

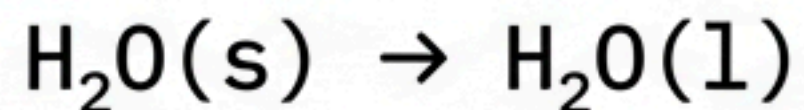
# Why Enzymes Make Reactions Fast

Deconstructing Chemical Reactions  
and Reaction Rates

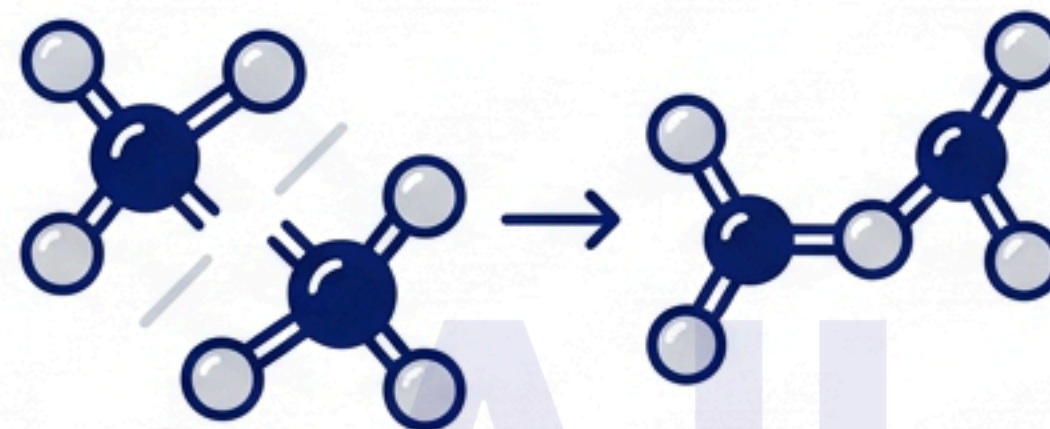
## Physical Change



Change in shape or state of matter without breaking internal bonds.



