

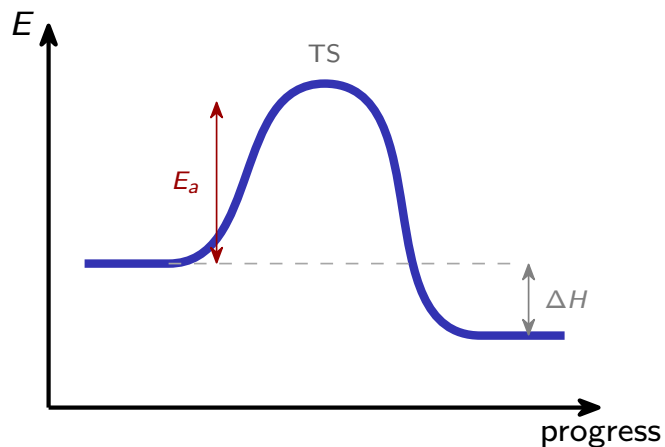
Exercise walk-through

5.6

Reaction Energy Profile

AP Chemistry

Energy profiles and Arrhenius



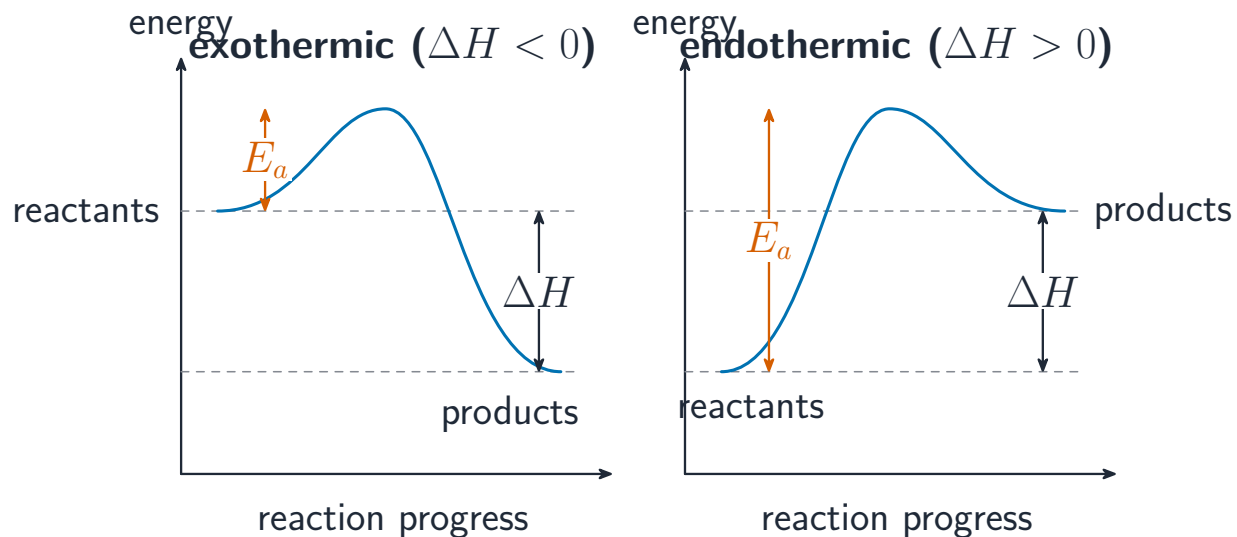
The **transition state** is the peak. Forward E_a = reactants to peak.

Arrhenius equation

$$k = A e^{-E_a/(RT)}$$

Larger $E_a \Rightarrow$ smaller k . Products lower = **exothermic**.

