

8 Rate of reaction – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	Write it 3 times (English)		
effective collisions	_____	_____	_____
catalyst	_____	_____	_____
activation energy	_____	_____	_____
Boltzmann distribution	_____	_____	_____
enthalpy change	_____	_____	_____
homogeneous catalyst	_____	_____	_____
heterogeneous catalyst	_____	_____	_____

Recall

From Part 1 you know reactions need **effective collisions** . Here we look at how **temperature** and a **catalyst** change the rate.

- The **activation energy** is the least energy a collision needs.
- A graph called the Boltzmann distribution shows which molecules have enough.

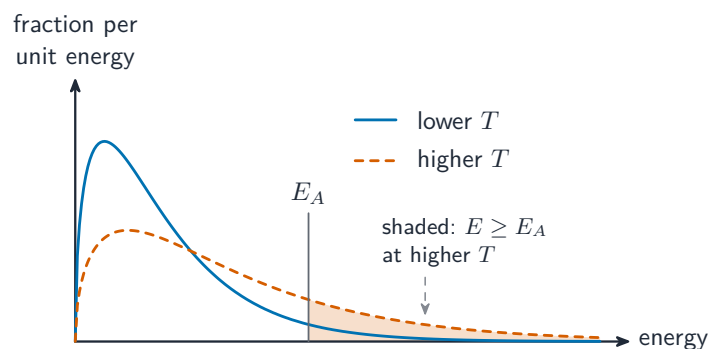
New ideas

Read these first, then do the Practice.

■ 1 The Boltzmann distribution

The **Boltzmann distribution** shows how the molecules' energies are spread at one temperature. Only the molecules to the **right** of the **activation energy** (E_A) have enough energy to react.

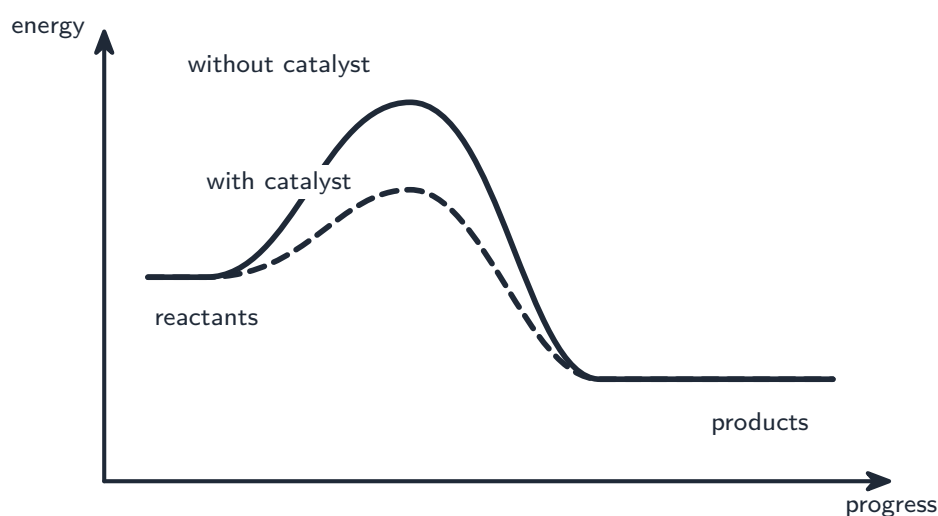
Raising the temperature **spreads the curve to the right**, so a **much larger fraction** of molecules now have energy above E_A – this is why a small temperature rise gives a big rise in rate.



■ 2 Catalysts

A **catalyst** speeds up a reaction but is **not used up**. It gives a new route with a **lower activation energy**, so more collisions are effective.

- the **enthalpy change** (ΔH) is **not** changed.
- a **homogeneous catalyst** is in the **same** state as the reactants.
- a **heterogeneous catalyst** is in a **different** state (e.g. a solid surface).



Watch out: a catalyst lowers the *activation energy* by giving an alternative route – it does *not* change ΔH (the reactant and product energies are unchanged), and it is not used up.

Practice

Try these in order.

8.1 What does the activation energy mean? [1]

8.2 On the Boltzmann distribution, which molecules are able to react? [1]

8.3 Explain why a small rise in temperature gives a large rise in rate. [2]

8.4 How does a catalyst speed up a reaction? [2]

8.5 Does a catalyst change the enthalpy change, ΔH , of a reaction? [1]

8.6 State the difference between a homogeneous and a heterogeneous catalyst. [2]

8.7 Challenge. Using the Boltzmann distribution, explain why a catalyst speeds up a reaction even at the *same* temperature. [2]
