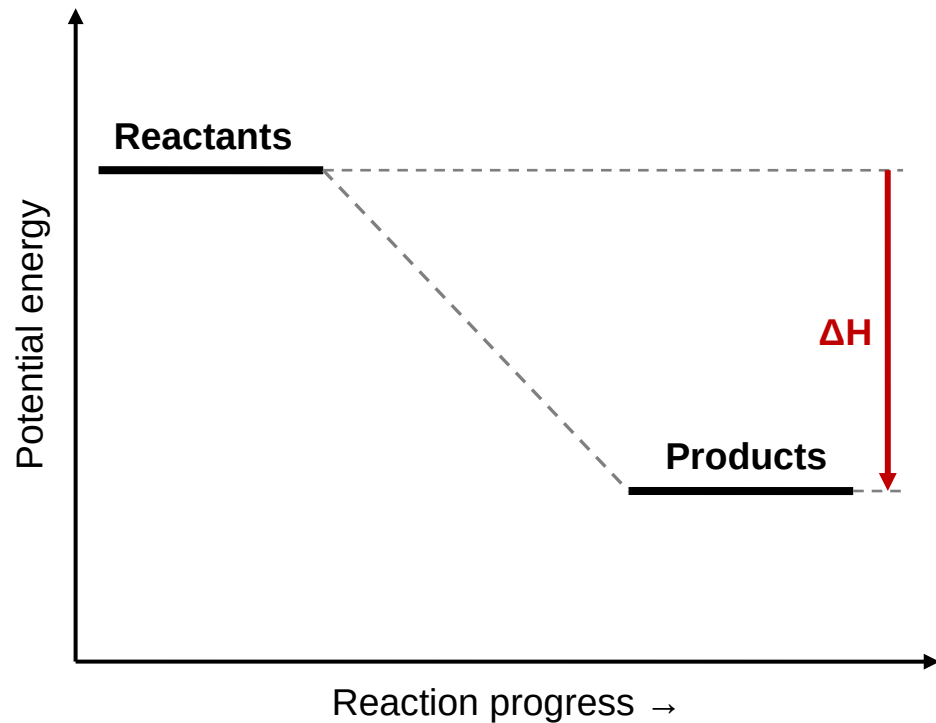


Essential Question

How can a picture show if energy is released or absorbed?

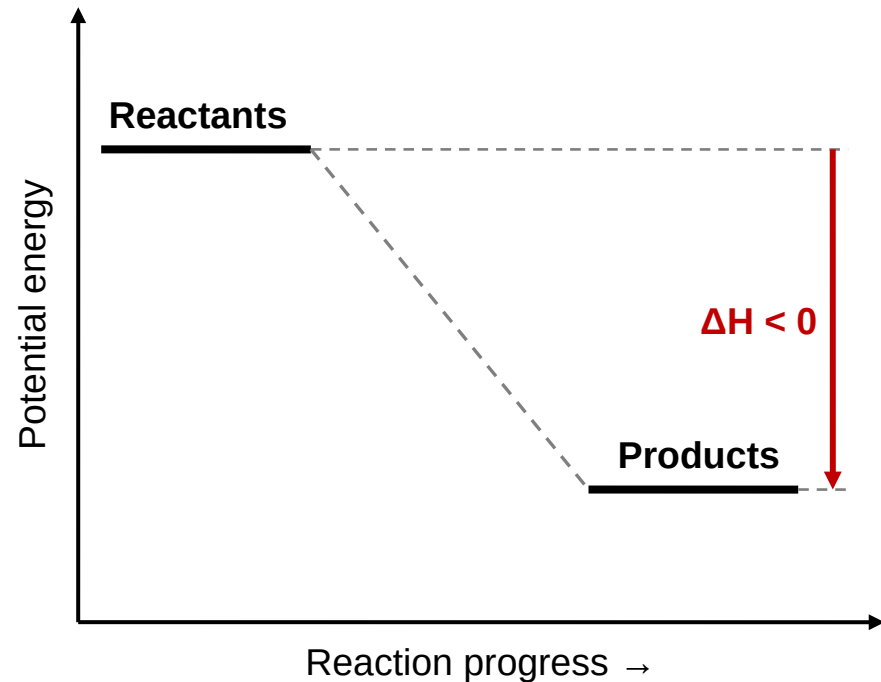
Parts of an Energy Diagram

- y-axis: potential energy
- x-axis: reaction progress
- Levels: reactants, products
- ΔH arrow: reactants $\rightarrow$ products



