

Energy Changes in Chemical Reactions

Name - _____

1.) You can think of this reaction, $\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$, as occurring in two steps (it doesn't go this way, but it is convenient to think of it this way).

Step 1 - $\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{C} + 4 \text{H} + 4 \text{O}$ (the reactants are broken down to individual atoms)

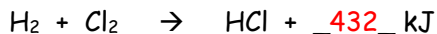
Step 2 - $\text{C} + 4 \text{H} + 4 \text{O} \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$ (the individual atoms are assembled into products)

- a.) Does step 1 absorb or give off energy? absorb
- b.) Does step 2 absorb or give off energy? give off
- c.) Since the overall reaction is exothermic, which step involves more energy, step 1 or 2?

Step 2

2.) The energy needed to break an H-Cl bond is 432 kJ. $2 \text{HCl} + 432 \text{ kJ} \rightarrow \text{H}_2 + \text{Cl}_2$

How many kilojoules of energy are given off in the following reaction? Why?



Answer - The two reactions are the exact opposite of each other.

3.) Is the burning of wood exothermic or endothermic?

Answer - exothermic as heat (energy) is produced.

4.) Is the melting of sugar exothermic or endothermic?

Answer - endothermic as heat (energy) is absorbed by the sugar to change phases.

5.) A beaker becomes warm when a reaction occurs in it. Are the chemicals in the beaker gaining or losing energy? Is the reaction endothermic or exothermic?

Answer - losing energy. Exothermic as energy is released (lost).

6.) Which contains more energy in an endothermic reaction, the reactants or products?

Answer - products. The reactants gain energy to become high energy products.

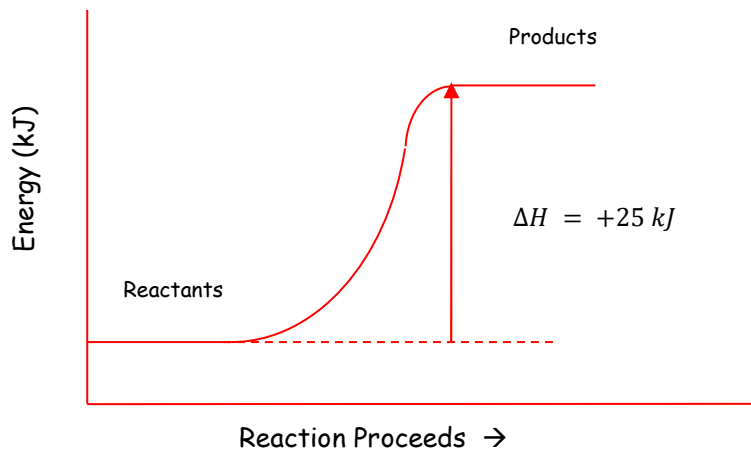
7.) In an exothermic reaction, do you have to add or remove energy in order to allow particles to form?

Answer - remove energy from reactants as lower energy products are formed.

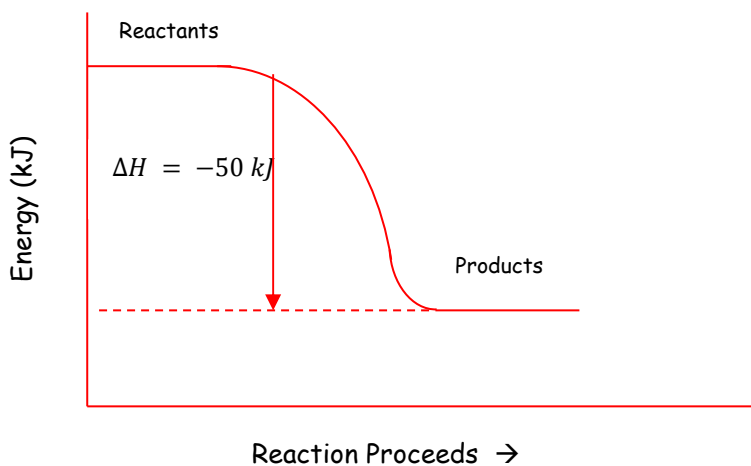
8a.) Is $\Delta H > 0$ or $\Delta H < 0$ for an endothermic reaction? $H_{\text{reactants}} < H_{\text{products}}$ and $\Delta H = H_p - H_r$

b.) Is $\Delta H > 0$ or $\Delta H < 0$ for an exothermic reaction? $\Delta H < 0$

9.) Draw an energy diagram having $\Delta H = +25 \text{ kJ}$.



10.) Draw an energy diagram having $\Delta H = -50 \text{ kJ}$.



11.) $\Delta H = -50 \text{ kJ}$ for the reaction $F \rightarrow G$. Re-write this equation to show the 50 kJ properly on the reactant or product side.

Answer - $F \rightarrow G + 50 \text{ kJ}$

12.) If a reaction absorbs 30 kJ of heat, what is the ΔH for the reaction? $\Delta H = +30 \text{ kJ}$

13.) If $P \rightarrow Q + 25 \text{ kJ}$, what is the ΔH for the reaction? Which have more energy, the reactants or products? $\Delta H = -25 \text{ kJ}$ reactants have more energy.