# AP Chemistry Daily Videos
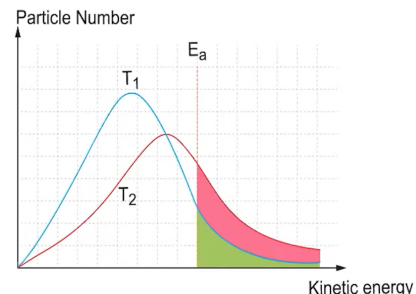# 5.5 Collision Model

1. Why don't all collisions produce a reaction? State three factors that need to be considered.

2. Explain what the Maxwell-Boltzmann curve communicates. Note, Ea= Activation Energy.

Particle Number

$E_a$

$T_1$

$T_2$

Kinetic energy

3. Why do all reactions (exothermic or endothermic) require energy to get started (activation energy)? Consider what chemical bonds must be broken for the reaction to proceed.

4. Pause the video at 1:26 and attempt the problem, then evaluate how you did and identify any errors.

Which of the following best helps explain why an increase in temperature increases the rate of a chemical reaction?

A   At higher temperatures, reactions have a lower activation energy.

B   At higher temperatures, reactions have a higher activation energy.

C   At higher temperatures, every collision results in the formation of product.

D   At higher temperatures, high-energy collisions happen more frequently.

5. Pause the video at 2:37 and attempt the problem, then evaluate how you did and identify any errors.

$NO(g) + NO_3(g) \rightarrow 2\ NO_2(g)$          rate = $k[NO][NO_3]$
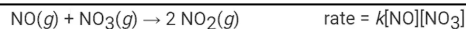
The reaction represented above occurs in a single step that involves the collision between a particle of NO and a particle of $NO_3$. A scientist correctly calculates the rate of collisions between NO and $NO_3$ that have sufficient energy to overcome the activation energy. The observed reaction rate is only a small fraction of the calculated collision rate. Which of the following best explains the discrepancy?

A   The energy of collisions between two reactant particles is frequently absorbed by collision with a third particle.

B   The two reactant particles must collide with a particular orientation in order to react.

C   The activation energy for a reaction is dependent on the concentrations of the reactant particles.

D   The activation energy for a reaction is dependent on the temperature.

6. Pause the video at 3:23 and attempt the problem, then evaluate how you did and identify any errors.

$$3S_8 + 8OH^- \rightarrow 8S_3^- + 4HOOH$$
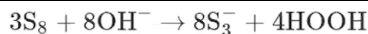
In an experiment, a student studies the kinetics of the reaction represented above and obtains the data shown in the following table.

  e. Use the data in the table to do the following.
   i. Determine the order of the reaction with respect to $S_8$. Justify your answer.

   ii. Determine the value of $[OH^-]$ that was used in trial 3, considering that the reaction is first order with respect to $OH^-$. Justify your answer.

| Experiment | Initial $[S_8]$ (M) | Initial $[OH^-]$ (M) | Initial Reaction Rate (M/s) |
|---|---|---|---|
| Trial 1 | 0.100 | 0.0100 | 0.699 |
| Trial 2 | 0.300 | 0.0100 | 2.10 |
| Trial 3 | 0.300 | ? | 4.19 |

The next day the student conducts trial 4 using the same concentrations of $S_8$ and $OH^-$ as in trial 1, but the reaction occurs at a much slower rate than the reaction in trial 1. The student observes that the temperature in the lab is lower than it was the day before.

  f. Using particle-level reasoning, provide TWO explanations that help to account for the fact that the reaction rate is slower in trial 4.

7. Pause the video at 5:52 and attempt the problem, then evaluate how you did and identify any errors.

Which of the following statements best explains why an increase in temperature of 5-10 degrees Celsius can substantially increase the rate of a chemical reaction?

A  The activation energy for the reaction is lowered.

B  The number of effective collisions between reactant particles is increased.

C  The rate of the reverse reaction is increased.

D  $\Delta H$ for the reaction is lowered.

E  $\Delta G$ for the reaction becomes more positive.