Exothermic Diagram

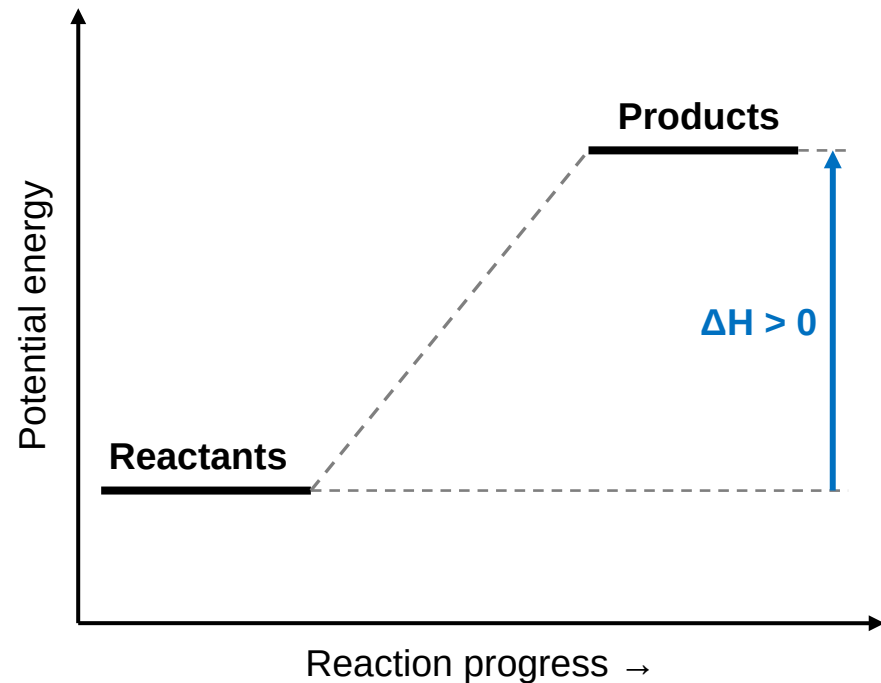
- Products lower than reactants
- $\Delta H < 0$ (negative)
- Energy released to surroundings



Products end up lower in energy

Endothermic Diagram

- Products higher than reactants
- $\Delta H > 0$ (positive)
- Energy absorbed from surroundings



Products end up higher in energy

Finding ΔH

$$\Delta H = E_{\text{products}} - E_{\text{reactants}}$$

Products lower

ΔH negative

exothermic

Products higher

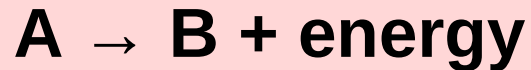
ΔH positive

endothermic

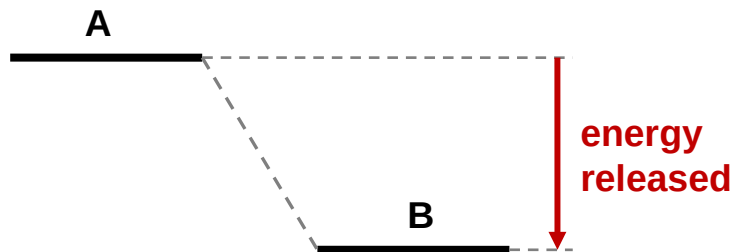
- Arrow starts at reactants, points to products

