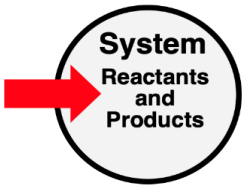
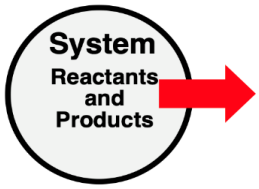
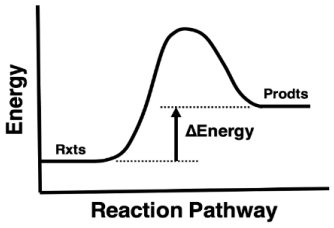
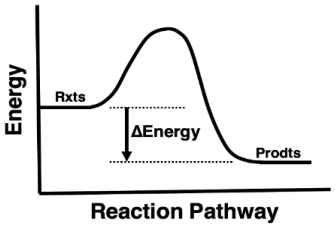
Thermochemistry **Name**_____

Energy and Heat

Read from **Lesson 1: Energy and Heat** in the **Chemistry Tutorial Section, Chapter 12** of **The Physics Classroom**:
Part a: Energy Part b: Heat and Temperature Part c: Chemical Reactions and Energy

	Endothermic	Exothermic
Word meaning	Endo = into	Exo = out of
Defintion	Energy is **absorbed from** the surroundings	Energy is **released to** the surroundings
Temperature of Surroundings	Surroundings **cool down** (temperature decrease)	Surroundings **warm up** (temperature increase)
Bond Energies	$\Delta E_{Bond\ Breaking} > \Delta E_{Bond\ Forming}$	$\Delta E_{Bond\ Breaking} < \Delta E_{Bond\ Forming}$
Energy of Rxts/Prodts	$E_{reactants} < E_{products}$	$E_{reactants} > E_{products}$
Net ΔEnergy	ΔEnergy is **Positive**	ΔEnergy is **Negative**
System Diagram		
Energy Level Diagram		
Chemical Equation	Reactants + E → Products	Reactants → Products + E
Rxt vs. Prod't?	Energy is *a reactant*.	Energy is *a product*.

Questions

1. What are the differences between temperature and heat?

2. Could a cold object ever have more total energy than a hot one? How?

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3. Aaron Agin and Molly Cule are discussing thermal equilibrium. Aaron claims that if 25 grams of hot iron were placed in 25 grams of cold water, the final temperature would always be the average of their initial temperatures. How can Molly explain why Aaron's assumption is incorrect?

4. What distinguishes an endothermic process from an exothermic one in terms of energy flow? Answer in terms of system and surroundings. Give an example of both types of processes.

5. Think about what you learned in your biology class.
   The reaction for photosynthesis is $6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$
   and the reaction for cell respiration is $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$.
   Which one of these reactions are exothermic? Endothermic? Explain your answer.

6. Can the same chemical reaction be endothermic under some conditions and exothermic under others? If so, include an example in your answer. If not, explain why this cannot happen.

Part 2: Thermochemistry Lab

Ann Hydrous and Ben Zene are studying thermochemistry in the lab. They do two experiments, make observations about the reactions, and measure the temperature change with a temperature sensor in each reaction.

In reaction 1, they place a piece of mossy zinc in a solutions of 1 M HCl. In reaction 2, they add baking soda ($NaHCO_3$) to a 5% acetic acid solution. Both acid solutions are at room temperature, 25°C. when the reaction begins.

1. Write the balanced equation between the zinc and hydrochloric acid. Include states of matter in the equation.

2. Write the balanced equation between the baking soda and acetic acid. Include states of matter in the equation.

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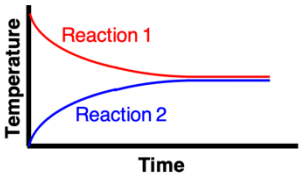
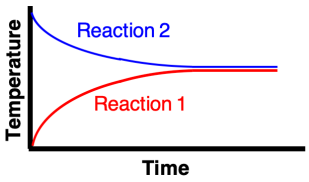
3. Here is the temperature data for reaction 1 and 2. Which of the following graphs best represents this data? _____

Reaction	Initial Temperature	Final Temperature
1: Trial 1	25°C	35°C
1: Trial 2	25°C	32°C
1: Trial 3	25°C	36°C
2: Trial 1	25°C	18°C
2: Trial 2	25°C	17°C
2: Trial 3	25°C	15°C

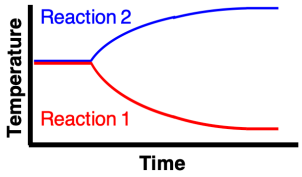
Graph A



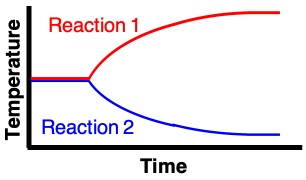
Graph B



Graph C



Graph D



4. Read each statement carefully. If the statement applies to **reaction 1**, write **"1"** in the space before it. If it applies to **reaction 2**, write **"2"** in the space before it. If it describes **both reactions**, write **"B"** in the space before the statement.

_____ a. The temperature increased as the reaction proceeds.

_____ b. The temperature decreased as the reaction proceeds.

_____ c. This reaction is endothermic.

_____ d. This reaction is exothermic.

_____ e. This reaction produced a gas.

_____ f. This reaction absorbs energy from its surroundings.

_____ g. This reaction releases energy to its surroundings.

_____ h. This reaction is a single replacement type of reaction.

_____ i. This reaction is a double replacement type of reaction.

_____ j. Energy is a reactant in this reaction.

_____ k. Energy is a product in this reaction.

_____ l. Energy is required to break the bonds of the reactants.