Ministry of Higher Education and Scientific Research
AL-Mustaqbal University College of Science
Department of Biochemistry

Physical Chemistry

Lecture 4

Scholar year 2023-2024

First semester

Collision theory & Reaction Rates

By

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Collision Theory and Reaction Rates

- The Collision Theory is a theory which states how reacting particles (like atoms and molecules) must interact to start a chemical reaction.

The Collision Theory States 3 Things:

1st: Reactant particles must collide in order for the reaction to occur.

The Collision Theory Continued . . .

2nd: Reactant particles must collide the "right way" with proper orientation.

3rd: Reactant particles must collide with enough energy to "stick together."

- E_a is called activation energy.
- Activation energy is the minimum amount of energy required for a reaction to occur.

High Activation Energy (E_a)

- LOTS of energy needed for the reaction to happen.
- It takes a long time to get this energy, so there is a slow reaction rate.

Low Activation Energy (E_a)

- LESS energy needed for the reaction to occur.

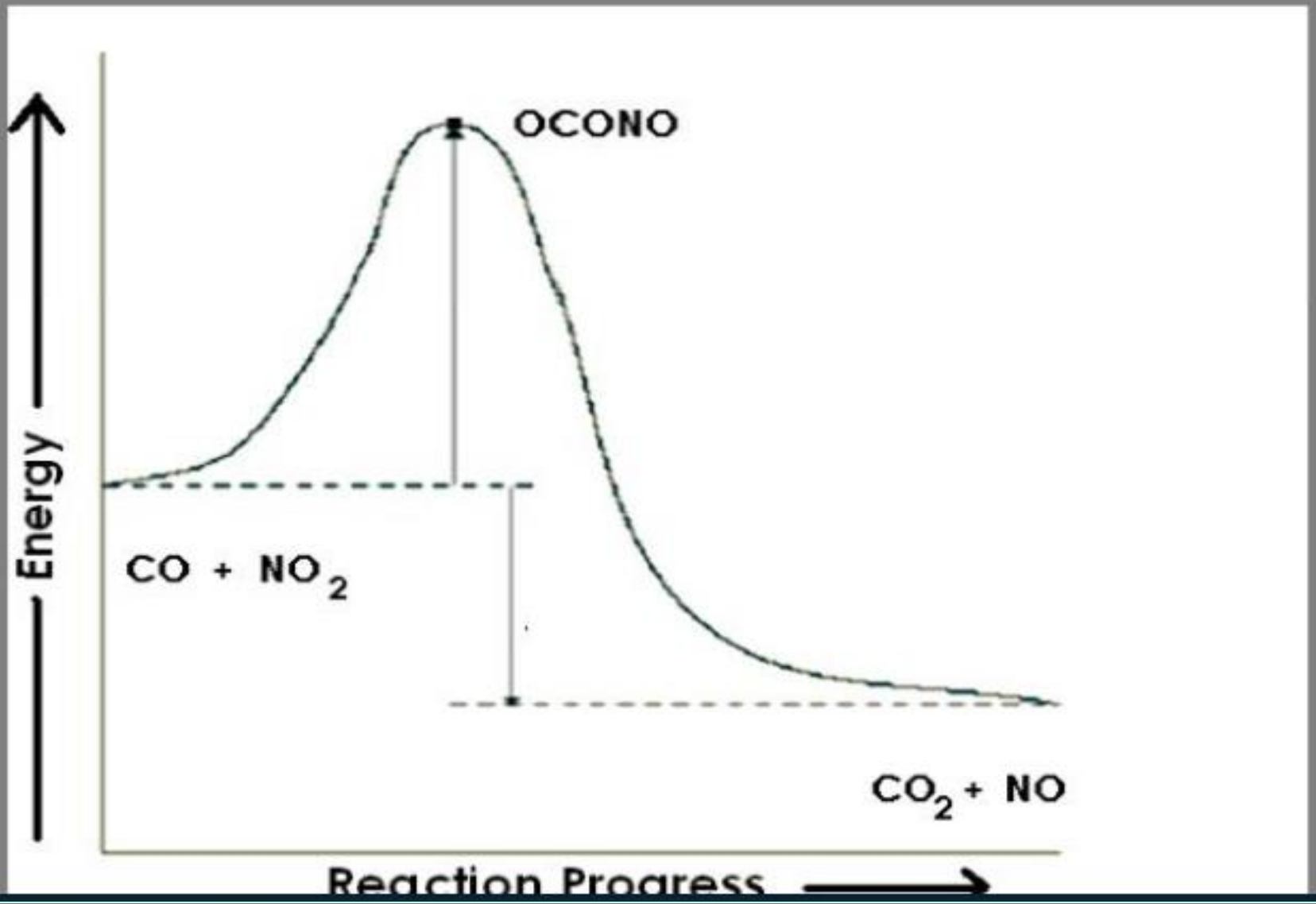
- It takes less time to get needed energy so there is a fast reaction rate.

