Multistep Reaction Energy Profile

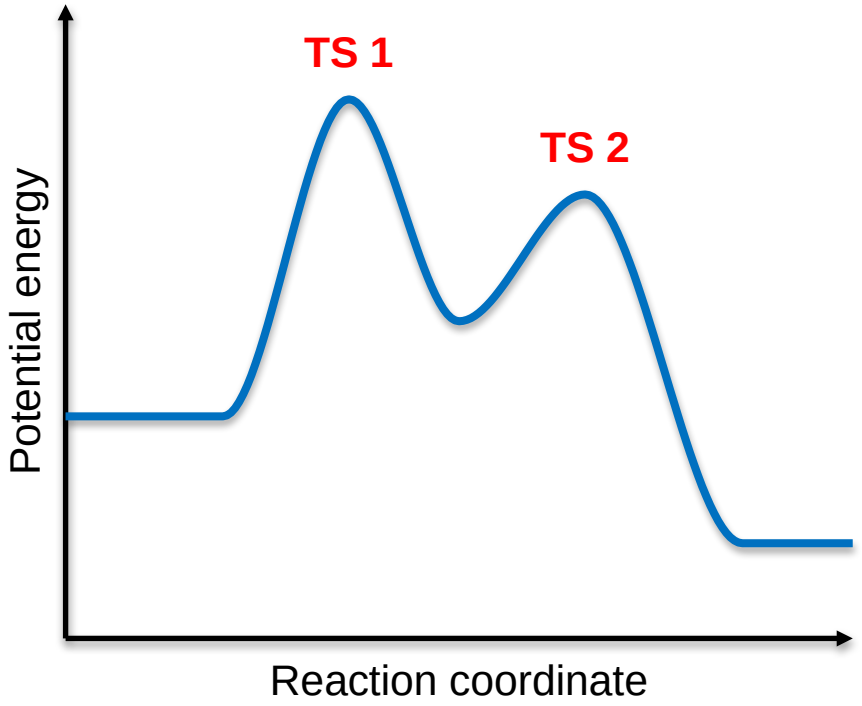
Essential Question

How does an energy profile show each step of a mechanism?

Multistep Reaction Energy Profile

One Hill per Step

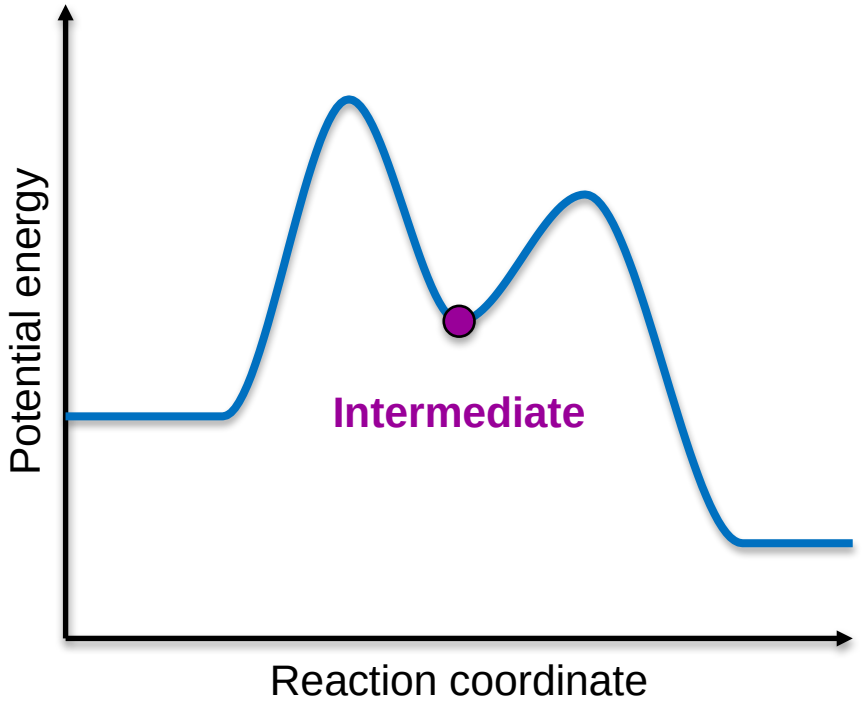
- Each step has its own transition state
- Two steps → two hills



