

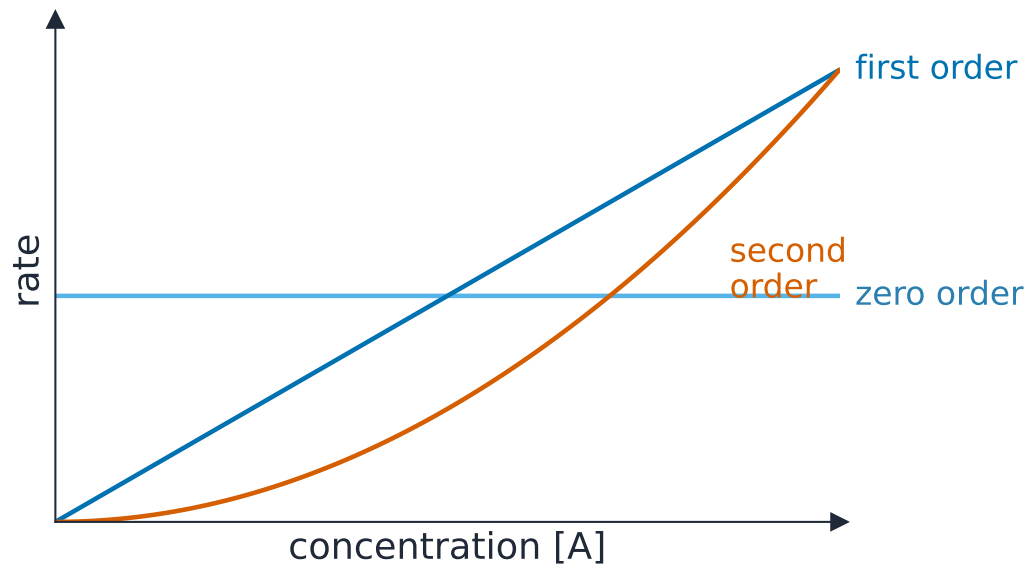
Exercise walk-through

5.4

Elementary Reactions

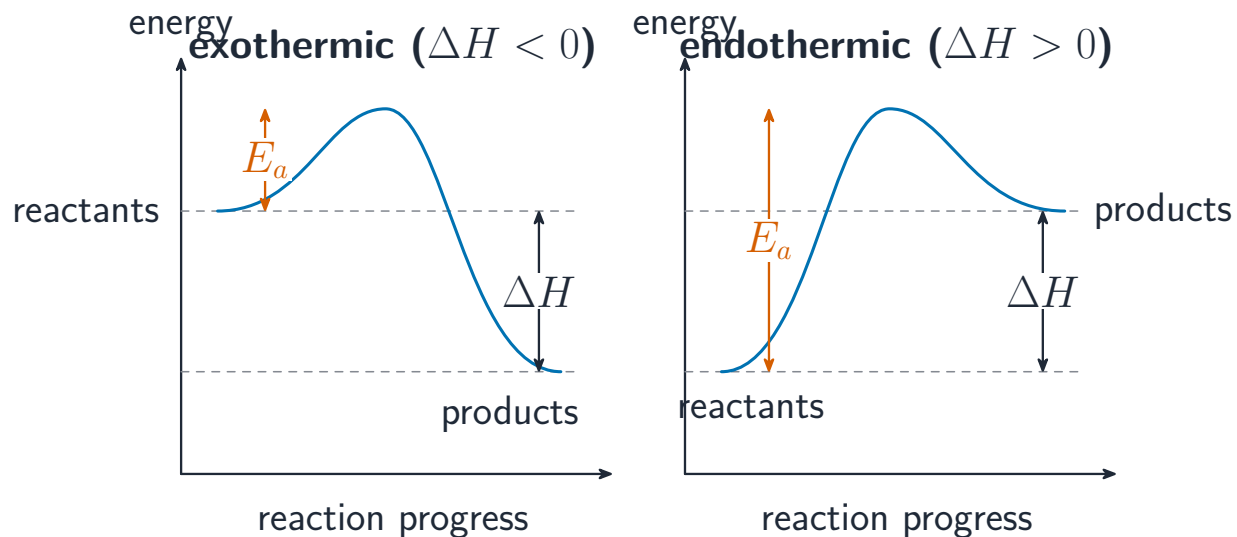
AP Chemistry

Rate against concentration for zero-



Rate against concentration for zero-, first-, and second-order reactions

Reading an Energy Profile



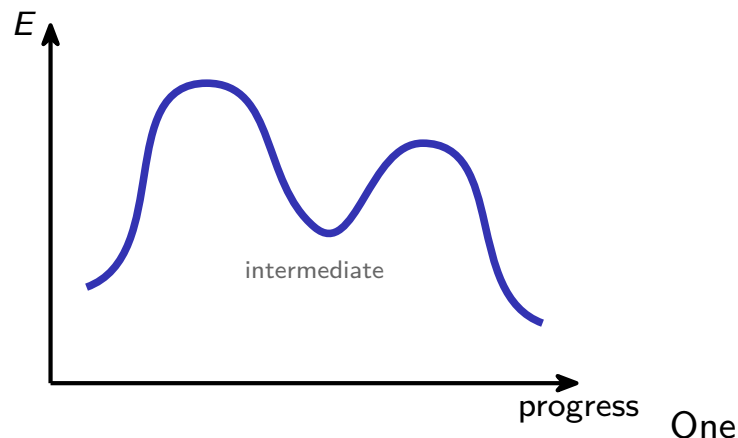
Exothermic reactions end lower than the reactants; endothermic end higher

Reaction mechanisms

A **mechanism** is the ordered list of **elementary steps**.

- an **intermediate** is made, then used up
- steps must add to the overall equation
- for an elementary step, the rate law comes from its stoichiometry

The slow **rate-determining step** sets the overall rate.



peak per step; a valley is the intermediate.

Exercises 2.1-2.3

2.1 What is an intermediate?

[1]

2.2 Write the rate law for the elementary step $A + B \rightarrow C$.

[1]

2.3 In a two-step mechanism, a species is made in step 1 and used in step 2. Name it.[1]

Exercises 2.1-2.3

2.1 What is an intermediate? [1]

2.1

- A species made in one step and consumed in a later step (not in the overall equation)
-

2.2 Write the rate law for the elementary step $A + B \rightarrow C$. [1]

2.2

- $\text{rate} = k[A][B]$
-

2.3 In a two-step mechanism, a species is made in step 1 and used in step 2. Name it. [1]

2.3

- An intermediate

Exercise 3.1

3.1 For an **elementary** step $2\text{NO} \rightarrow \text{N}_2\text{O}_2$, the rate law is