- If the reactant particles meet ALL THREE requirements then an activated complex forms when the reactant particles "stick together".

An Activated Complex Represen

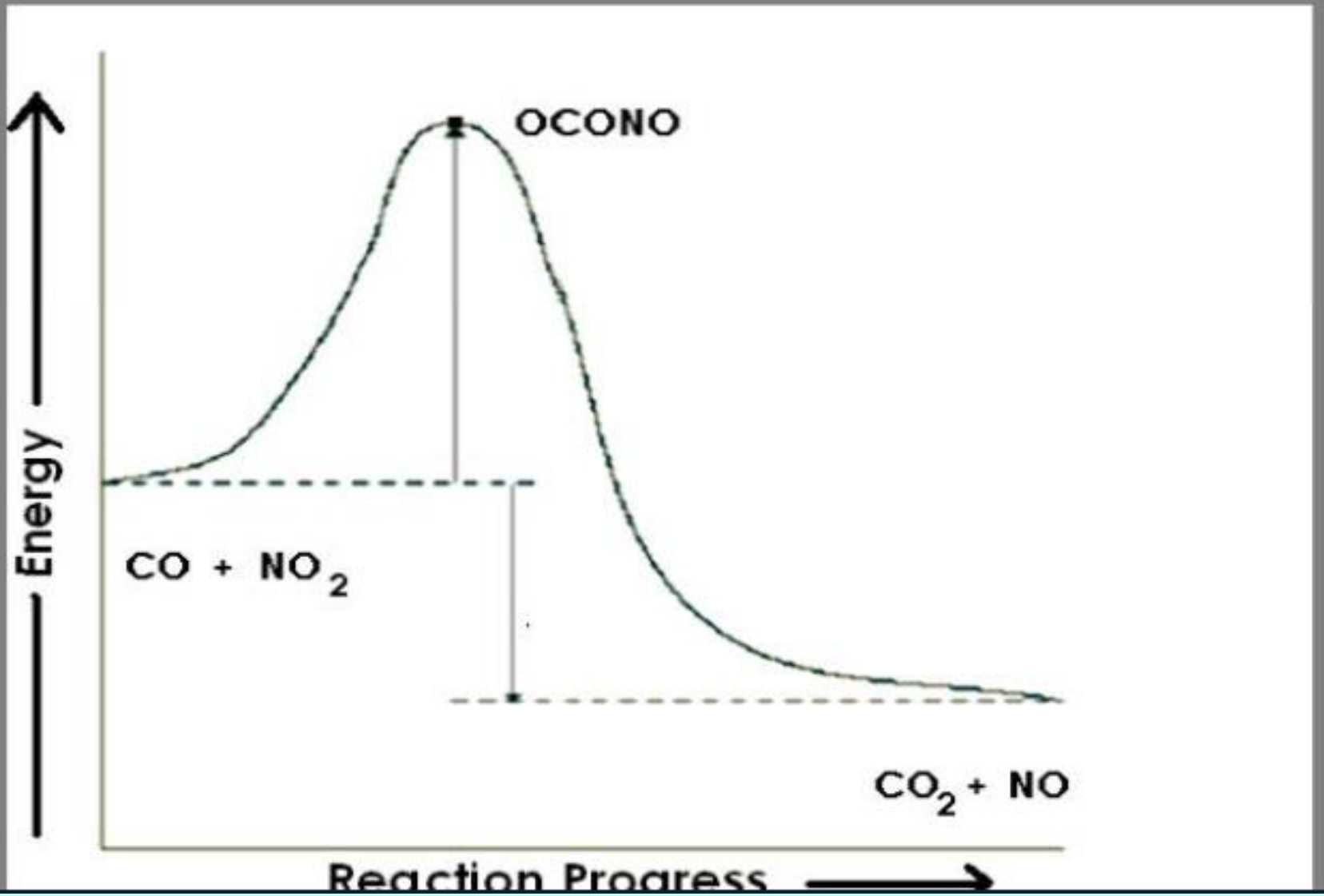
- a temporary, unstable structure
- the transition between the breaking of old bonds and the forming of new bonds

Endo- or Exothermic?

