# Catalysts and Reaction Rate

**T-Level Science · Chemistry · A11.3.1–A11.3.2**

Name: _____ Date: _____

## 1. Retrieval

1.1 Define activation energy and state the two conditions for a successful collision.

## 2. Defining a catalyst

2.1 Write the complete definition of a catalyst.

| Scenario | Rate up? | Permanent change? | Catalyst? | Justification |
|---|---|---|---|---|
| X faster; recovered unchanged | | | | |
| Y faster; converted to a product | | | | |
| Z recovered; no rate effect | | | | |

## 2.2 Evidence

What evidence would support the claim that an unknown substance is acting as a catalyst?

## 3. Alternative pathway

3.1 Explain how a catalyst increases rate using alternative pathway and activation energy.

3.2 Explain why a lower activation energy increases the proportion of successful collisions.

## 4. Maxwell–Boltzmann distribution

4.1 At constant temperature, does adding a catalyst change the Maxwell–Boltzmann distribution? Explain.

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## 4.2 Two activation energies

A reaction has Ea = 85 kJ mol$^{-1}$ without a catalyst and 52 kJ mol$^{-1}$ with a catalyst. Which Ea line should be further left, and why?

4.3 What does the area to the right of an Ea line represent? How does a catalyst affect this area?

## 5. Catalyst versus temperature

| Change | Maxwell–Boltzmann distribution | Activation energy | Why rate increases |
|---|---|---|---|
| Increase temperature | | | |
| Add catalyst, same T | | | |

## 6. Error detective

6.1 ‘A catalyst is any substance that speeds up a reaction.’

6.2 ‘A catalyst gives the reacting particles more kinetic energy.’

## 6. Error detective continued

6.3 ‘A catalyst changes the shape of the Maxwell–Boltzmann distribution at constant temperature.’

6.4 ‘A catalyst is used up during the reaction.’

## 7. Catalyst identification

7.1 A reaction takes 180 s without A and 65 s with A. A is recovered with no permanent chemical change. Is A a catalyst? Justify.

7.2 B increases rate but is completely converted and not regenerated. Does this satisfy the definition? Explain.

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## 8. Exam-style questions

8.1 [2] Define a catalyst.

8.2 [2] Explain how a catalyst increases rate in terms of activation energy.

8.3 [3] Explain how catalysed and uncatalysed pathways should be shown on one Maxwell–Boltzmann distribution at constant temperature.

8.4 [2] Explain why the catalysed pathway gives a greater proportion of successful collisions.

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## 9. Final knowledge check

9.1 Give the full definition of a catalyst.

9.2 What pathway does a catalyst provide?

9.3 What happens to Ea?

9.4 Does the energy distribution change at constant temperature?

9.5 What happens to the proportion with E ≥ Ea?

9.6 Why does rate increase?