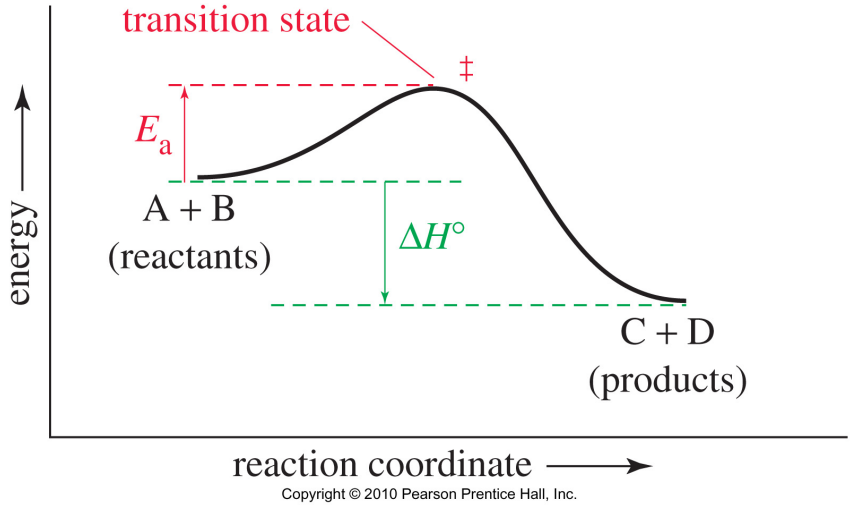
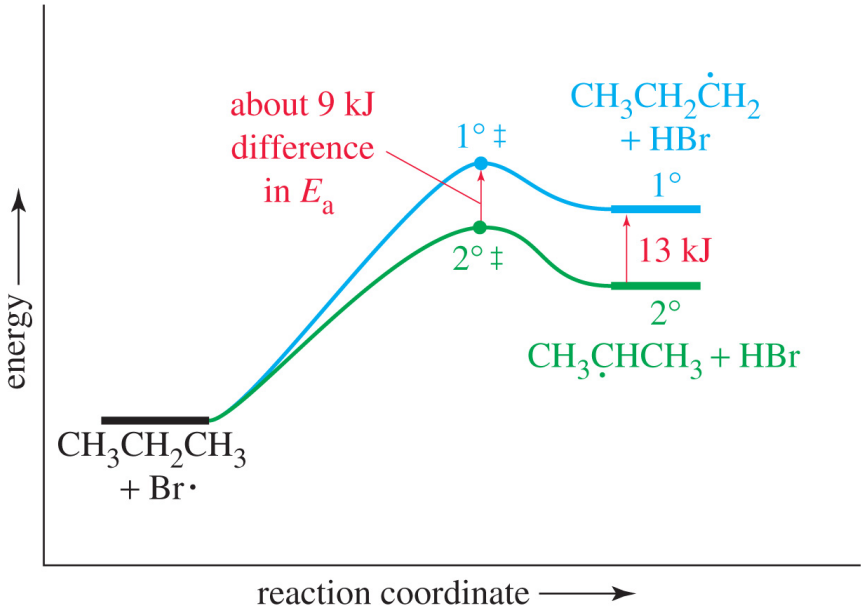
Energy Profile Diagrams

