## Unit 5

# Reaction Rates, Mechanisms, and Energy Diagrams

### SOURCE LOCK

Built from SCH3U video-distilled notes, video range P97–P101, 5 lessons. No outside textbook text added.

### Big idea

- Reaction-rate questions ask how fast a reaction proceeds and which step controls the speed.

### Lesson map

- P97 Reaction Rate: Concepts and Calculations (49m 4s)
- P98 Rate Factors and Collision Theory (49m 38s)
- P99 Elementary Steps, Mechanisms, Activation Energy, and Catalysts (54m 53s)
- P100 Mechanism and Energy Diagram Strategies (34m 16s)
- P101 Practice with Elementary Steps, Activation Energy, and Catalysts (1h 21m)

# Core Notes

## What to know

- Reaction rate compares concentration change with time.
- Collision theory explains rate changes using collision frequency, collision energy, and successful orientation.
- Temperature, concentration, surface area, and catalysts affect the number or success of collisions.
- A catalyst changes the pathway and lowers activation energy, but is regenerated overall.
- In an energy diagram, the largest activation-energy barrier usually marks the rate-determining step.

## Problem-solving workflow

- Identify whether the question is asking for rate calculation, factor explanation, mechanism reading, or energy-barrier comparison.
- For mechanism diagrams, mark what enters, what leaves, what is regenerated, and what appears only in the middle.
- For energy diagrams, compute barriers by subtracting the reactant/intermediate energy from the transition-state energy.
- Use the largest barrier to locate the slow or rate-determining step.
- Connect catalyst questions back to lower activation energy and regenerated catalyst.

## Common traps

- Do not call every species in a cycle a catalyst; a catalyst must be regenerated overall.
- Intermediates are produced in one elementary step and consumed in another.
- A lower overall $\Delta H$ does not automatically mean a faster reaction.
- The rate-determining step is about the highest activation barrier, not the most visually dramatic step.

# Teacher Moves

### WHY THESE MATTER

These are the teacher-style moves distilled from the video notes: how to decide, not just what to memorize.

### Move 1

- When calculating rate, compare concentration change over time. | Source: P97 00:05:18, P98 00:17:19, P99 00:17:20.

### Move 2

- Explain rate changes using successful collisions. | Source: P97 00:11:20, P98 00:07:29, P99 00:53:35.

### Move 3

- A catalyst changes the pathway and is regenerated overall. | Source: P98 00:32:55, P100 00:01:43.

### Move 4

- Activation energy is the barrier from the current state to the transition state. | Source: P98 00:44:37, P101 00:15:22.

### Move 5

- Convert through moles before jumping between particles, mass, volume, and concentration. | Source: P97 00:37:24.

### Move 6

- A rate increase should be explained by more frequent or more energetic successful collisions. | Source: P98 00:27:26.

# Move 7

## Move 7

- The largest activation-energy barrier usually identifies the rate-determining step. | Source: P100 00:24:58.

## Move 8

- An intermediate is formed in one elementary step and consumed in a later step. | Source: P100 00:02:34.

# Worked Example Cards

### video-pattern example

Average reaction rate

Source: Unit 5 rate calculation, P97

1. Rate compares concentration change with time.
2. If concentration changes from 0.80 mol/L to 0.50 mol/L in 30 s, $\Delta c = -0.30$ mol/L.
3. Use the magnitude for average disappearance rate.
4. Rate = 0.30 / 30 = 0.010 mol/(L·s).

Answer: 0.010 mol/(L·s) for disappearance.

### video-pattern example

Find the rate-determining step from an energy diagram

Source: Unit 5 energy-barrier strategy, P100-P101

1. For each step, subtract the current valley energy from the next peak energy.
2. The biggest activation-energy barrier is the slowest step.
3. A catalyst lowers the barrier by changing the pathway.
4. Do not use overall $\Delta H$ to decide the rate-determining step.

Answer: The step with the largest activation-energy barrier is rate-determining.

### Practice prompts

- Find average reaction rate from concentration-time data.
- Explain the effect of a catalyst using an energy diagram.
- Identify intermediates, reactants, products, and catalyst in a mechanism.