Reading an Energy Profile

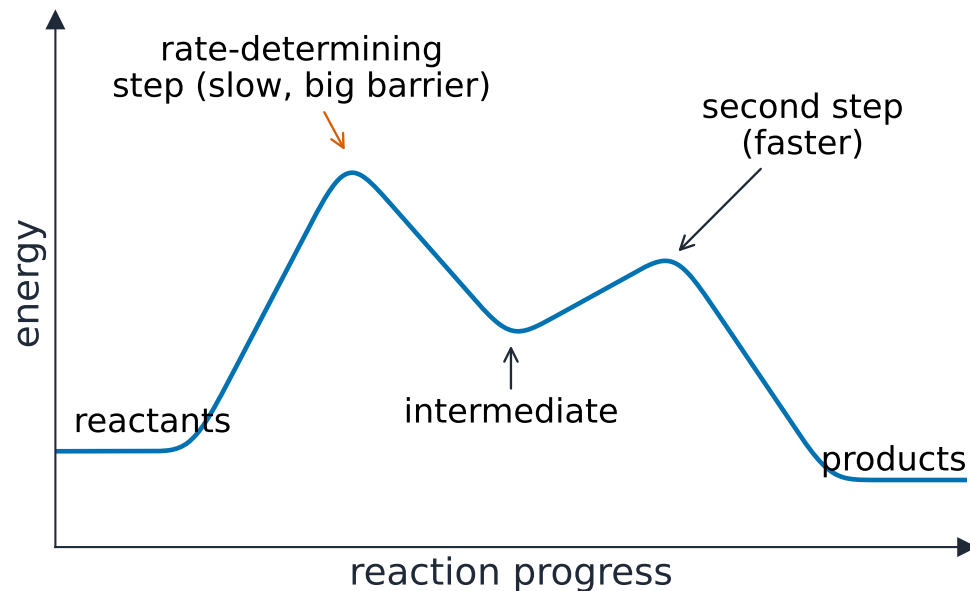


Exothermic reactions end lower than the reactants; endothermic end higher

The Sequence of Steps

In a multi-step mechanism, the steps must **add up** to the overall balanced equation (intermediates cancel).

Each step has its own energy hill; the tallest hill is the slowest step.



Exercises 2.1-2.3

2.1 On an energy profile, where is the activation energy measured from and to? [1]

2.2 Reactants at 60 kJ, products at 40 kJ. Find ΔH and classify it. [2]

2.3 What does the peak of an energy profile represent? [1]

Exercises 2.1·2.3

2.1 On an energy profile, where is the activation energy measured from and to? [1]

2.1

- From the reactants up to the peak (transition state)
-

2.2 Reactants at 60 kJ, products at 40 kJ. Find ΔH and classify it. [2]

2.2

- $\Delta H = 40 - 60 = -20$ kJ; exothermic
-

2.3 What does the peak of an energy profile represent? [1]

2.3

- The transition state (the highest-energy point)

Exercise 3.1

3.1 An exothermic reaction has products that are

[1]

☐

A higher in energy than reactants

B lower in energy than reactants

C equal to reactants

D at the peak

Exercise 3.1

3.1 An exothermic reaction has products that are

[1]

☐

A higher in energy than reactants

B lower in energy than reactants

C equal to reactants

D at the peak

3.1 B

- products lower in energy than reactants

Exercise 3.2 (a)

3.2 An energy profile shows reactants at 80 kJ, the peak at 150 kJ, products at 110 kJ.

(a) Find the activation energy.

[2]

Exercise 3.2 (a)

3.2 An energy profile shows reactants at 80 kJ, the peak at 150 kJ, products at 110 kJ.

(a) Find the activation energy.

[2]

(a)

- $E_a = 150 - 80 = 70 \text{ kJ}$

Exercise 3.2 (b)

3.2 An energy profile shows reactants at 80 kJ, the peak at 150 kJ, products at 110 kJ.

(b) Find ΔH and state whether the reaction is exo- or endothermic. [2]

Exercise 3.2 (b)

3.2 An energy profile shows reactants at 80 kJ, the peak at 150 kJ, products at 110 kJ.

(b) Find ΔH and state whether the reaction is exo- or endothermic. [2]

(b)

- $\Delta H = 110 - 80 = +30$ kJ, endothermic

Exercise 3.3

3.3 Sketch-describe how the energy profile changes when a catalyst is added, and state which quantity is unaffected. [2]

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3.3

- A catalyst lowers the peak (a smaller E_a , an alternative pathway); ΔH (the reactant-to-product energy difference) is unchanged