Enthalpy & Thermochemical Equations – Practice Problems

Chemical and physical equations can be written to express if the reaction which occurred was endothermic or exothermic. These type of equations are referred to as "thermochemical equations".

Endothermic: Heat is written as a reactant in the equation. This is because energy must be put into the system for the reaction to occur.

Exothermic: Heat is written as a product in the equation. This is because energy is released or "produced" by the reaction.

* *Note:* Often, the word "energy" is replaced in the equation by The actual quantity of heat absorbed or released

At constant pressure, the word enthalpy is synonymous with heat (both have the same meaning), Enthalpy is typically represented by the symbol, ΔH. This is another way to distinguish if a chemical reaction is endothermic or exothermic. The value of ΔH is listed at the end of a balnced chemical or physical reaction. Just like with heat, in an endothermic reaction, ΔH = + and in an exothermic reaction, ΔH = −.

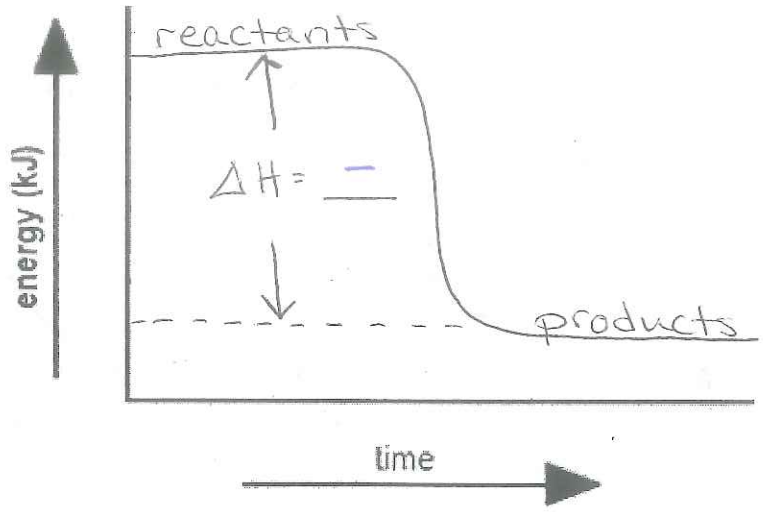
Reaction	**Exo or Endothermic?**
1) $C_6H_{12}O_6\,(s) + O_2\,(g) \rightarrow CO_2 + H_2O +$ energy (product)	1) exo
2) $H_2O\,(l) +$ 483.6 (reactant) $\rightarrow H_2\,(g) + O_2\,(g)$	2) endo
3) $2\,N_2\,(g) + O_2\,(g) \rightarrow 2\,N_2O\,(g)$ $\quad \Delta H = +66.4$ kJ	3) endo
4) $2\,C_2H_2\,(g) + 5\,O_2\,(g) \rightarrow 4\,CO_2\,(g) + 2\,H_2O\,(l) +$ 2598.8 kJ (product)	4) exo
5) $H_2\,(g) + Cl_2\,(g) \rightarrow 2\,HCl\,(g)$ $\quad \Delta H = -183$ kJ	5) exo

* *Note:* Any reaction can be reversed and the sign of ΔH would become the opposite (ex: if it was endothermic, the reverse reaction would be exothermic)

Enthalpy Diagrams – Practice Problems

Enthalpy diagrams are used to express if a chemical reaction is endothermic or exothermic by comparing the energy of the reactants to the products.

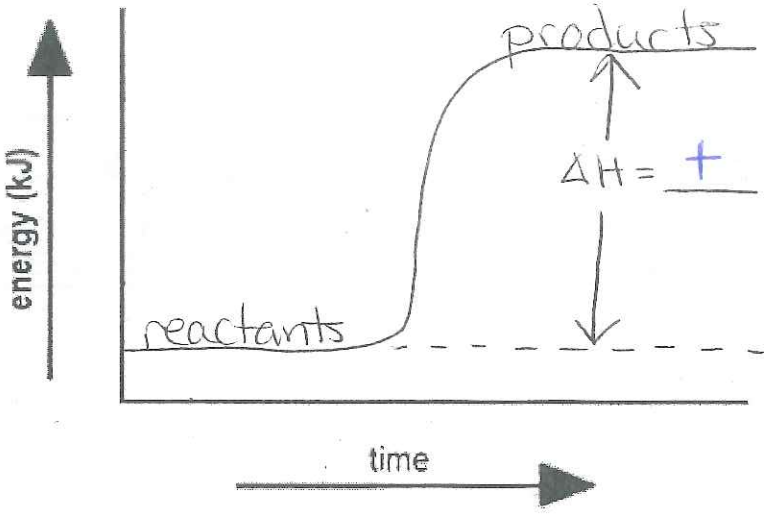
1) Endothermic or (Exothermic)



Why?