Multistep Reaction Energy Profile

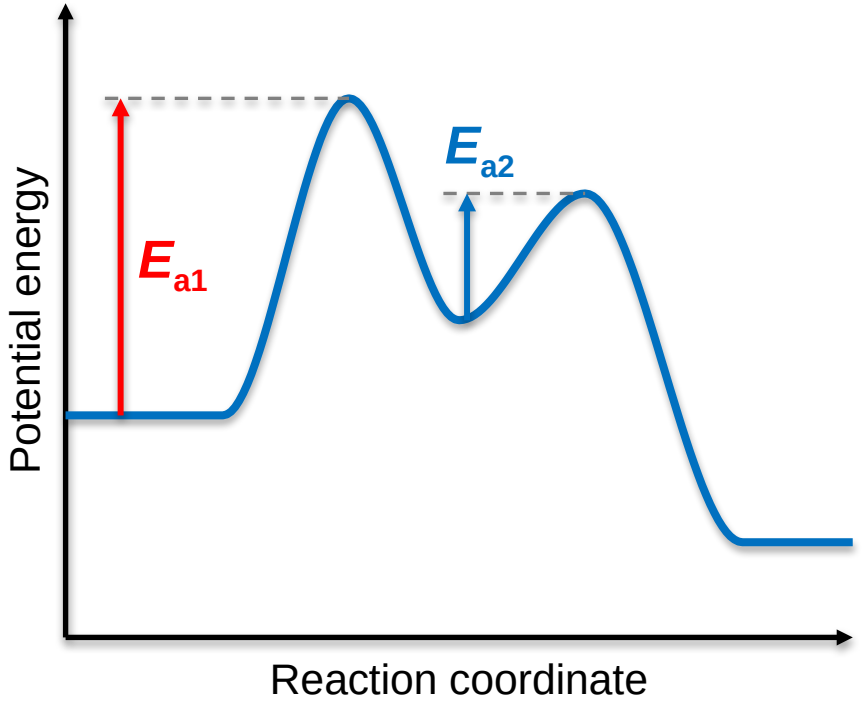
Intermediates in the Valleys

- Valley between hills = intermediate
- Made by one step, used by the next



Finding the Slow Step

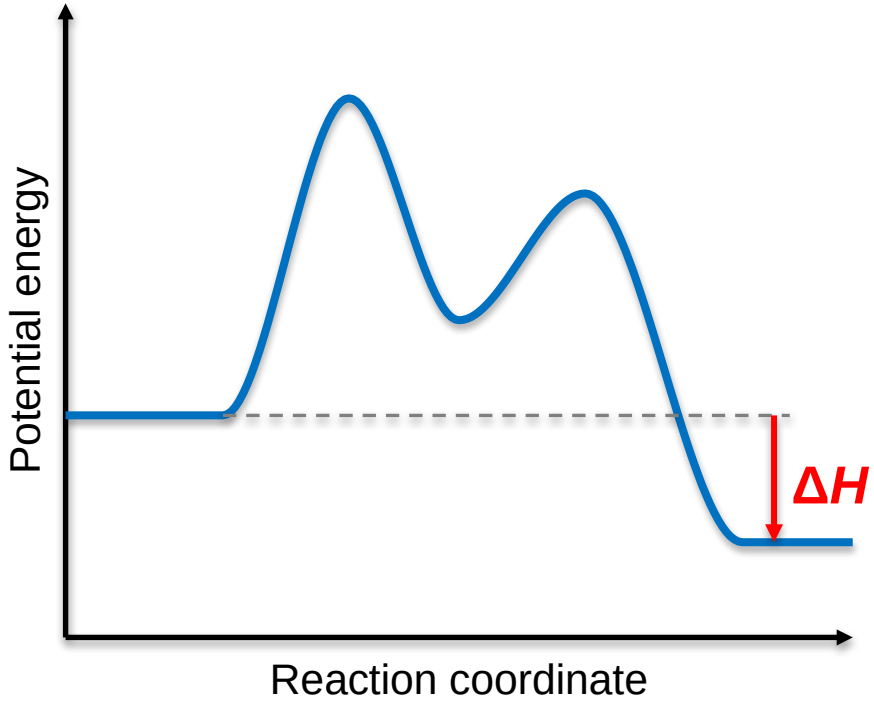
- Measure each E_a from the start of that step
- Largest E_a = slowest step