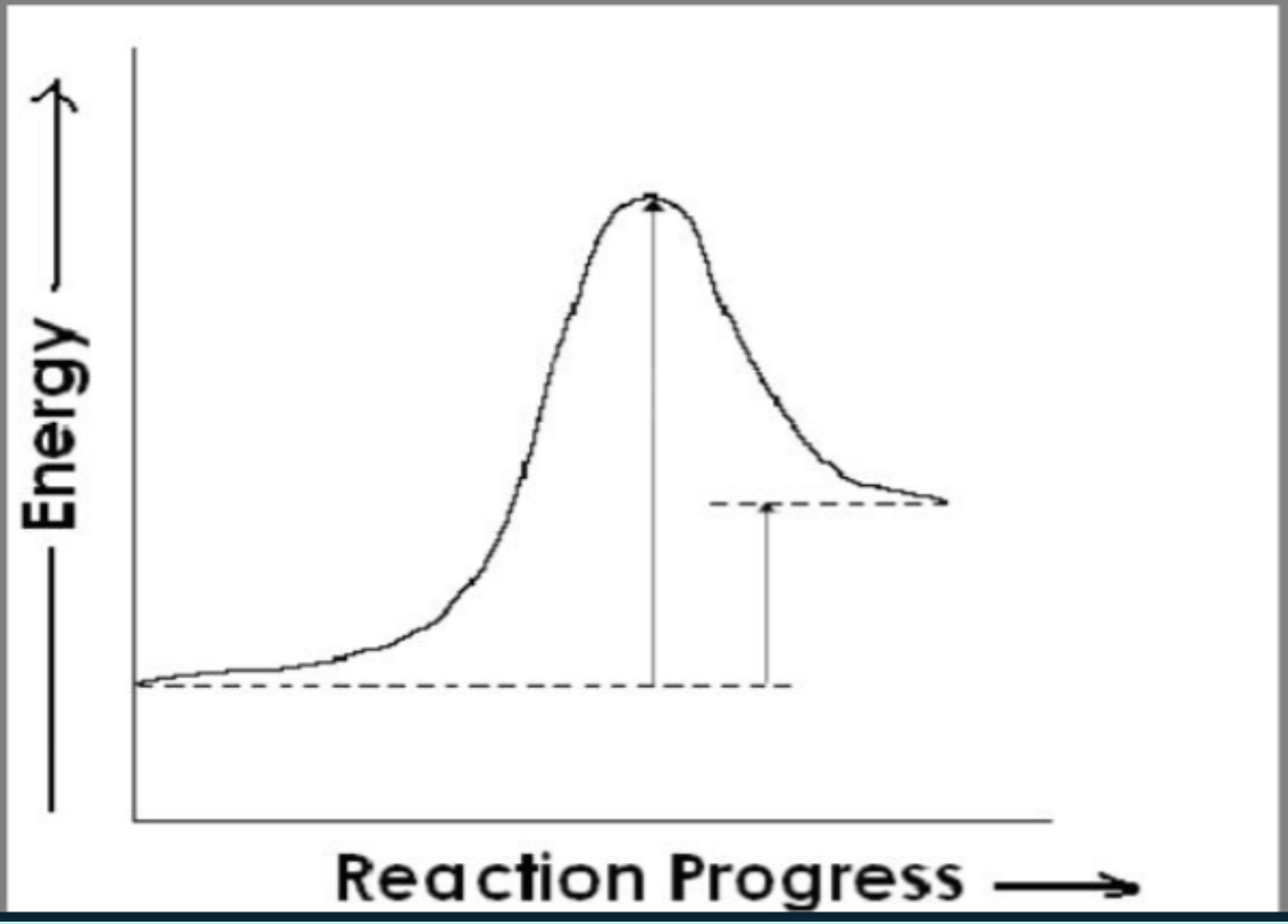


Exothermic

Label reactants, produ
