

Chemical Reactions & Equations

Kinetics Rate of Reaction

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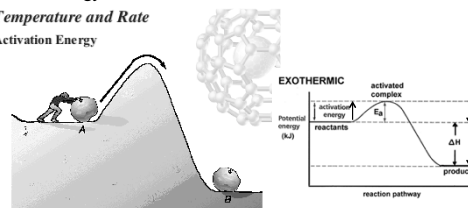
<https://www.youtube.com/watch?v=OttRV5ykP7A>

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Molecules must collide in order to react.

Activation Energy, (E_a) & Temperature: molecules must collide with enough energy to react. Raising the temperature increases the K.E. of the molecules, the number of collisions and the energy of the collisions.

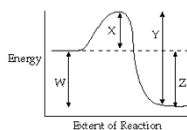
Temperature and Rate
Activation Energy



Generally, raising the temperature 10°C doubles the rate.

QUESTION

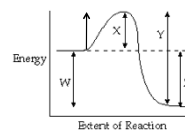
Which line in the Energy Diagram corresponds to the activation energy for the forward reaction?



- A. X
- B. Y
- C. Z
- D. W

Answer

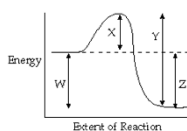
Which line in the Energy Diagram corresponds to the activation energy for the forward reaction?



- A. X
- B. Y
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QUESTION

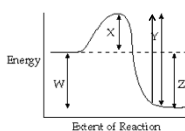
Which line in the Energy Diagram corresponds to the activation energy for the reverse reaction?



- A. X
- B. Y
- C. Z
- D. W

ANSWER

Which line in the Energy Diagram corresponds to the activation energy for the reverse reaction?



- A. X
- B. Y
- C. Z
- D. W

Molecules must collide in order to react.

<http://chemconnections.org/general/movies/Ea-1.MOV>

Molecules must collide in order to react.

Concentration:
The higher the concentration, the higher number of collisions.
 $\text{Rate} = k (\text{collision frequency}) = k (\text{concentration})$

http://chemconnections.org/general/movies/html-swf/reactionrate_conc.htm

Molecules must collide in order to react.
Physical state: molecules must physically mix in order to collide. The physical state (solid, liquid, gas) will affect frequency of collisions, as well as the physical size of droplets (liquid) or particles in the case of solids (heterogeneous vs. homogeneous).

Collision Theory

Catalysts: change the reaction's pathway, lowering the Energy of Activation, and increase the reaction rate.

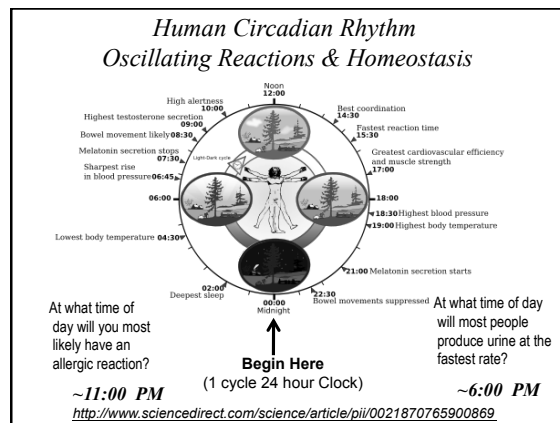
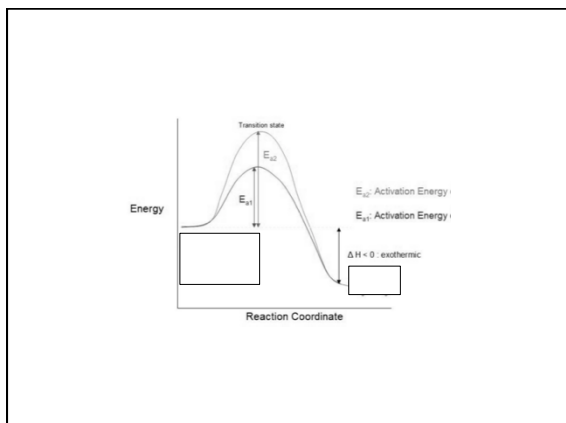
Effect of Catalyst on Reactions

<http://chemconnections.org/general/movies/html-swf/homogeneouscatalysis.htm>

Enzymes Catalytic Power

- Enzymes can accelerate biological reactions as much as 10^{16} times over uncatalyzed rates, i.e., 10,000,000 billion times!
- Urease:** (Found in bacteria, yeast & higher plants)
 - Breaks down urea into ammonia, CO_2 and releases energy.
 - Catalyzed rate: $3 \times 10^4/\text{sec}$
 - Uncatalyzed rate: $3 \times 10^{-10}/\text{sec}$
 - Relative difference is 1×10^{14} (100,000 billion times)

Enzymes Catalytic Power
 Enzymes lower the Energy of Activation.



Factors that Effect Reaction Rates

Molecules must collide in order to react.

1) Concentration:

The higher the concentration, the higher number of collisions.

Rate = k (collision frequency) = k (concentration)

k = rate constant

2) Physical state:

Molecules must physically mix to come in contact and collide.

3) Energy/Temperature: (Activation Energy, E_a)

Molecules must collide effectively with enough energy to react.

Raising the temperature increases the number of effective collisions and the energy of the collisions.

4) Catalysts:

Lower the Energy of Activation and speed up the reaction.