Key Questions

1. Did a reaction take place between **Reactant A** and **Reactant B** in Scenario 1? Why or why not? Explain your reasoning in terms of the *nature* of the collision.

No Reaction because the ball and bat did not collide with each other

2. Did a reaction take place between **Reactant A** and **Reactant B** in Scenario 2? Why or why not? Explain your reasoning in terms of the *nature* of the collision.

No Reaction because the ball and bat did not hit each other with enough energy

3. Did a reaction take place between **Reactant A** and **Reactant B** in Scenario 3? Why or why not? Explain your reasoning in terms of the *nature* of the collision.

No Reaction because the ball and bat did not collide with each with the correct orientation

4. Did a reaction take place between **Reactant A** and **Reactant B** in Scenario 4? Why or why not? Explain your reasoning in terms of the nature of the collision.

yes because the ball and bat collided with the correct amount of energy and in the correct orientation.

5. Based on your responses to Key Questions 1-4 and your reasoning, what insight has your team gained about the term effective collision?

→ collision
→ amount of energy
→ correct orientation

6. Based on your answer to Key Question 5, complete the following statement: Collision theory states that a reaction is most likely to occur if...

if the reactants collide with the correct amount of energy and is in a correct orientation.

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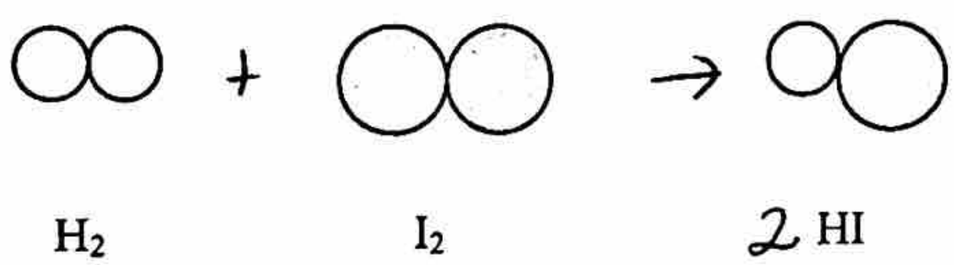
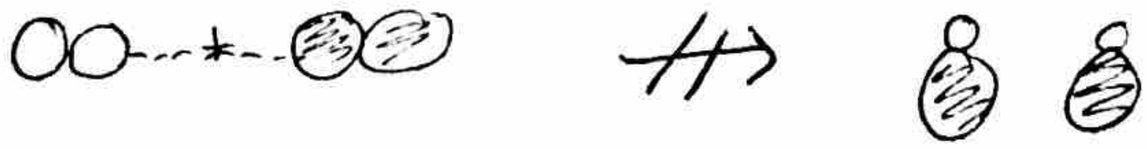
7. With your group, develop a different analogy/model to explain the collision theory to someone who is not in your group.

Exercise

1. Hydrogen gas and iodine vapor combine to form hydrogen iodide gas, as shown in the equation $H_2 + I_2 \rightarrow 2\ HI$. Using the representations shown below, draw a diagram to show an orientation for the reactant molecules that could produce an effective collision capable of producing two hydrogen iodide molecules.



2. Using the representations shown in question 1, draw a diagram to show an orientation for the reactant molecules that would NOT produce an effective collision.



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Collision Theory

1. Chemical reactions occur when reactants collide. For what reasons may a collision fail to produce a chemical reaction?