"Downhill" curves show that the products have less energy than the reactants. This means heat is lost over the course of the reaction

2) (Endothermic) or Exothermic



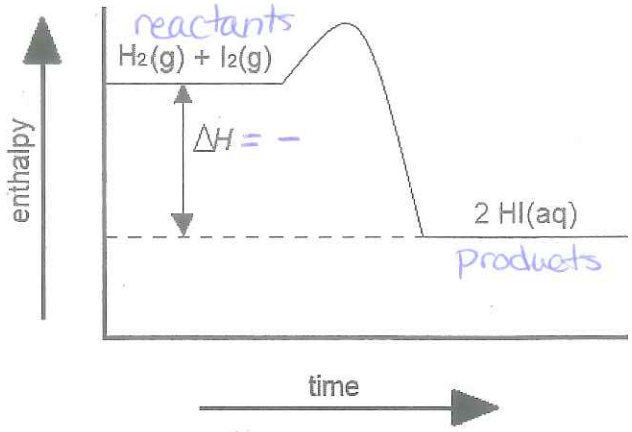
Why?

"Uphill" curves show that the products have more energy than the reactants. This means heat is gained over the course of the reaction.

Enthalpy Diagrams & Thermochemical Equations – Practice Problems

Directions: *Evaluate the following enthalpy diagrams and answer the associated questions*

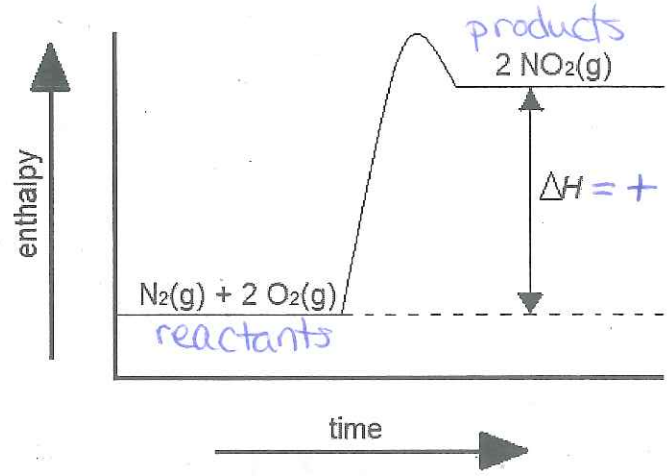
1) $H_2\,(g) + I_2\,(g) \rightarrow 2\,HI\,(aq)$



1) Is this reaction endothermic or exothermic? Explain why.

Exothermic: products have less energy than the reactants so ΔH = − (heat is lost/released)

2) $N_2\,(g) + 2\,O_2\,(g) \rightarrow 2\,NO_2\,(g)$



2) Is this reaction endothermic or exothermic? Explain why.

Endothermic: products have more energy than the reactants so ΔH = + (heat is absorbed/gained)

Directions: *Answer the following questions based on the information given.*

3) Are the following reactions endothermic or exothermic?

a. $2\,C\,(s) + H_2\,(g) + 226.6\,kJ \rightarrow C_2H_2(g)$ endothermic

(226.6 kJ: reactant)

b. $2\,C_3H_6\,(g) + 9\,O_2\,(g) \rightarrow 6\,CO_2\,(g) + 6\,H_2O\,(l) + 4439.4\,kJ$ exothermic

(4439.4 kJ: product)

c. $2\,C_2H_6\,(g) + 7\,O_2\,(g) \rightarrow 4\,CO_2\,(g) + 6\,H_2O\,(l)\quad \Delta H = -3120\,kJ$ exothermic

4) $2\ Ag_2O(s) + 122\ kJ \rightarrow 4\ Ag(s) + O_2(g)$

(122 kJ: reactant)

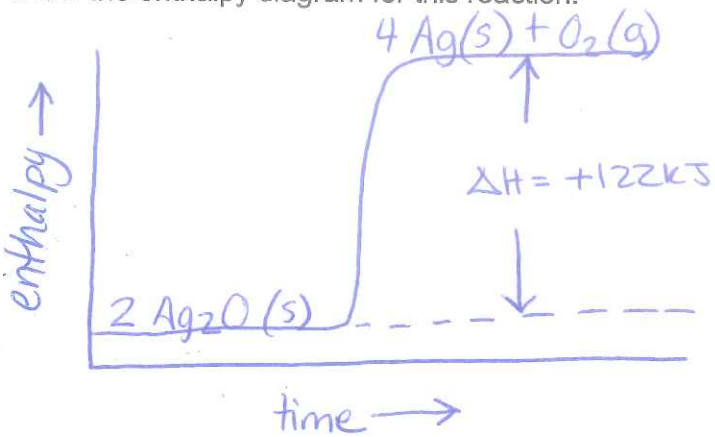
heat is gained by reactants

a. Is the reaction endothermic or exothermic? endothermic

b. What is the sign of ΔH for this reaction? = +ΔH

c. Which has a higher enthalpy, the reactant or the products? products

d. Draw the enthalpy diagram for this reaction:



5) $S(s) + O_2(g) \rightarrow SO_2(g)$ $\Delta H = -297\ kJ$

heat is lost by reactants

a. Is the reaction endothermic or exothermic? exothermic

b. Which has a higher enthalpy, the reactant or the products? reactants

c. REVERSE this thermochemical reaction and write it below:

$SO_2(g) \rightarrow S(s) + O_2(g)$ $\Delta H = +297\ kJ$ (endothermic)

d. Draw the enthalpy diagram for the REVERSE reaction below: