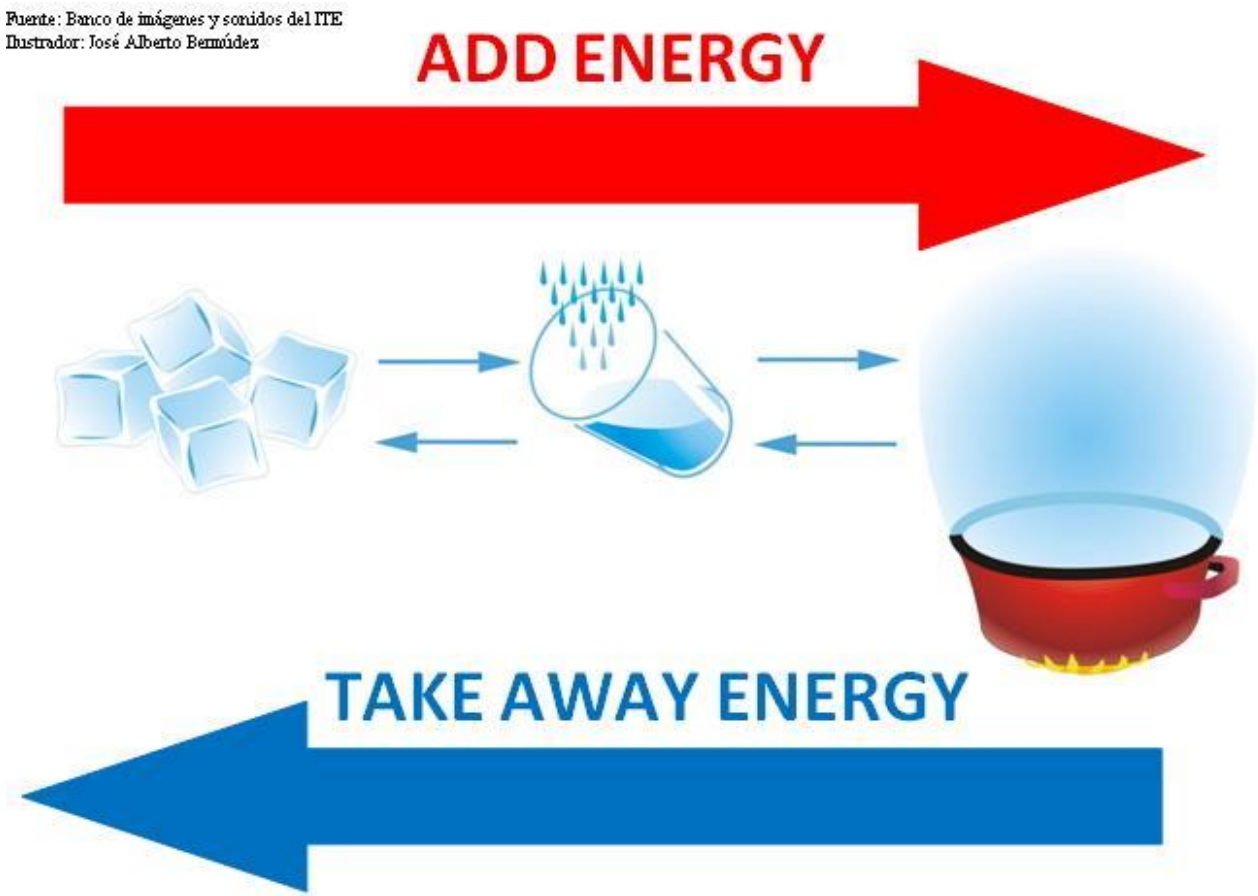
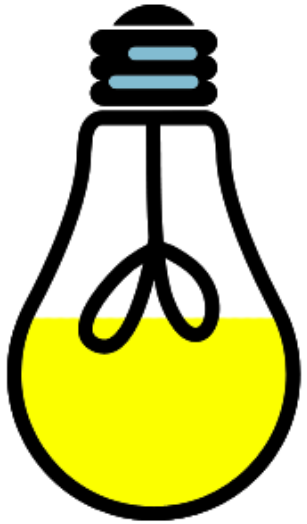
# [1.8] - Energy Changes in Reactions