- not enough energy
- incorrect orientation

2. If every collision between reactants lead to a reaction, what determines the rate at which the reaction occurs?

- The # of collisions per second

3. What is the activation energy of a reaction, and how is this energy related to the activated complex of the reaction?

- the amount of energy required to get the reaction started
- it is the amount of energy required to get to the activated complex

4. What happens when a catalyst is used in a reaction?

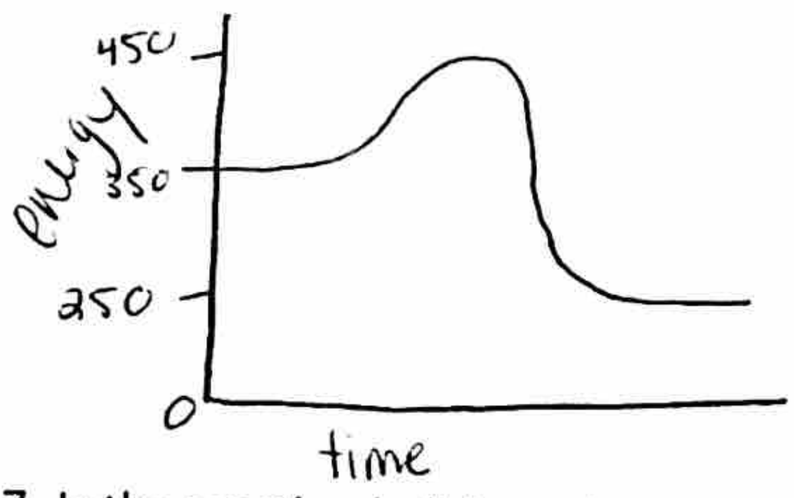
- the activation energy is lowered

5. Name 4 things that will speed up or slow down a chemical reaction.

- temp
- concentration
- catalyst
- surface area

6. Draw an energy diagram for a reaction. (label the axis)

Potential energy of reactants = 350 KJ/mole
Activation energy = 100 KJ/mole
Potential energy of products = 250 KJ/mole



7. Is the reaction in # 6 exothermic or endothermic? Explain.

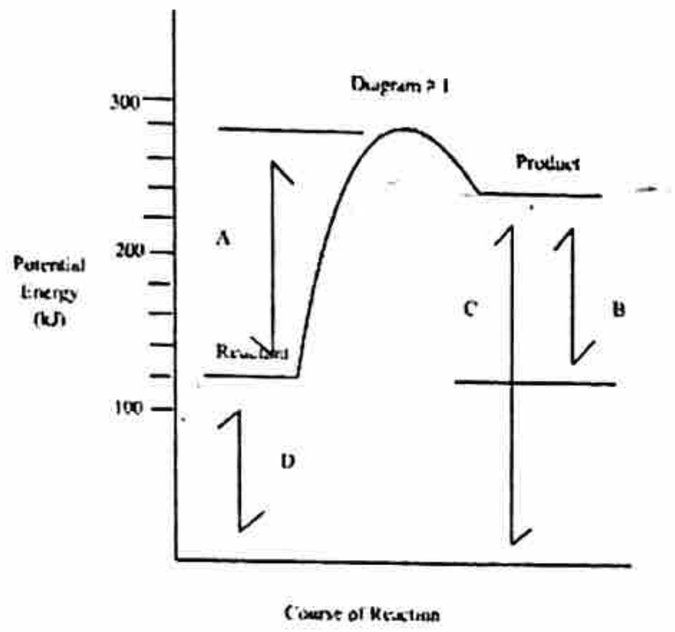
exothermic b/c the products have less energy than the reactants

8. How could you lower the activation energy for the reaction in #6?

introduce a catalyst

Potential Energy Diagrams

Diagram #1: use the diagram below to answer questions 1-4 .