## Chemical Reaction

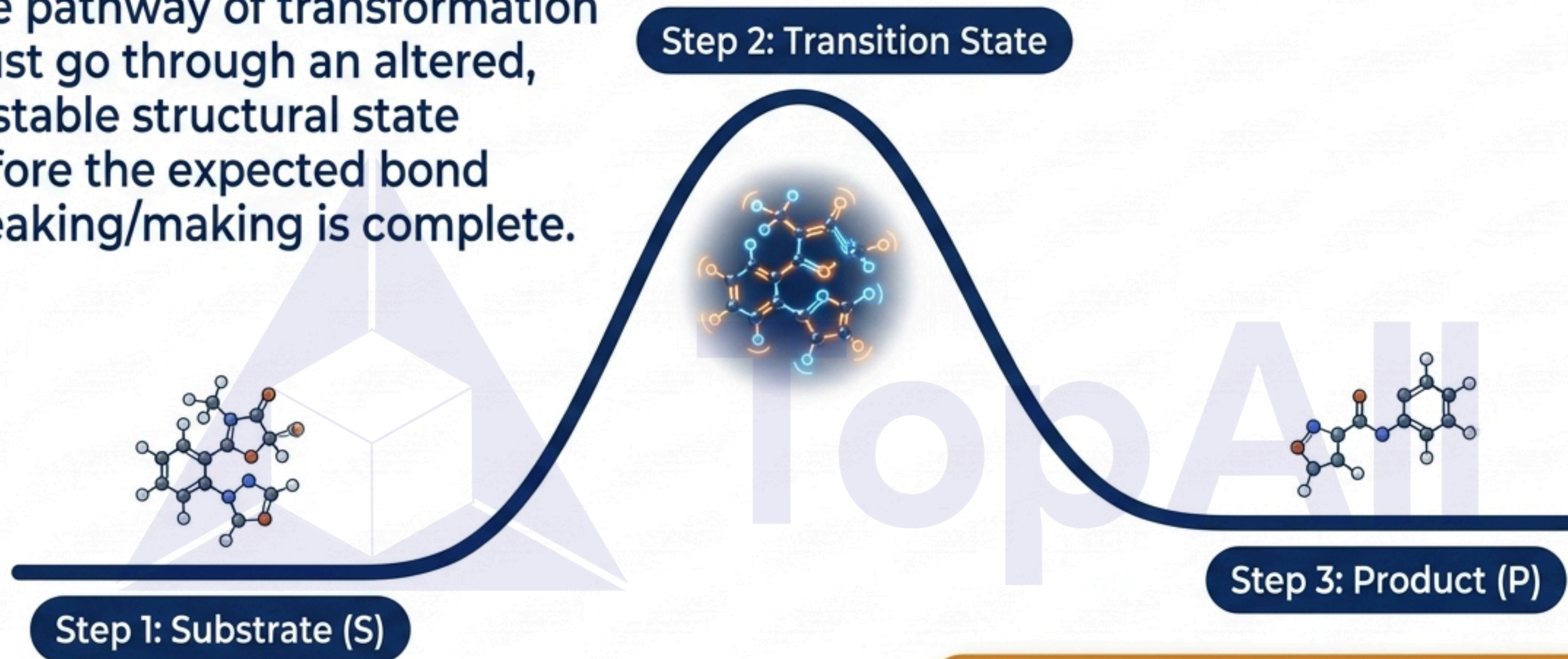


Internal bonds are broken and new bonds are formed during the transformation.