Energy Diagram of One-Step Exothermic Reaction

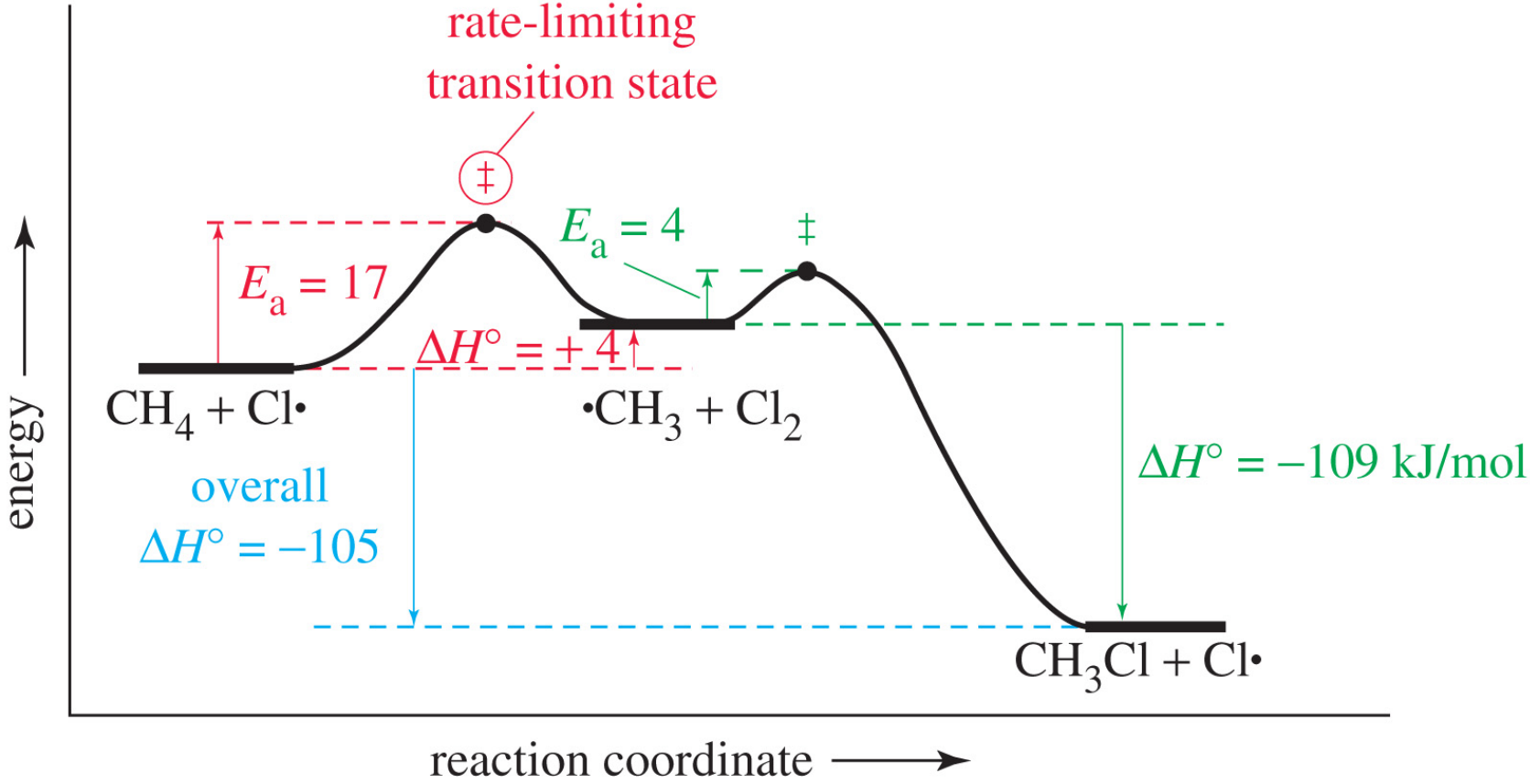


- The **vertical** axis in this graph represents the **potential energy**.
- The **transition state** is the highest point on the graph, and the **activation energy** is the energy difference between the reactants and the transition state.

Energy Diagram of Endothermic Reaction



Energy Diagram for the Chlorination of Methane



Rate-Limiting Step

- Reaction **intermediates** (*e.g.* $CH_3^{\bullet}$) are **reactive** species however, **they can be stable** (i.e. less reactive) as long as they don't collide with another molecule or atom.
- **Transition states** are at **energy maximums**.
- **Intermediates** are at **energy minimums**.
- The reaction step with **highest E_a** will be the **slowest**, therefore **rate-determining** for the entire reaction.

Hammond Postulate

- Related species that are **similar in energy** are also **similar in structure**.
- The structure of the **transition state** resembles the structure of the closest stable species.
- ***Endothermic reaction***: Transition state is product-like.
- ***Exothermic reaction***: Transition state is reactant-like.

Endothermic and Exothermic Diagrams