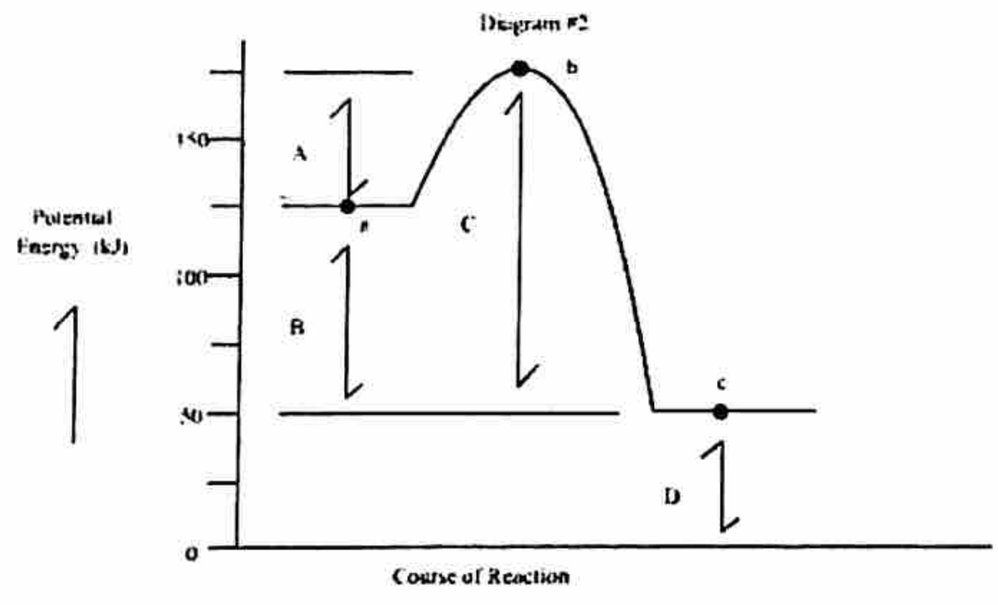
1. Which letter represents the activation energy for the forward reaction? A
2. What is the value of the activation energy in kJ?

AE = activated complex − reactants = 280 kJ − 120 kJ = 160 kJ

3. What letter represents the ΔH for the reaction, and what is its value? Products − reactants
4. Is this reaction endothermic or exothermic? 240 − 120 = 120 kJ
5. How would introducing a catalyst change the diagram?

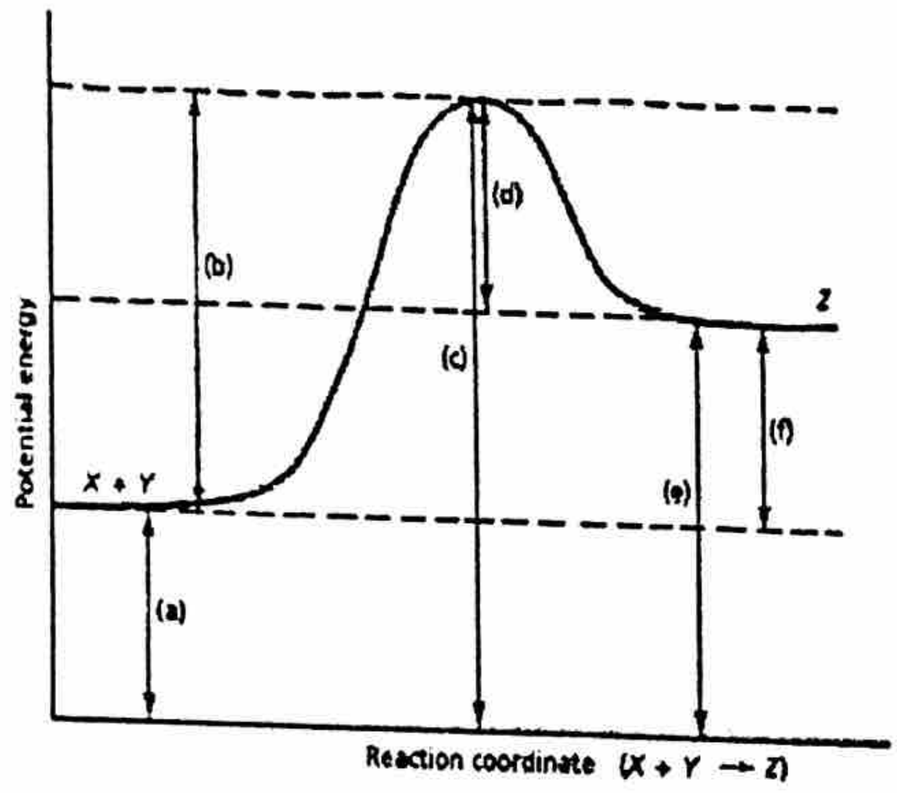
lower the activation energy

Diagram #2: use the diagram below to answer questions 5-8.