Energy as a Reactant or Product

Exothermic



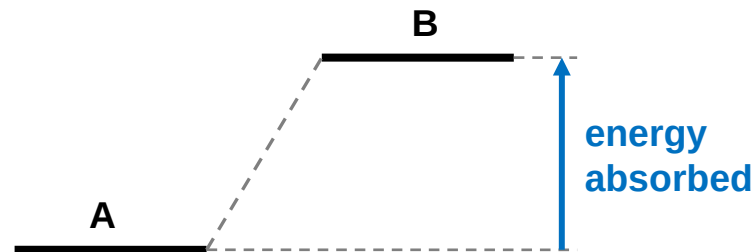
energy is a product



Endothermic

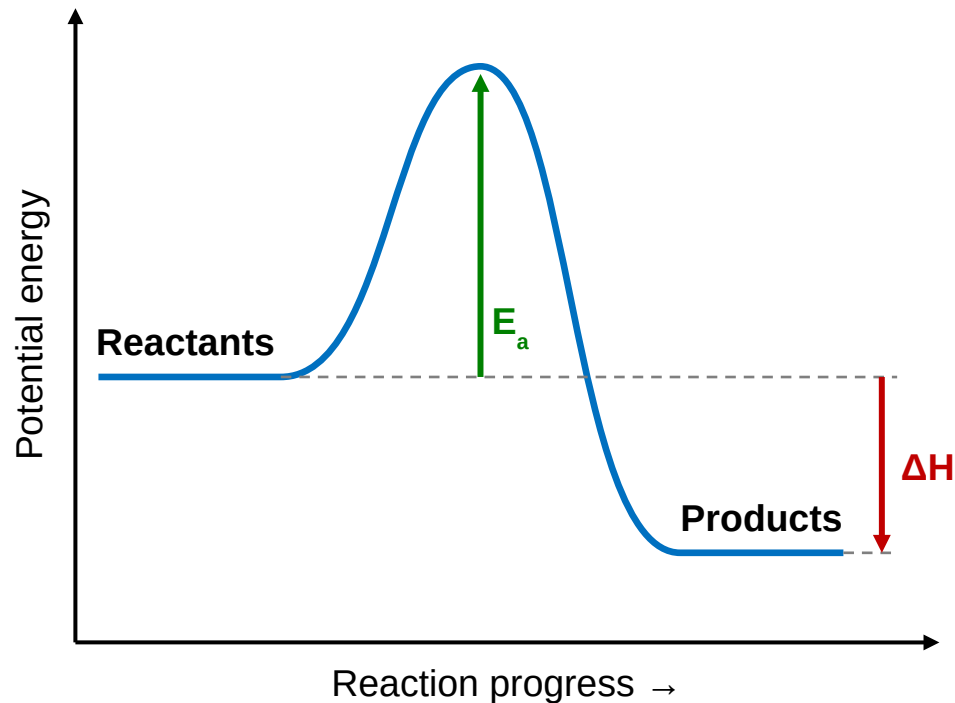


energy is a reactant

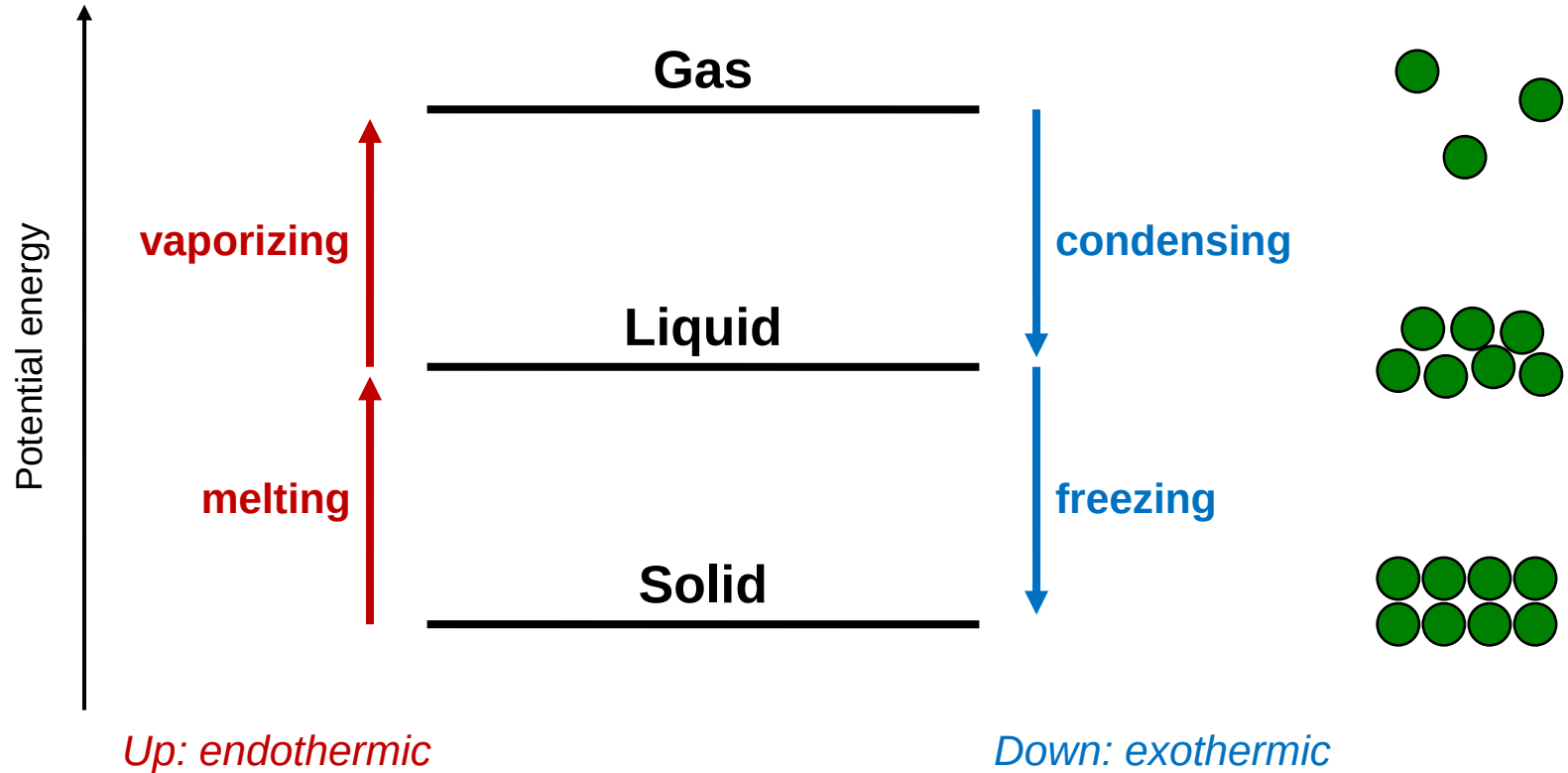


The Hump: Activation Energy

- Activation energy (E_a): energy to get started
- ΔH : only start and end levels