# Energy Changes

- **Energy** is measured in Joules (J) or kilojoules (kJ)

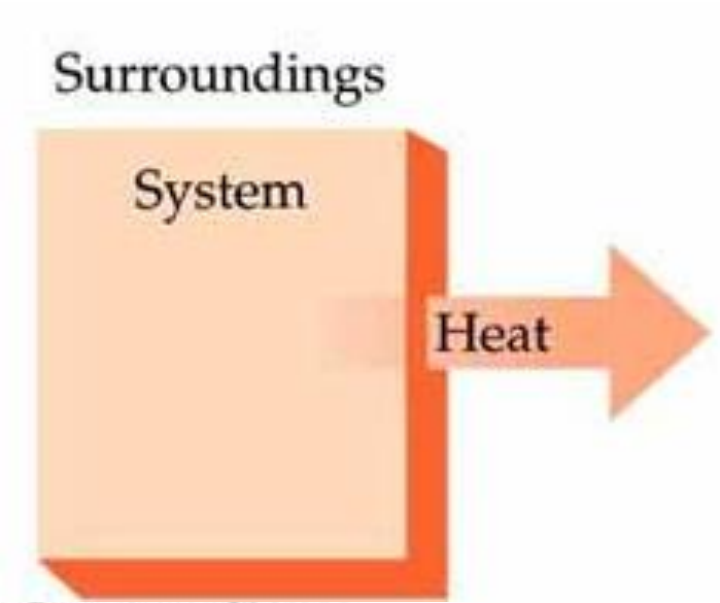
- **Enthalpy**: change in energy



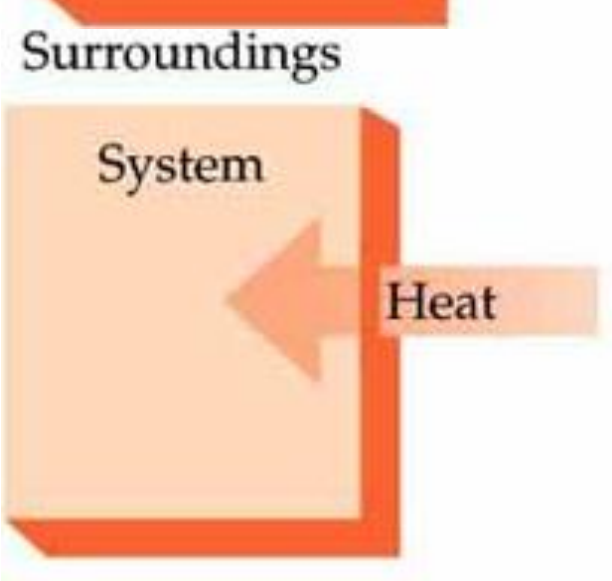
Total ENERGY = Joules (J)