E_a, activated complex, ΔE

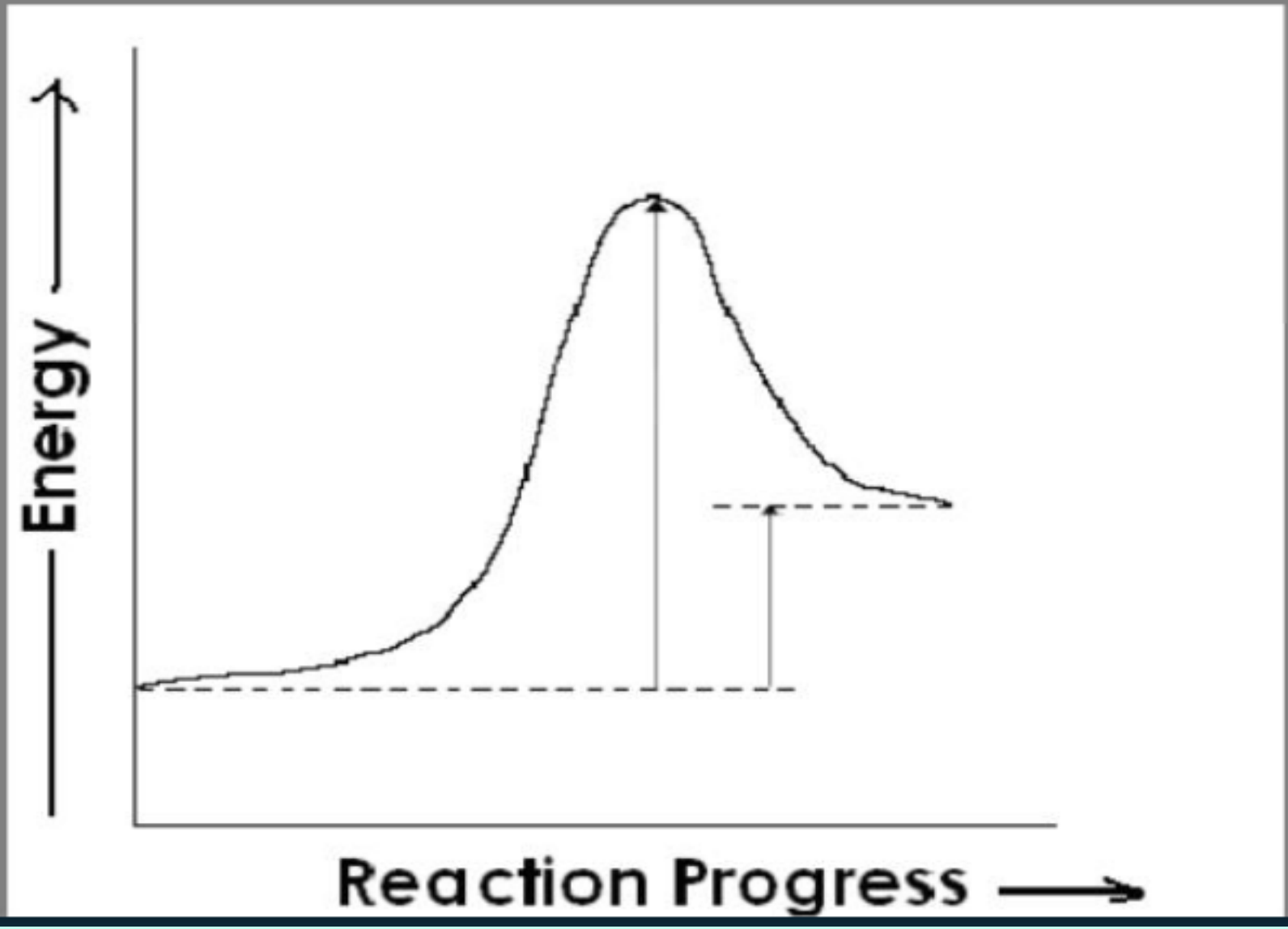


Endo- or Exothermic?



