5 Rate laws and energy profiles – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	Write it 3 times (English)		
rate law			
rate constant			
orders			
energy profile			
transition state			
catalyst			

Recall

In Part A you saw that reactions need collisions with enough energy. Now put that on a graph and in a formula:

- An **energy profile** shows the energy hill a reaction must climb.
- A catalyst lowers that hill.
- The rate depends on how much reactant is present.

Each idea has a worked example before the Practice.

New ideas

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1 The rate law

The **rate law** links the rate to the reactant concentrations:

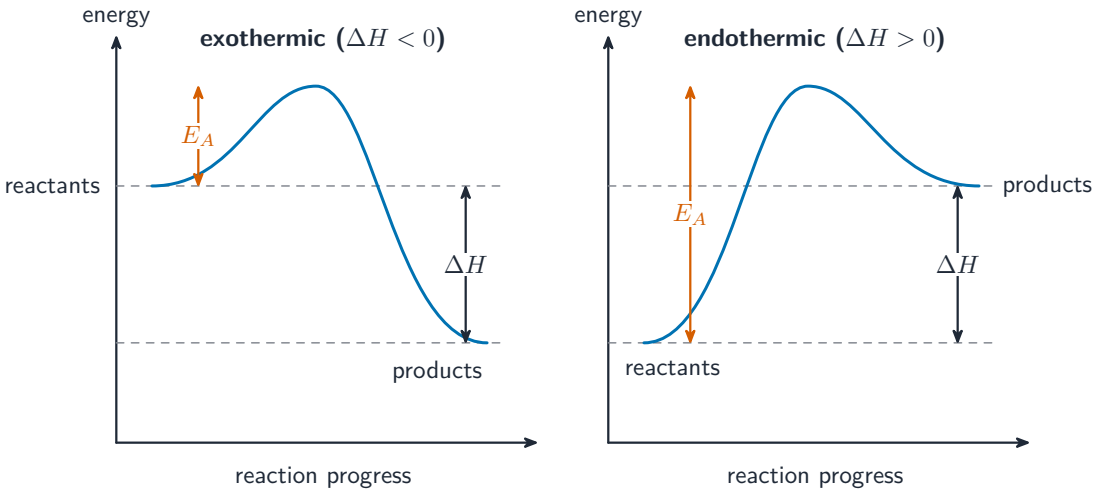
$$\text{rate} = k[\text{A}]^m[\text{B}]^n,$$

where k is the **rate constant** and m, n are the **orders**. The orders are found by **experiment**, not from the equation.

Worked example. If doubling [A] makes the rate four times bigger, the reaction is **second order** in A ($2^2 = 4$), so rate $= k[\text{A}]^2$.

2 Energy profiles

An **energy profile** plots energy along the reaction path.



- the height of the hill is the **activation energy** E_a,
- the peak is the **transition state**,
- the gap between reactants and products is ΔH.

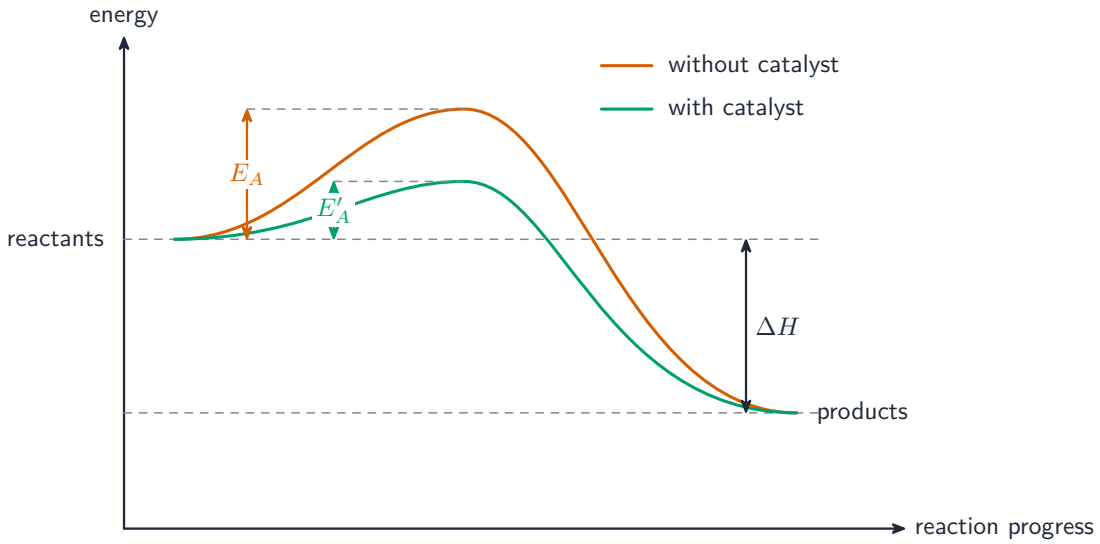
3 Exothermic and endothermic

If the products end **lower** than the reactants, energy is released (**exothermic**); if **higher**, energy is absorbed (**endothermic**).

4 Catalysts

A **catalyst** gives the reaction a new path with a **lower activation energy**, so it goes faster – but it is not used up and does not change ΔH.

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Watch out: the reaction orders come from **experiment**, not from the balanced equation's coefficients. You cannot read them off the equation.

Practice

Try these in order. The methods are all above.

2.1 In a rate law, state what k and the "order" mean. [2]

2.2 Doubling [A] doubles the rate. State the order of the reaction in A. [1]

2.3 On an energy profile, state what the height of the hill represents. [1]

2.4 A reaction's products are lower in energy than the reactants. State whether it is exothermic or endothermic. [1]

2.5 Explain how a catalyst speeds up a reaction, and state what it does **not** change. [2]