# Reactions with Energy Changes

**Exothermic Reaction**: Gives off (releases) heat to its surroundings. Heat **EXITS** the reaction

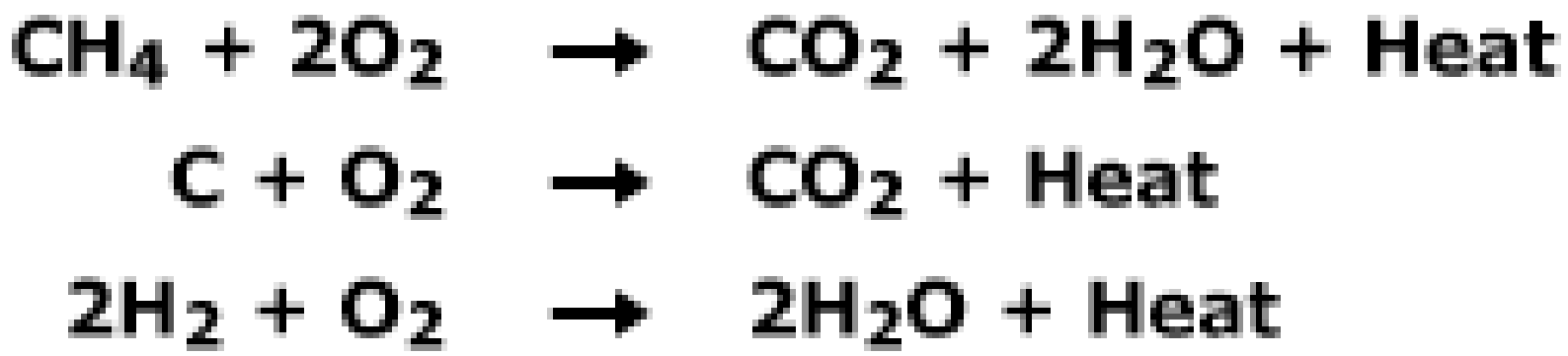



**Endothermic Reaction**: Absorbs heat from its surroundings. Heat **ENTERS** the reaction



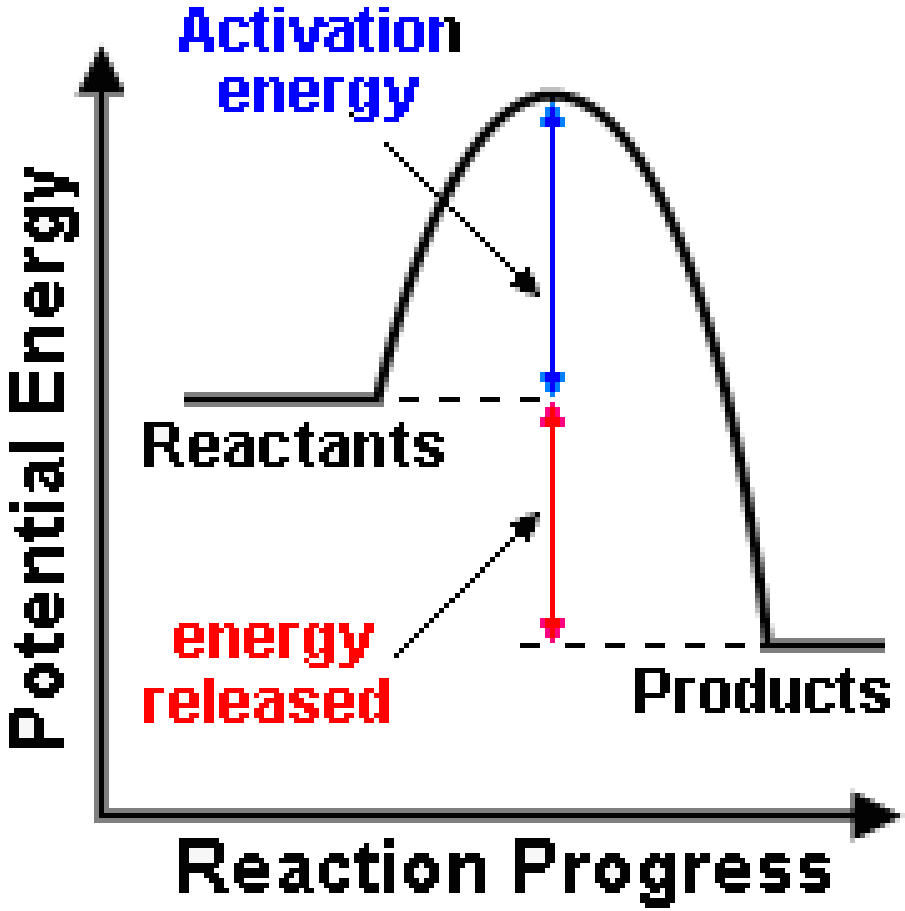
# Exothermic Reactions

- **Exothermic** reactions **give off** energy
- Energy is measured in **kJ** or **J**
- Change in energy (**enthalpy**) is **negative** indicating lose in energy
- Energy can also be written as a **product**