Endothermic

Label reactants, product
E_a, activated complex, ΔE



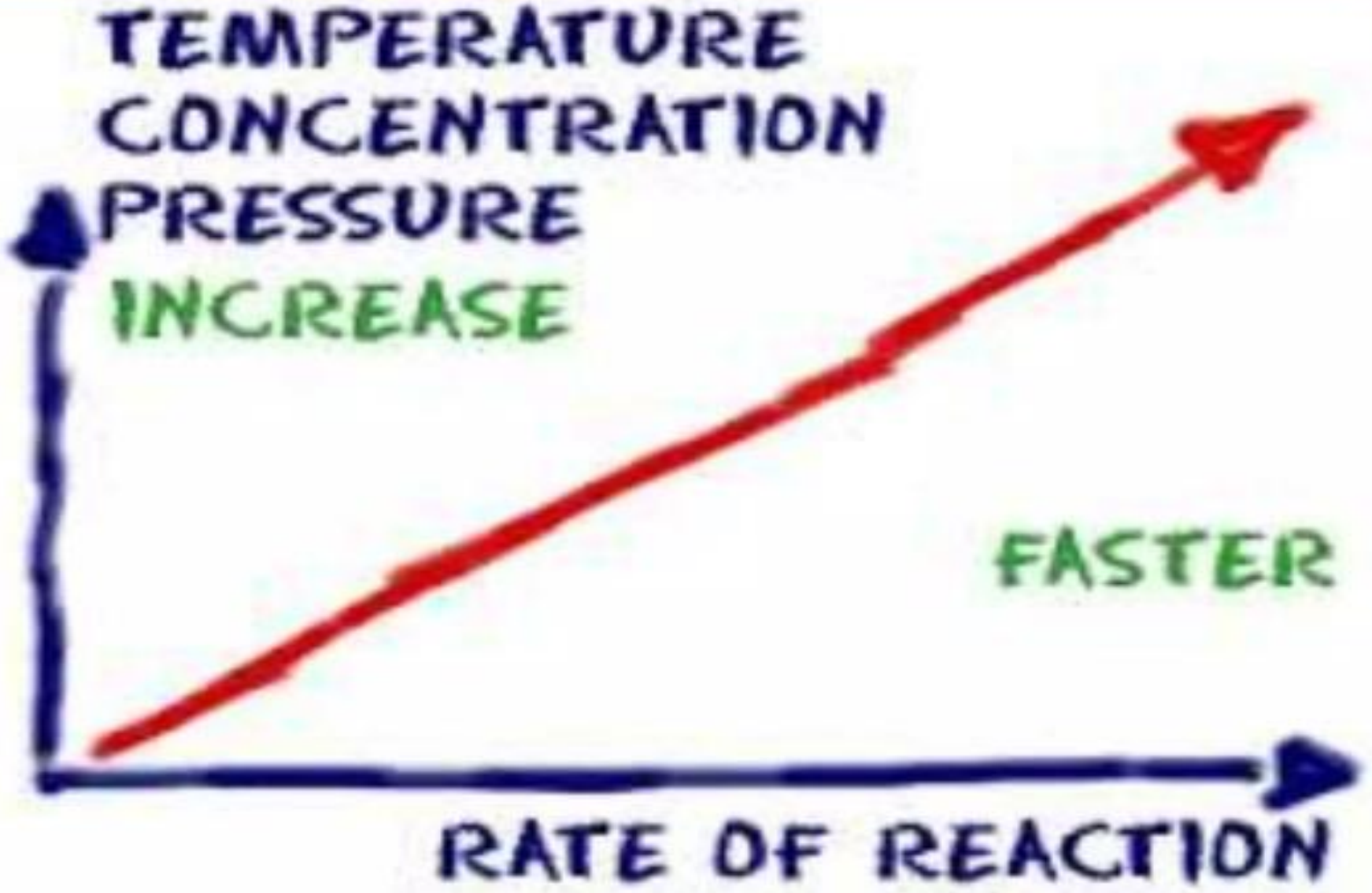
Factors affecting reaction rate

- Temperature
- Surface area
- Concentration of reactants
- Catalyst

Temperature

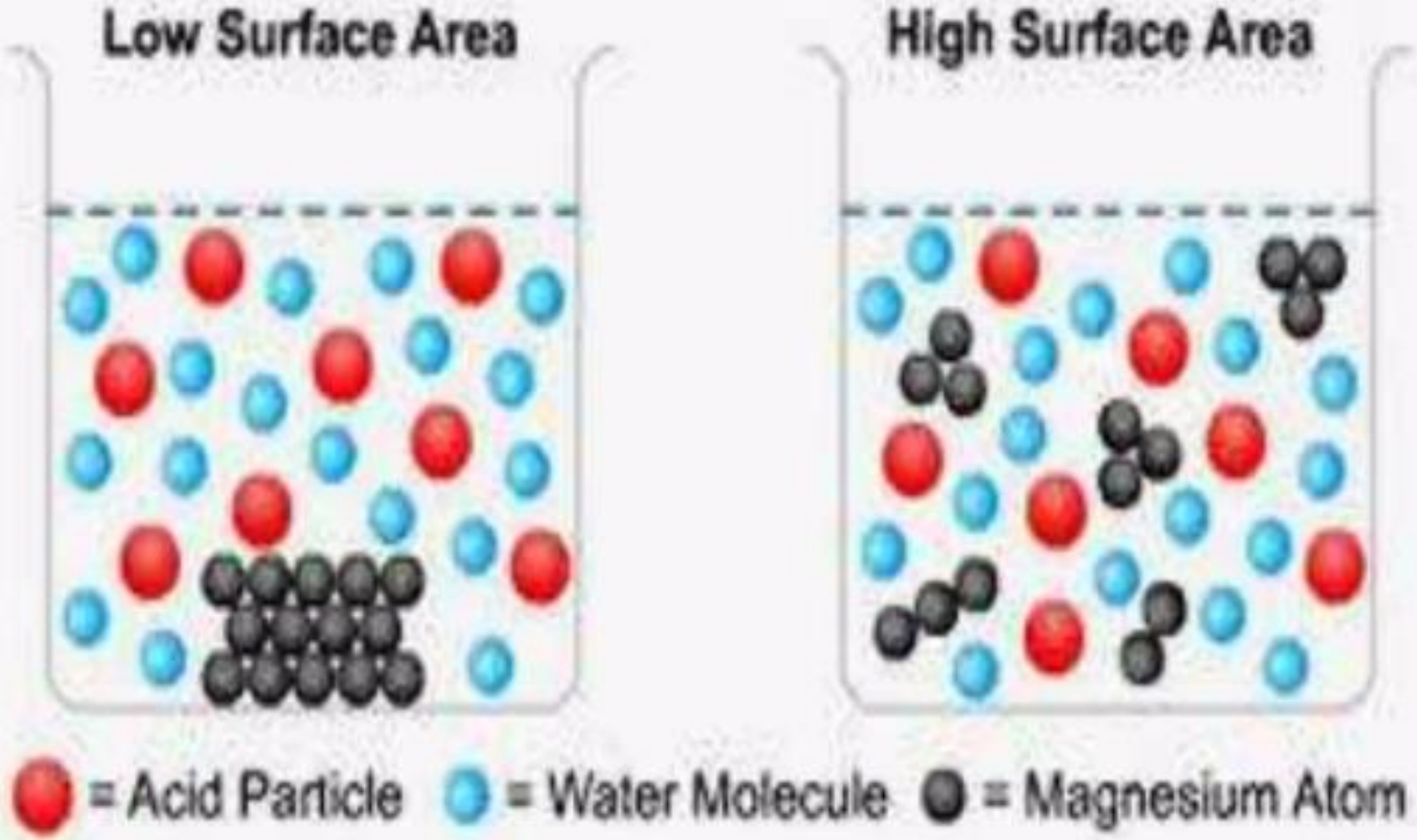
If the temperature is increased:

* the reactant particles move more quickly
* the reactant particles have more kinetic energy
* the reaction rate increases


TEMPERATURE
CONCENTRATION
PRESSURE
INCREASE
FASTER
RATE OF REACTION

Surface area

Larger surface area would have a larger space of collision between particles of a reaction.