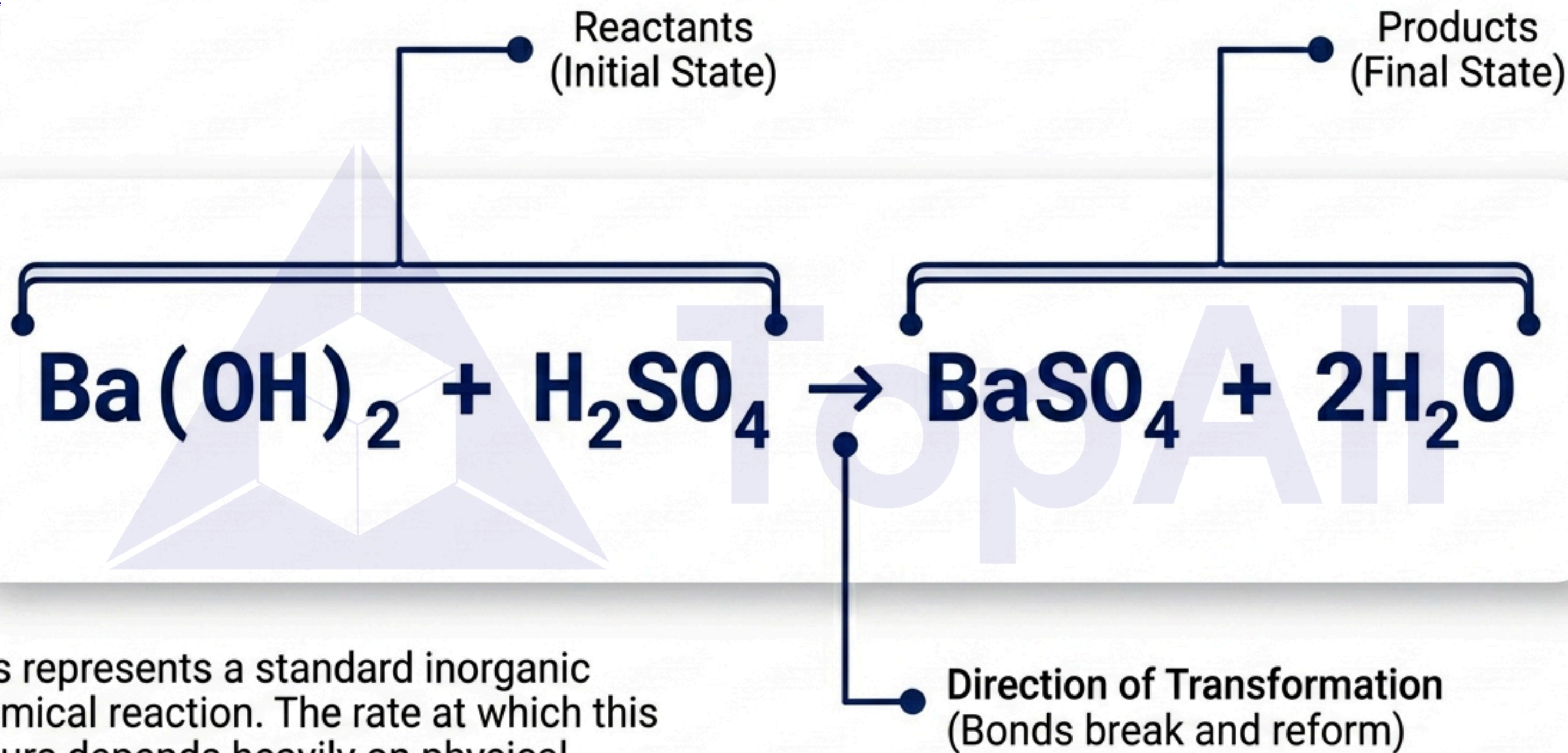
Substrate  $\rightarrow$  Product

Do not confuse physical state changes (melting, vaporizing) with chemical bond transformations.

The pathway of transformation must go through an altered, unstable structural state before the expected bond breaking/making is complete.



**Activation Energy:** The difference in average energy content between the Substrate and the Transition State.

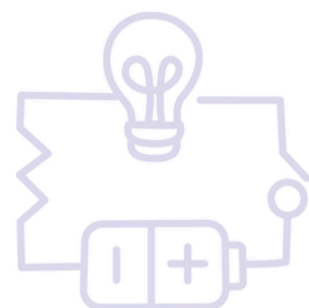


This represents a standard inorganic chemical reaction. The rate at which this occurs depends heavily on physical environmental factors.



# You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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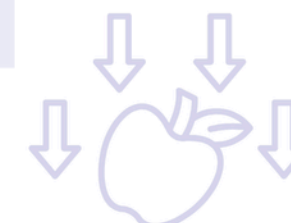
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## Key Highlights

- » Free Study Material, Videos & Infographics
- » Push Your Limits with Level-Based Challenges
- » Climb the Leaderboard Among Fellow Aspirants
- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter



$$\text{rate} = \frac{\delta P}{\delta t}$$

$\delta$  = Change in...

P = Amount of  
product formed

t = Unit of time

**Rule of Thumb:** Rate becomes velocity if the specific direction of the reaction is specified.

Rates of physical and chemical processes are heavily influenced by temperature. This general rule of thumb dictates standard chemical kinetics.

**Rate  
Doubles  
( $\times 2$ )**

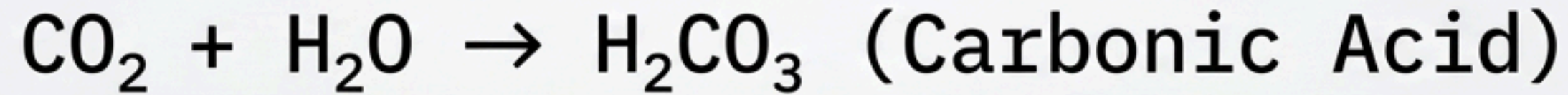
**+10°C**

**Thermometer Step-Curve**

**-10°C**

**Rate  
Decreases  
by Half ( $\div 2$ )**

# The Carbonic Anhydrase Reaction



**200**

molecules / hour

Sluggish reaction in the absence of any enzyme.

**10  
MILLION  
TIMES  
FASTER**



**600,000**

molecules / second

Lightning-fast reaction utilizing the enzyme carbonic anhydrase present in the cytoplasm.

# Biological Cheat Codes

While inorganic reactions are strictly governed by physical rules—requiring high temperatures or long periods to overcome activation energy barriers—biological organisms bypass these limits.



**Enzymes act as the ultimate molecular catalysts, lowering energy barriers to create the high-speed metabolic pathways absolutely necessary for life to exist.**



# You've Learned the Theory.

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