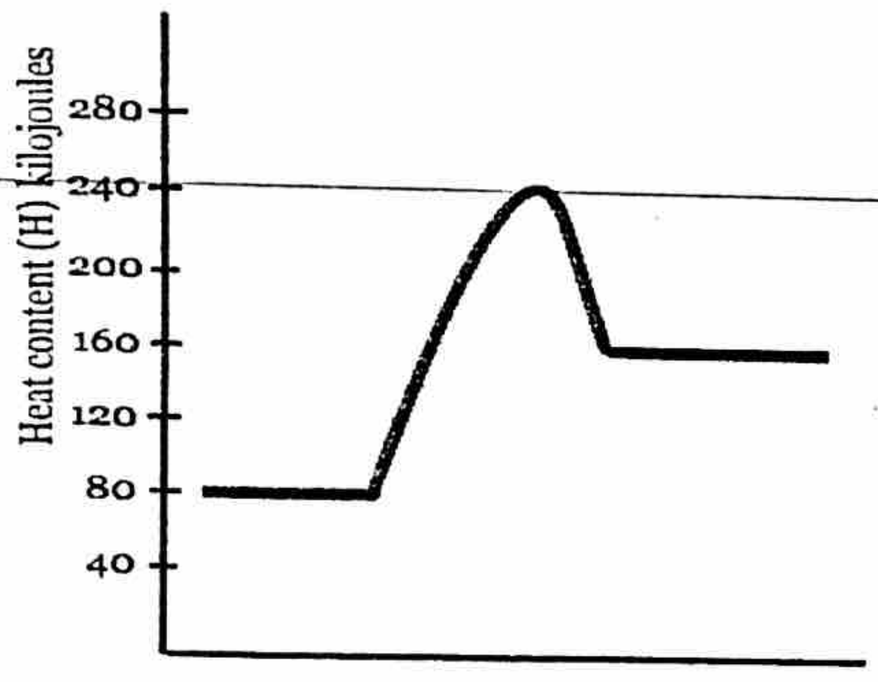


5. Indicate if this reaction is exothermic or endothermic and give the letter corresponding to the ΔH. exothermic - B
6. What is the letter that represents the activation energy and what is its value? A, 50 kJ
7. What is the effect on the diagram of increasing the concentration of the reactant? What is the effect on rate? it will increase the rate bc more [ ] means more possible collisions
8. Which letter represents the position of the activated complex? What is the energy of the activated complex? b - 175 kJ
9. How would introducing a catalyst change the diagram? it would lower the activation energy

Potential Energy Diagram Worksheet



1. Which of the letters a–f in the diagram represents the potential energy of the products? e
2. Which letter indicates the potential energy of the activated complex? c
3. Which letter indicates the potential energy of the reactants? a
4. Which letter indicates the activation energy? b
5. Which letter indicates the heat of reaction? f
6. Is the reaction exothermic or endothermic? endo
7. Which letter indicates the activation energy of the reverse reaction? d
8. Which letter indicates the heat of reaction of the reverse reaction? f
9. Is the reverse reaction exothermic or endothermic? exo



1. The heat content of the reactants of the forward reaction is about 80 kilojoules.
2. The heat content of the products of the forward reaction is about 160 kilojoules.
3. The heat content of the activated complex of the forward reaction is about 240 kilojoules.
4. The activation energy of the forward reaction is about 160 kilojoules. $E_a = E_{ac} - E_R$ 240 − 80
5. The heat of reaction (ΔH) of the forward reaction is about 80 kilojoules.
6. The forward reaction is endo (endothermic or exothermic).
7. The heat content of the reactants of the reverse reaction is about 160 kilojoules.
8. The heat content of the products of the reverse reaction is about 80 kilojoules.
9. The heat content of the activated complex of the reverse reaction is about 240 kilojoules.
10. The activation energy of the reverse reaction is about 80 kilojoules.
11. The heat of reaction (ΔH) of the reverse reaction is about −80 kilojoules.
12. The reverse reaction is exo (endothermic or exothermic).