- The hump does not change ΔH

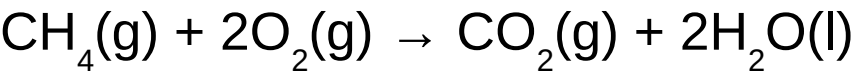


Phase Changes on an Energy Diagram



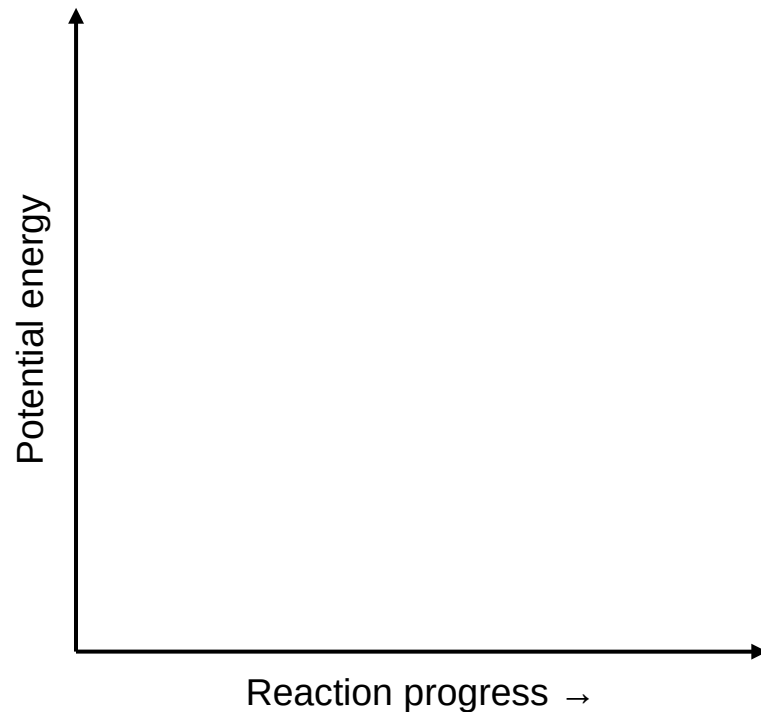
Example: Sketch a Diagram

The combustion of methane releases energy:



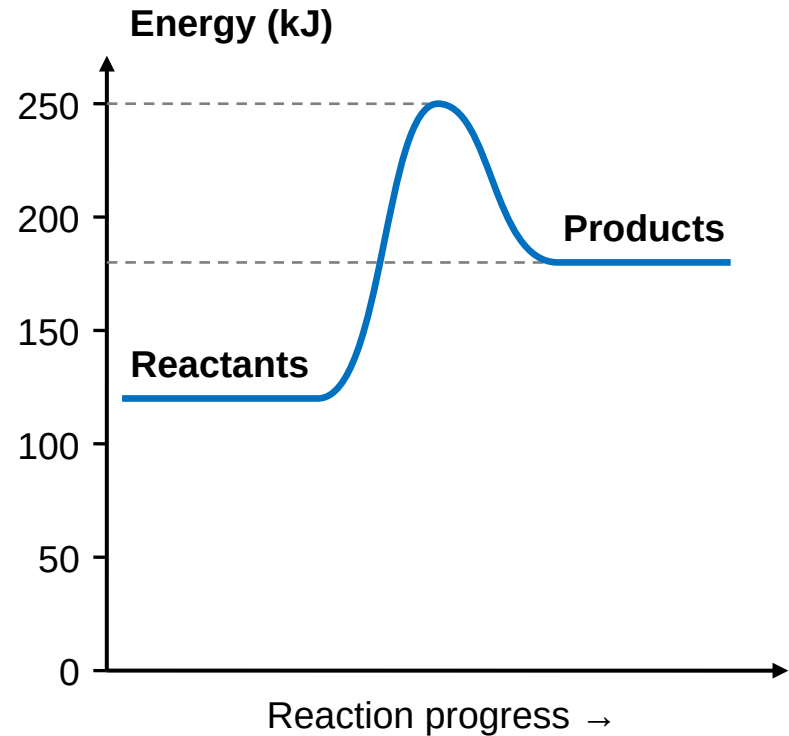
$$\Delta H = -890 \text{ kJ/mol}_{\text{rxn}}$$