# Exothermic Reactions: Free Energy Diagrams

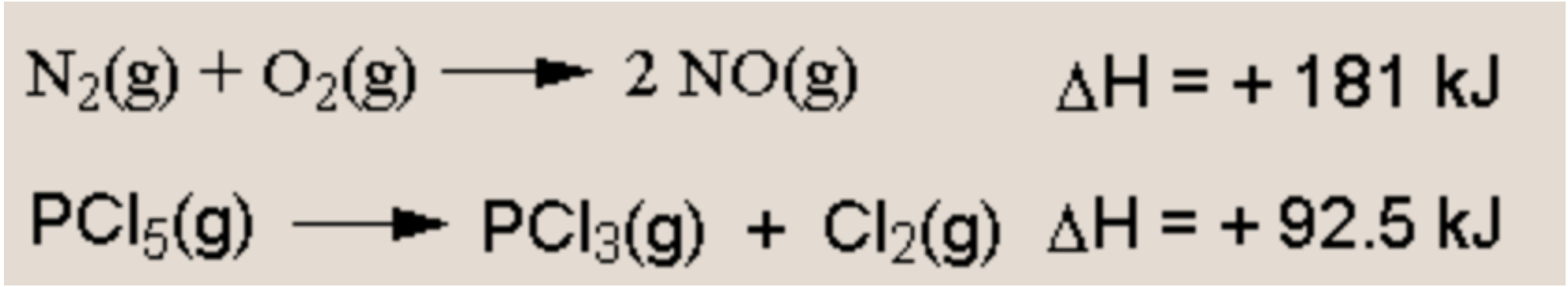
- **Energy diagrams** are visual representations of the change in energy in a reaction
- **Activation Energy**: The maximum amount of energy needed for the reaction to occur
- **Enthalpy (ΔH)**: Amount of energy released/absorbed




