ
$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$	$H^0_c = 2(-285.5)$ kJ
$CO_2(g) + 2H_2O(l) \longrightarrow CH_4(g) + 2O_2(g)$	$H^0 = 890.8$ kJ
$C(s) + 2H_2(g) \longrightarrow CH_4(g)$	$H^0_f = -73.7$ kJ

Since the heat of formation of methane gas is a negative, that

means energy must enter the system so it is endothermic.

The energy can be written as a positive number and placed on the reactants side.

$C(s) + 2H_2(g) + 73.7\text{ kJ} \longrightarrow CH_4(g)$

May 5-1:31 PM