[1]

☐

A $k[\text{NO}]$

B $k[\text{NO}]^2$

C $k[\text{N}_2\text{O}_2]$

D k

Exercise 3.1

3.1 For an **elementary** step $2\text{NO} \rightarrow \text{N}_2\text{O}_2$, the rate law is

[1]

☐

A $k[\text{NO}]$

B $k[\text{NO}]^2$

C $k[\text{N}_2\text{O}_2]$

D k

3.1 B

- an elementary step's rate law uses its coefficients: $k[\text{NO}]^2$

Exercise 3.2 (a)

3.2 A mechanism is: Step 1 $A \rightarrow X$; Step 2 $X + B \rightarrow C$.

(a) Identify the intermediate.

[1]

Exercise 3.2 (a)

3.2 A mechanism is: Step 1 $A \rightarrow X$; Step 2 $X + B \rightarrow C$.

(a) Identify the intermediate.

[1]

(a)

- X

Exercise 3.2 (b)

3.2 A mechanism is: Step 1 $A \rightarrow X$; Step 2 $X + B \rightarrow C$.

(b) Write the overall equation.

[2]

Exercise 3.2 (b)

3.2 A mechanism is: Step 1 $A \rightarrow X$; Step 2 $X + B \rightarrow C$.

(b) Write the overall equation.

[2]

(b)

- Adding the steps, X cancels: $A + B \rightarrow C$

Exercise 3.3

3.3 Explain why you cannot write the rate law of an **overall** reaction directly from its coefficients, but you can for an elementary step. [2]

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3.3

- The overall equation may hide several steps, so its coefficients need not match the true dependence; an elementary step **is** a single collision event, so its molecularity gives its rate law directly