Exothermic reaction

# Endothermic Reactions

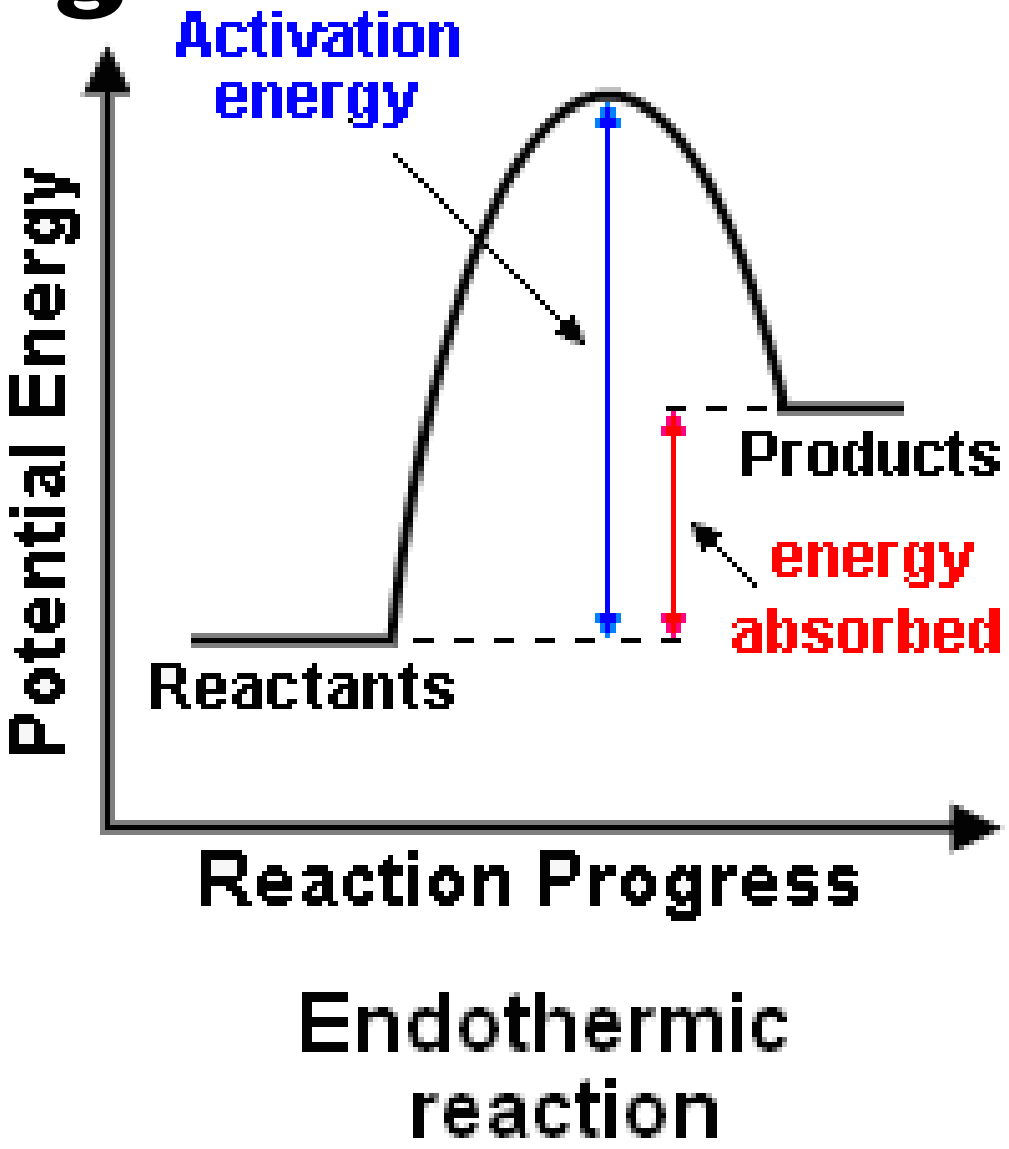
- **Endothermic** reactions **take in** energy
- Energy is measured in **kJ** or **J**
- Change in energy (**enthalpy**) is **positive** indicating gain in energy
- Energy can also be written as a **reactant**