Potential Energy Diagrams

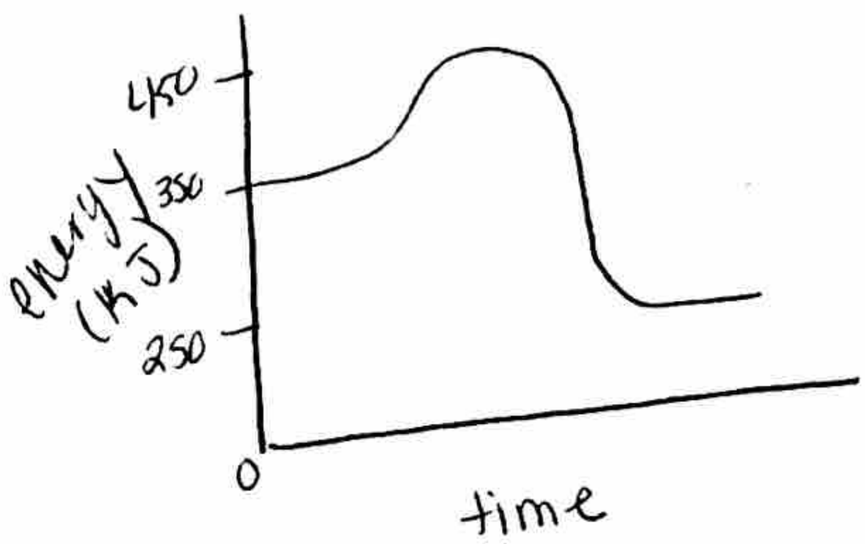
Complete the following potential energy diagrams and questions.

1. Reactant energy = 350 kJ
Activation energy = 100 kJ
Product energy = 250 kJ

ΔH = -100 kJ

Eac = 450 kJ

Potential Energy Diagram



2. Potential energy of reactants = 200 kJ
Potential energy of activated complex = 400 kJ
ΔH = +150 kJ

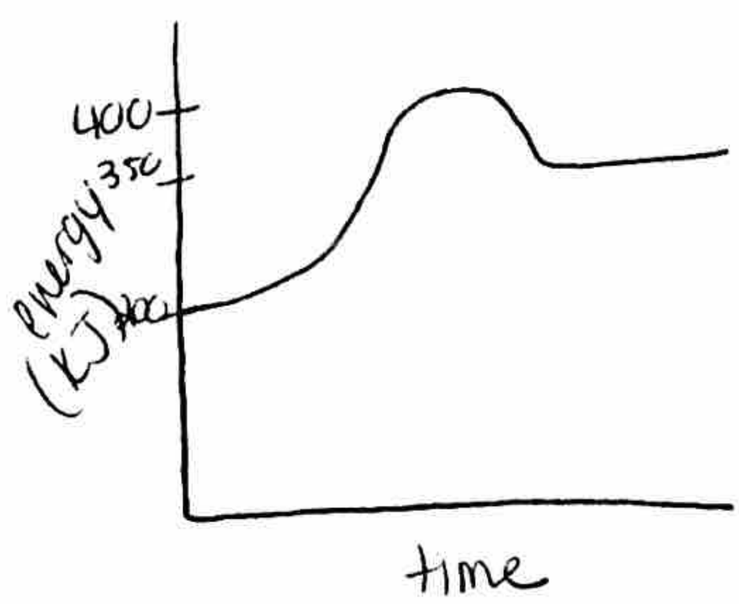
Activation energy = 200 kJ

Product energy = 350 kJ

200 + 150

ΔH = products - reactants

Potential Energy Diagram



3. Activation energy = 300 kJ
ΔH = +50 kJ
Product energy = 150 kJ

Reactant energy = 100 kJ

Eac = 400 kJ

ΔH = products - reactants

50 = 150 - x

x = 100

Potential Energy Diagram