Name: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** Block**: \_\_\_\_ Thermochemical Equations Notes**

Recap:

* An **exothermic** change is a reaction that releases energy: energy can be thought of as a product
* An **endothermic** change is one in which the energy must be added for the reaction to occur: energy can be thought of as a reactant
* **Enthalpy (H)** is the energy (heat) content of a system at constant pressure**.** You cannot measure the actual energy or enthalpy of a substance, but you can measure the change in enthalpy ∆Hrxn.

Complete the following chart:

|  |  |  |
| --- | --- | --- |
| **Type of Reaction** | **Sign of ∆Hrxn** | **Which has more energy: reactants or products?** |
| **Exothermic** |   |  |
| **Endothermic** |   |  |

 Make enthalpy diagrams for the two chemical reactions from above, showing clearly the amount of energy released or gained.

 Exothermic Change       Endothermic Change

Energy

Time

Energy

Time

* Chemistry problems involving **enthalpy** changes are similar to the dimensional analysis problems.
* The amount of energy that is absorbed or released in a reaction depends on the number of moles of reactants involved.

 *minus sign tells you heat is released*

**Example Problem:**

How much heat will be **released** if 1.0 gram of hydrogen peroxide H2O2 decomposes? 2H2O2  🡪  2H2O  +  O2 +190 kJ

   1.0 grams H2O2 \_1 mol H2O2\_ \_- 190 kJ\_\_   =  - 2.7924 kJ  = - 2.8 kJ

 34.02 g H2O2 2 moles H2O2

1.  How much heat is absorbed during photosynthesis when 9.22 grams of glucose C6H12O6 is produced?

 6CO2   +    6H2O  +2803 kJ  🡪 C6H12O6    +  6O2

2.  How many moles of NO2(g) is dissolved in excess water when 177 kJ of energy is released?

 3NO2 +   H2O  🡪  2HNO3   +  NO + 138 kJ

3. Calculate the heat released when 1.43 moles of SO2 reacts according to the following equation.

 2SO2  +   O2 🡪  2SO3   ∆H  =  -99.1 kJ

4.  Given the following reaction: C(s) + 2 S(s) + 89.3 kJ 🡢 CS2(l)

 How many atoms (particles) of Carbon can be burned if 520.0 kJ of energy are available?

5. a. If the following reaction produces energy (Δ H = - 357 kJ) is this an endo or exothermic reaction?\_\_\_\_\_

 CH4 + 2 O2 → CO2 + 2 H2O

1. Is the energy written on the reactant or product side of the equation?\_\_\_\_\_\_\_\_-
2. If 15.0 grams of CH4 reacts with excess oxygen how much energy is produced?

**Homework Problems: (Do on separate paper)**

Answers: 1c: 1409 kJ 2b: 4.99 grams

1. CH4 (g) + 2O2 (g) 🡺CO2 (g) + 2H2O (l) ΔH = - 890.2 kJ
	1. Is this reaction exothermic or endothermic?
	2. Draw an energy path diagram that represents this reaction
	3. Calculate the amount of heat given off/absorbed when 25.40 g of methane, CH4, burns.
2. Glycine is important for biological energy. The combustion of glycine is given by the following equation:

 4C2H5O2N (s) + 9O2 (g) 🡺 8CO2 (g) + 10 H2O (l) + 2N2 (g) + 3857 kJ .

* 1. Is this reaction endothermic or exothermic?
	2. How many grams of glycine (C2H5O2N) is needed when 64.2 kJ of energy is absorbed/produced?