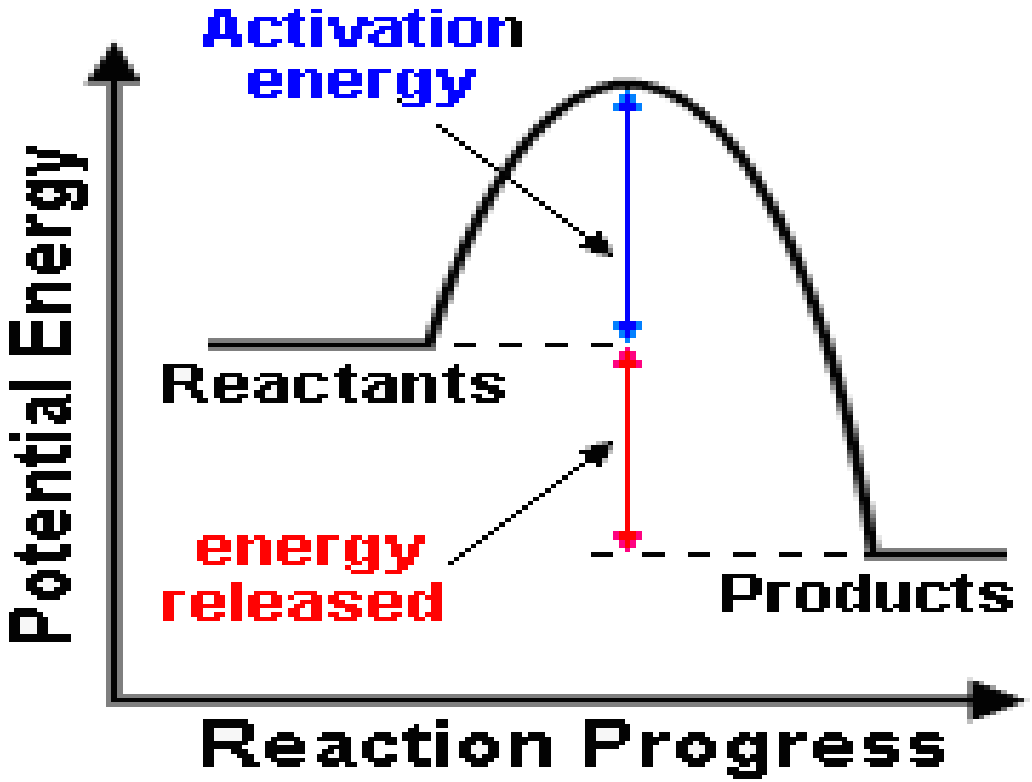

**$N_2O_{4(g)}$ + energy → $2NO_{2(g)}$**

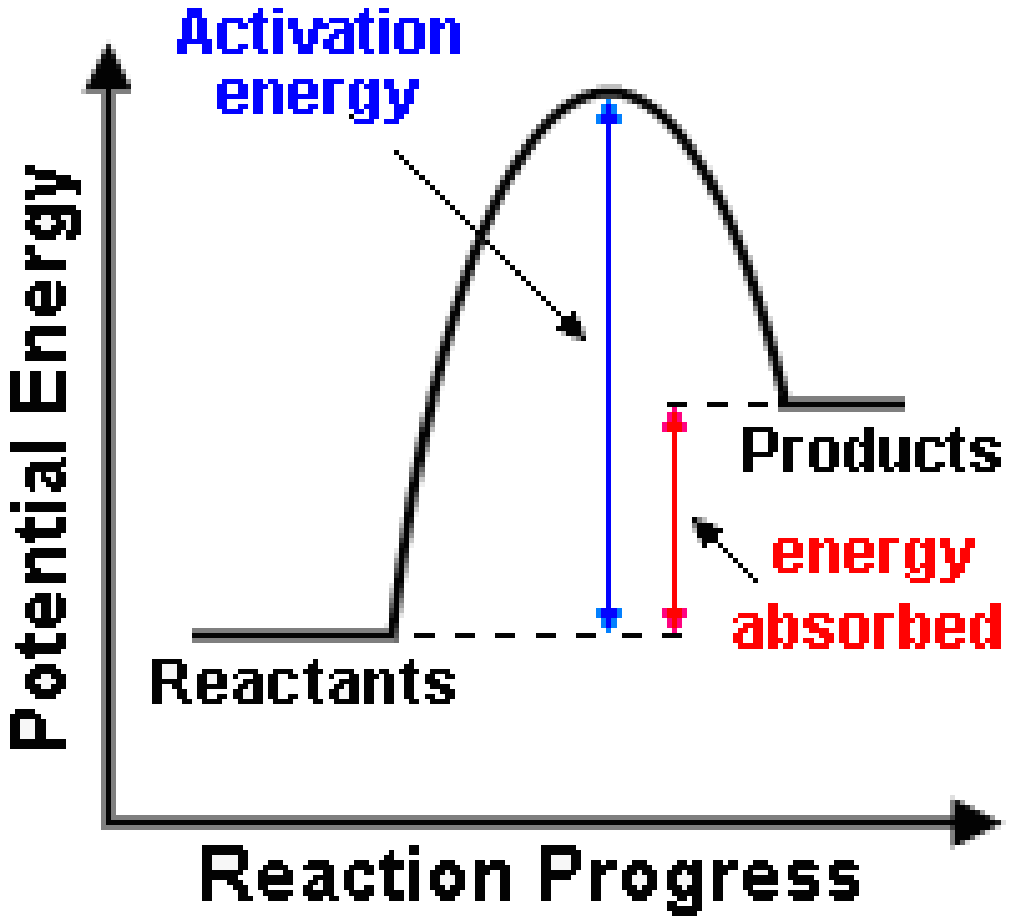
# Endothermic Reactions: Free Energy Diagrams