Low Surface Area
High Surface Area
= Acid Particle
= Water Molecule
= Magnesium Atom

Concentration of reactants

If the concentration is increased:

* the reactant particles become more crowded
* there is a greater chance of the particles colliding;
* the rate of reaction increases

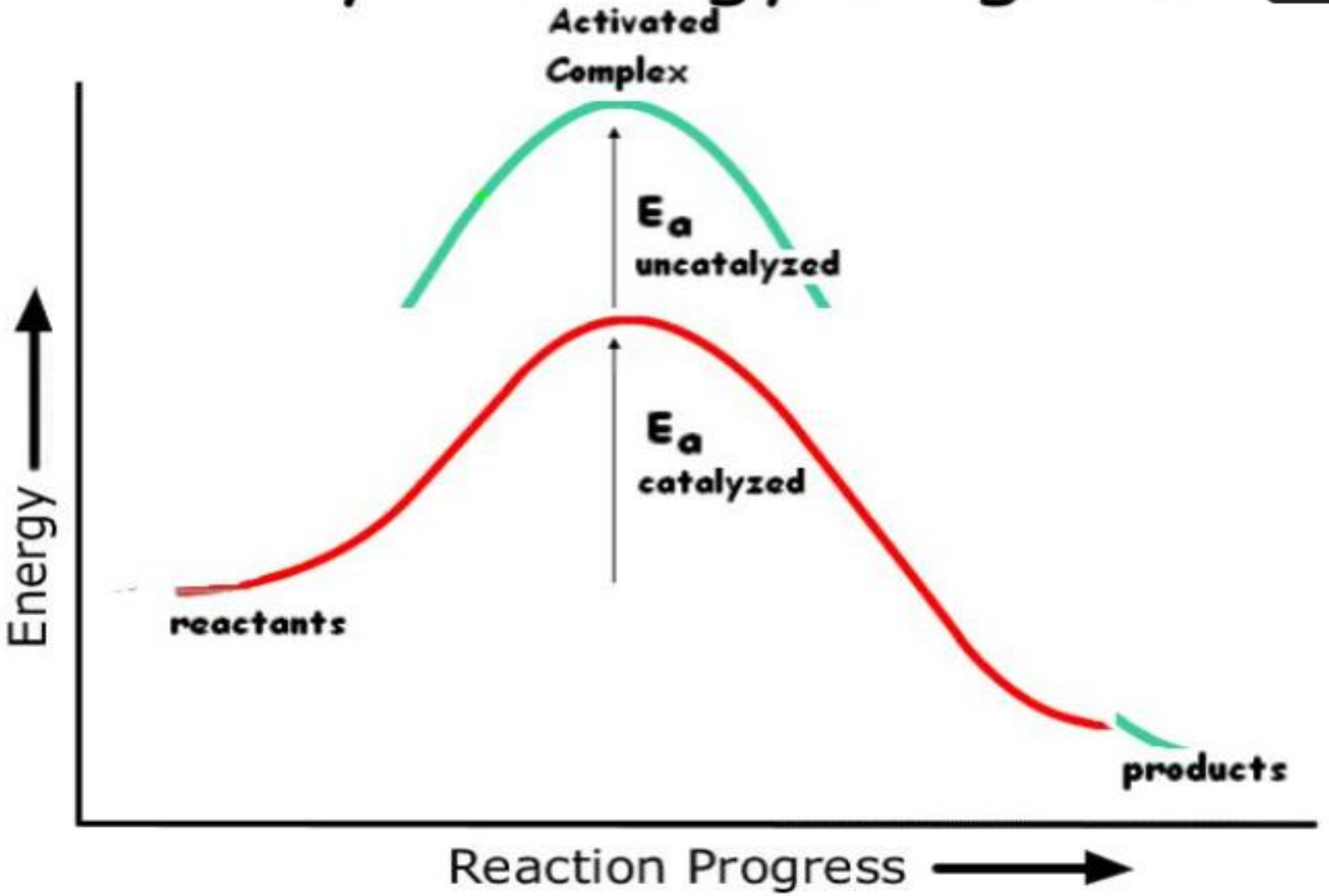
Low concentration = Few collisions

High concentration = More collisions

Catalyst

Catalyst is a substance that makes a chemical reaction faster.

Catalyst Energy Diagram



Example

Which would work faster: Aspirin in powder form or aspirin in tablet form? Explain why.

Answer: The aspirin would work faster if taken in powder form because the fact that it has been crushed increases surface area. This will make more frequent collisions and more frequent collisions with proper orientation – which will make the aspirin work faster.

Example:

Download

Will a strip of Mg react faster in 1 M HCl at 75°C or in 1 M HCl at 23°C? Explain.

Answer: The Mg reacts faster in the acid at 75°C because the Mg will absorb more kinetic energy in the acid at the higher temperature causing more frequent collisions and more frequent collisions with proper orientation and more collisions with sufficient E_a.

Thank you