Multistep Reaction Energy Profile

Overall ΔH

- ΔH = products − reactants
- Intermediates don't change ΔH



Drawing a Multistep Profile

1
Draw reactant and product levels (from ΔH)

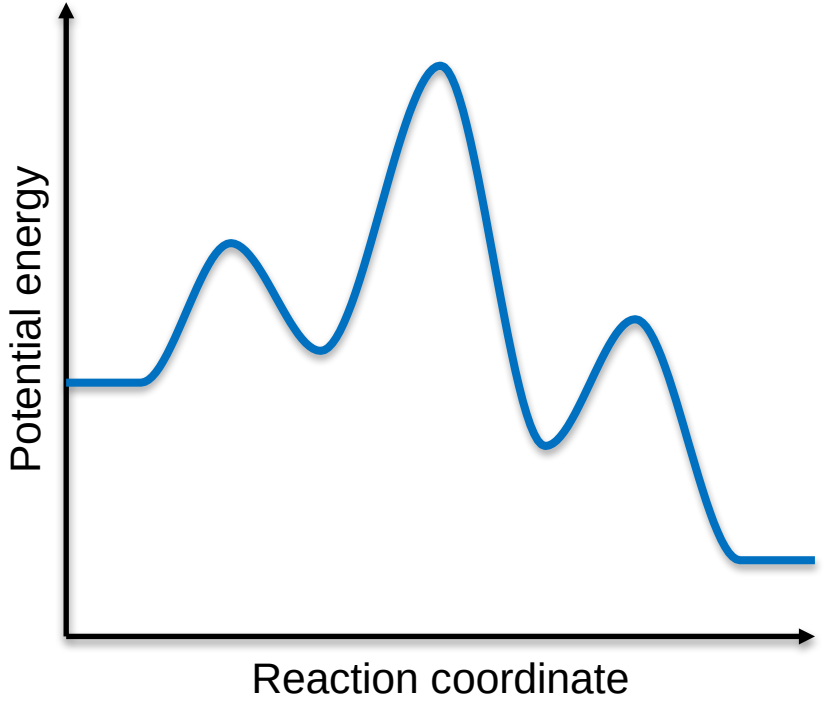
2
Draw one hill for each step

3
Put a valley at each intermediate

4
Make the slow step's hill the biggest

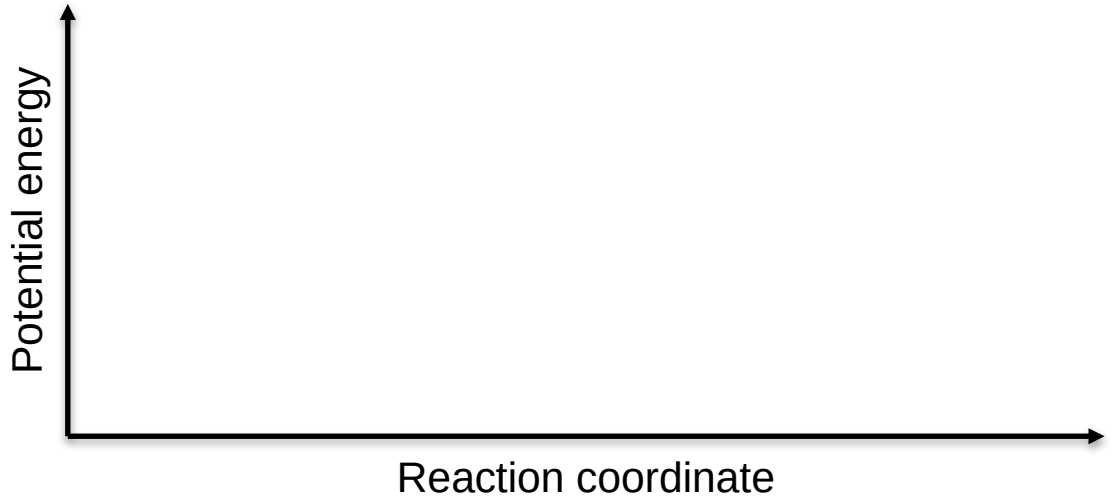
Example: Reading a Multistep Profile

How many steps are there? How many intermediates? Which step is rate-determining? Is the reaction exothermic or endothermic?



Example: Sketching a Profile

