**Heat of Reaction (a.k.a Enthalpy)**

**YOYO:** Directions: Read the claim. Write 1 sentence describing something you already know that relates to the claim below (Evidence) [HINT: the emoji to the right.] Then, write 2 sentences explaining how your evidence can be used to either support of claim stated below (Reasoning).

* **Claim:** Breaking bonds are considered to be endothermic processes and forming bonds are considered to be exothermic processes:
* **Evidence:**
	+ **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* **Reasoning:**
	+ **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Heat of Reaction

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* ΔHheat of reaction = Hproducts – Hreactants
* ΔH = **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Endothermic Reactions

* Heat is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** by **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
	+ Energy is stored in chemical bonds of the products
	+ **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
	+ **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Endothermic Example A +B 🡪 C

* If HA = 40 kJ and HB = 20 kJ, then the reactants have a total or 60 kJ
* If HC = 110 kJ, then 50 kJ of heat must have been absorbed by the reactants.
	+ (110-60 = 50kJ)
	+ Rewritten: A + B + 50 kJ 🡪C
* Total energy on both sides are equal (law of conservation of energy)

Exothermic Reactions

* Heat is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** as a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
	+ **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
	+ More stable reaction
	+ Spontaneous
	+ **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
		- Energy is written as a product

Exothermic Example A + B 🡪 C

* If HA = 60 kJ and HB = 40 kJ, then the reactants have a total of 100 kJ
* If HC = 30 kJ, then 70 kJ of heat must be released as a product
	+ (100-30 = 70)
	+ Rewritten: A + B 🡪 C + 70 kJ
* Total energy on both sides are equal (law of conservation of energy)

Table I: Heat of Reaction at 101.3 kPa and 298 K

* \*The ΔH values are based on molar quantities represented in the equations. A minus sign indicates an exothermic reaction
* Two ways to write + ΔH (an ENDOTHERMIC REACTION)
	+ N2*(g)* + O2*(g)* 🡪 2NO*(g)* [ΔH +182.6 kJ]
	+ 182.6 kJ + N2(g) + O2(g) 🡪 2NO(g)
* Two ways to write - ΔH (an EXOTHERMIC REACTION)
	+ CH4*(g)*+ 2O2*(g)*🡪 CO2*(g)* + 2H2O*(l)* [ΔH -890.4 kJ]
	+ CH4*(g)*+ 2O2*(g)*🡪 CO2*(g)* + 2H2O*(l)* + 890.4 kJ

Question Scenarios Using Table I

* If the reaction in the question matches Table I exactly…just use the ΔH value given
* If the reaction in the question is OPPOSITE of Table I…change the sign of ΔH
* If the reaction in the question shows double the amount of each part of the reaction…double ΔH
* If the reaction in the question shows HALF the amount of each part of the reaction…half ΔH

Things to Remember:

* A reaction is exothermic if…
	+ It releases heat
	+ Heat is produced
	+ ΔH is negative
	+ Heat is written as a product
* A reaction is endothermic if…
	+ It absorbs heat
	+ Heat is added
	+ ΔH is positive
	+ Heat is written as a reactant

Question: What if the reaction is the opposite of what it says on Table I?

* What is the ΔH of the following reaction? Is this exothermic or endothermic?
	+ 2H2O*(l)* 🡪 2H2*(g)* + O2*(g)*
	+ Table I says: 2H2*(g)* + O2*(g)* 🡪 2H2O*(l)* [ΔH = -571.6]
* Answer: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
	+ **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Sample Problems

1. Given the reaction 2CO*(g)* + O2*(g)*🡪 2CO2*(g)*ΔH = -556.0 kJ
	1. How much heat would be released is 4 moles of carbon monoxide were consumed by oxygen?
2. Given the reaction 2H2*(g)* + O2*(g)* 🡪 2H2O*(l)* [ΔH = -571.6]
	1. Calculate ΔH for the following reaction: H2*(g)*+ ½O2*(g)*🡪 H2O(l)

NOT YOU



NOT YOU

YOU