

17 • Reaction Rates

COLLISION THEORY WORKSHEET

1. Given the following Potential Energies:

- A = -50 kJ
- B = -80 kJ
- Transition State = -20 kJ

Draw the Potential Energy graph for the following reaction: $A \rightarrow B$

Label the:

- Potential Energy of A
- Potential Energy of B
- Potential Energy of the Transition State
- Activation Energy (E_a)
- Heat of Reaction (ΔH)



(a) Calculate the value of the:

- Activation Energy (E_a) + 30 kJ
- Heat of Reaction (ΔH) - 30 kJ

Is this reaction endothermic or exothermic? Why? $H_{prod} - H_{react}$ is negative.

(b) Using dashed lines, draw on the graph above what happens when a catalyst is added to the reaction mixture.

Using the graph that you drew, calculate the value of the:

- Activation Energy (E_a) + 20 kJ
- Heat of Reaction (ΔH) - 30 kJ

Circle the quantities that changed:

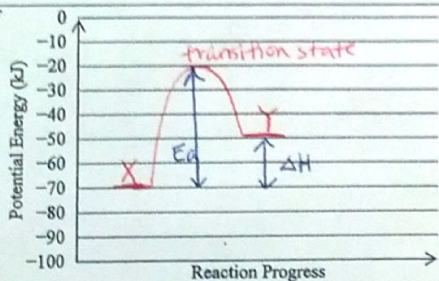
- PE of A PE of B PE of Transition State Activation Energy Heat of Reaction

2. For the reaction $X \rightarrow Y$, the potential energy of X is -70 kJ, $E_a = 50$ kJ and the $\Delta H = +20$ kJ.

Draw the Potential Energy graph for the reaction.

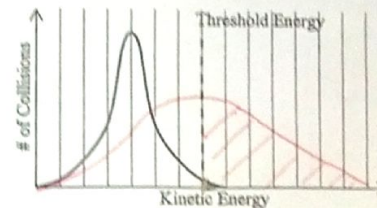
Label the:

- Potential Energy of X
- Potential Energy of Y
- Potential Energy of the Transition State
- Activation Energy (E_a)
- Heat of Reaction (ΔH)

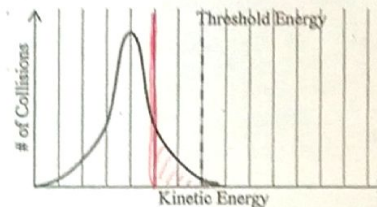


3. The distribution of the kinetic energy of collisions in a sample of Ar (g) at 40°C is shown below. On the graphs, each vertical line represents a 10°C change in temperature.

- (a) Color in completely the collisions that will result in a reaction.
- (b) Sketch the KE graph if the temperature is raised to 60°C.
- (c) Use a different color to identify the collisions that will result in a reaction at 60°C.



- (d) Color in completely the collisions that will result in a reaction.
- (e) Draw in the Threshold Energy if a catalyst is added to the reaction mixture.
- (f) Use a different color to identify the collisions that will result in a reaction after the catalyst is added.



4. State the main assumptions in Collision Theory.

- A reaction happens when ...
- 1) reactants collide
 - 2) collide with correct orientation
 - 3) collide with enough K.E. to overcome the activation energy
- We can speed up a reaction by ...

- 1) Increase [] of reactants
- 2) Increase surface area
- 3) Increase overall energy by adding heat or stirring
- 4) Add a catalyst