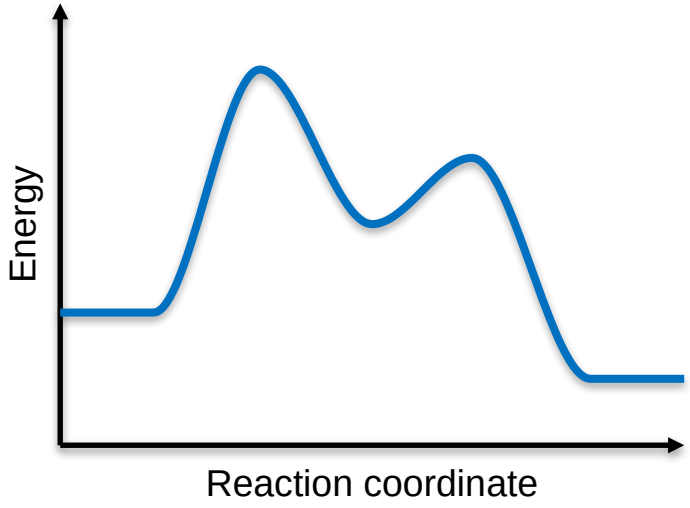
A two-step reaction has a slow, endothermic first step and a fast, exothermic second step. The overall reaction is exothermic. Sketch the energy profile.



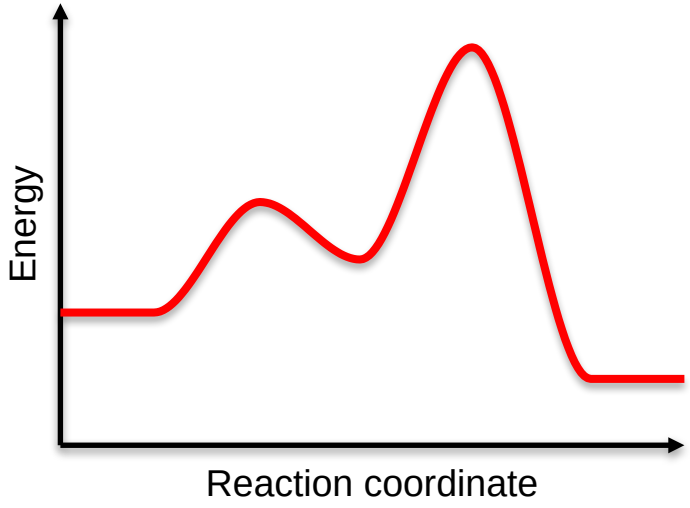
Example: Matching a Mechanism

In a two-step mechanism, step 1 is fast and step 2 is slow. Which profile, A or B, matches this mechanism?

Profile A



Profile B



Multistep Reaction Energy Profile

Big Ideas

- One hill (transition state) per step
- Valleys = intermediates
- Largest E_a from the step's start = slow step
- ΔH = products − reactants