Sketch and label an energy diagram for this reaction.



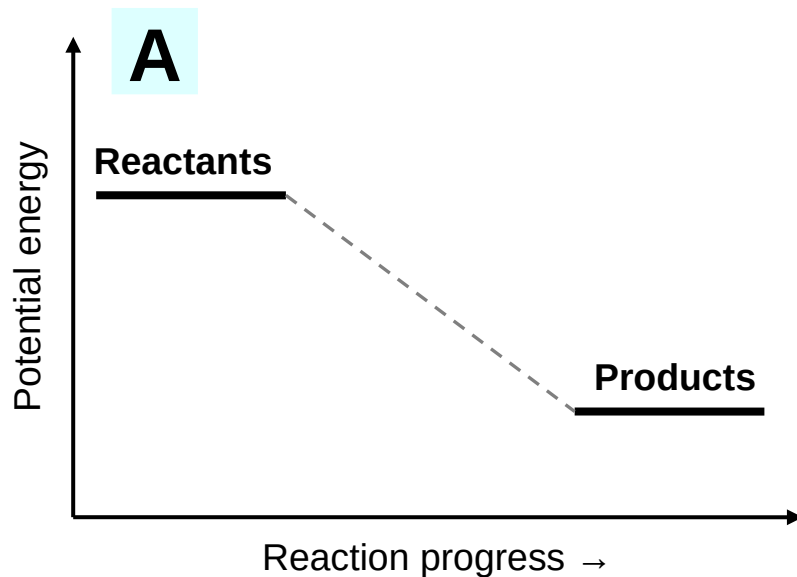
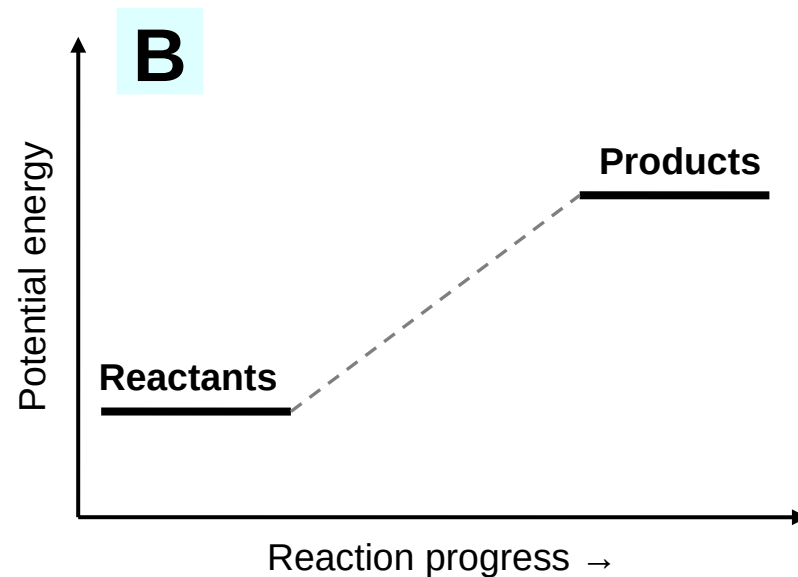
Example: Read a Diagram

Use the energy diagram to determine ΔH for the reaction. Is the reaction endothermic or exothermic?



Example: Match the Diagram

An instant cold pack gets cold when the solid dissolves. Which diagram represents the dissolving process? Justify.



Big Ideas

- Products lower: exothermic, $\Delta H < 0$
- Products higher: endothermic, $\Delta H > 0$
- ΔH arrow: reactants $\rightarrow$ products
- The hump does not change ΔH