- **Energy diagrams** are visual representations of the change in energy in a reaction
- **Activation Energy ($E_A$)**: The maximum amount of energy needed for the reaction to occur
- **Enthalpy ($\Delta H$)**: Amount of energy released/absorbed

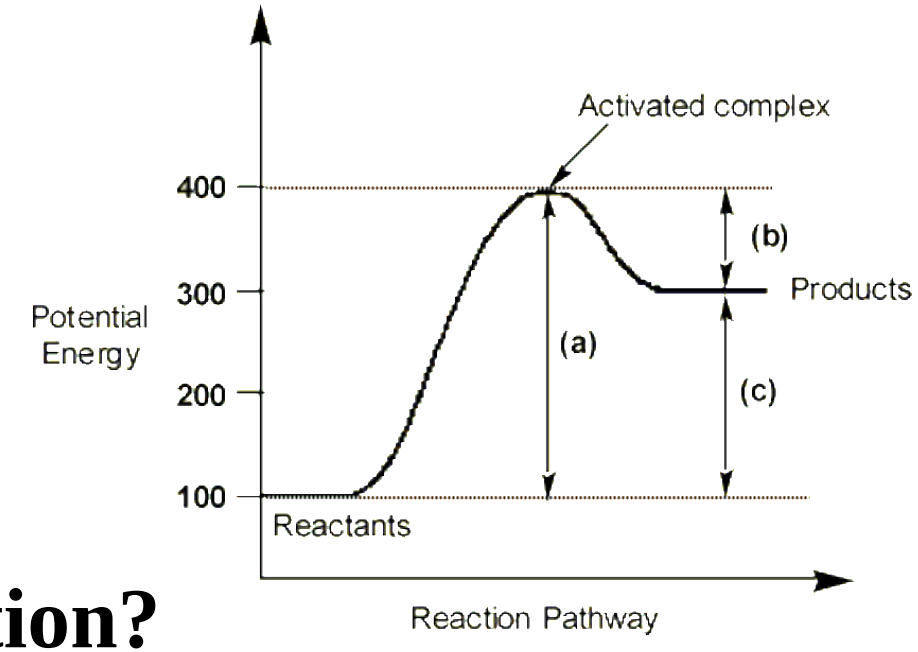


# Which energy diagram shows exothermic? Endothermic?



# Practice Problem #1




**Is the reaction exothermic or endothermic?**

Answer:

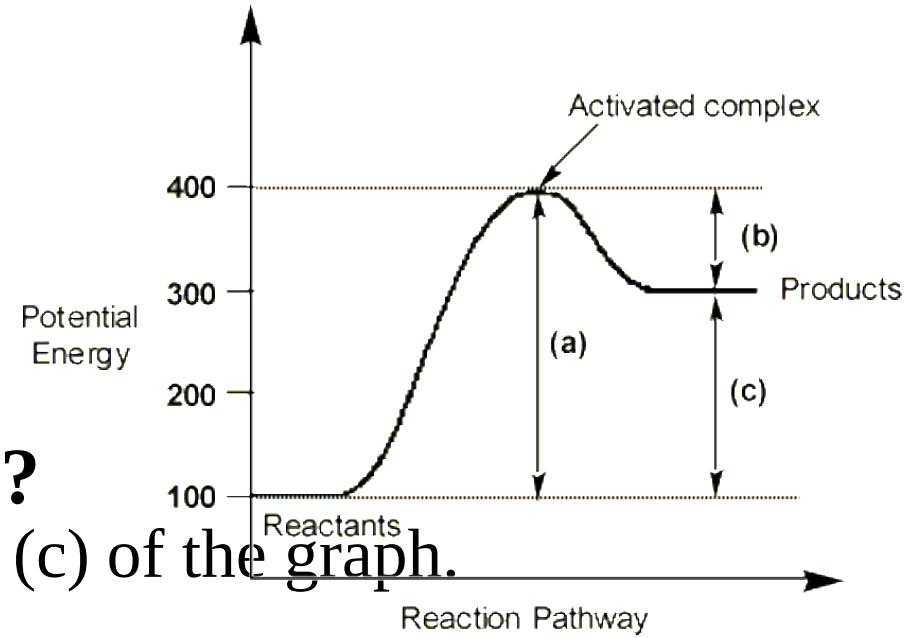
**What is the enthalpy change of the the reaction?**

Answer:

**What is the activation energy of the reaction?**

Answer:

# Practice Problem #1




**Is the reaction exothermic or endothermic?**

Answer: Endothermic – system is gaining energy

**What is the enthalpy change of the the reaction?**

Answer: The enthalpy change (**ΔH**) is seen on section (c) of the graph.

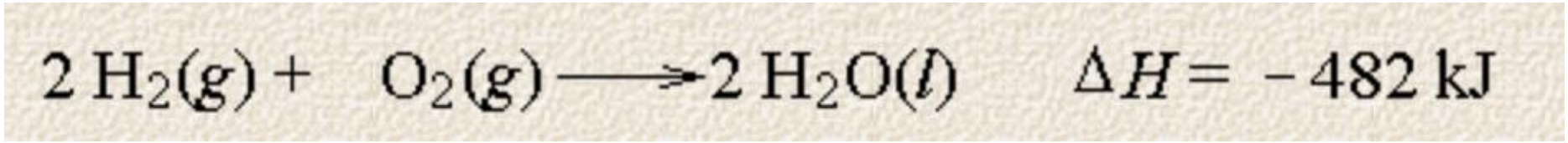
**ΔH = Final Energy – Initial Energy**
**= 300 kJ – 100 kJ**
**= 200 kJ**

**What is the activation energy of the reaction?**

Answer: The activation energy is seen on section (a) of the graph.

**$E_A$ = Final Energy – Initial Energy**
**= 400 kJ – 100 kJ**
**= 300 kJ**

# Practice Problem #2




**Is the following reaction exothermic or endothermic?**

Answer:

**Draw a fully labelled energy diagram for the reaction.** **(Include energy values on axis)**

Answer:

# Practice Problem #2

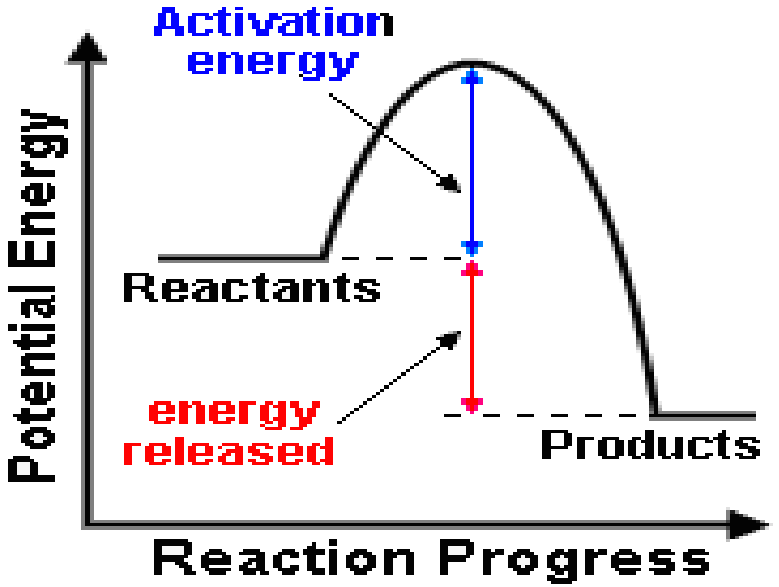
$$2\,H_2(g) + O_2(g) \longrightarrow 2\,H_2O(l) \qquad \Delta H = -482\ kJ$$

**Is the following reaction exothermic or endothermic?**

Answer: Exothermic – the reaction is **losing** energy (**ΔH** is negative)

**Draw a fully labelled energy diagram for the reaction.** **(Include energy values on axis)**

Answer:



# Homework

## Homework [1.8] on Handout