

Potential Energy Diagrams: Exothermic Reactions and Catalysts

You will analyze potential energy diagrams for chemical reactions, identify key features such as activation energy and enthalpy change, and explain how catalysts affect reaction pathways ([Outcome](#), [Outcome](#), [Outcome](#)). This worksheet develops your ability to interpret energy diagrams and communicate the role of catalysts in lowering activation energy without changing the overall energy released ([Topic](#)).

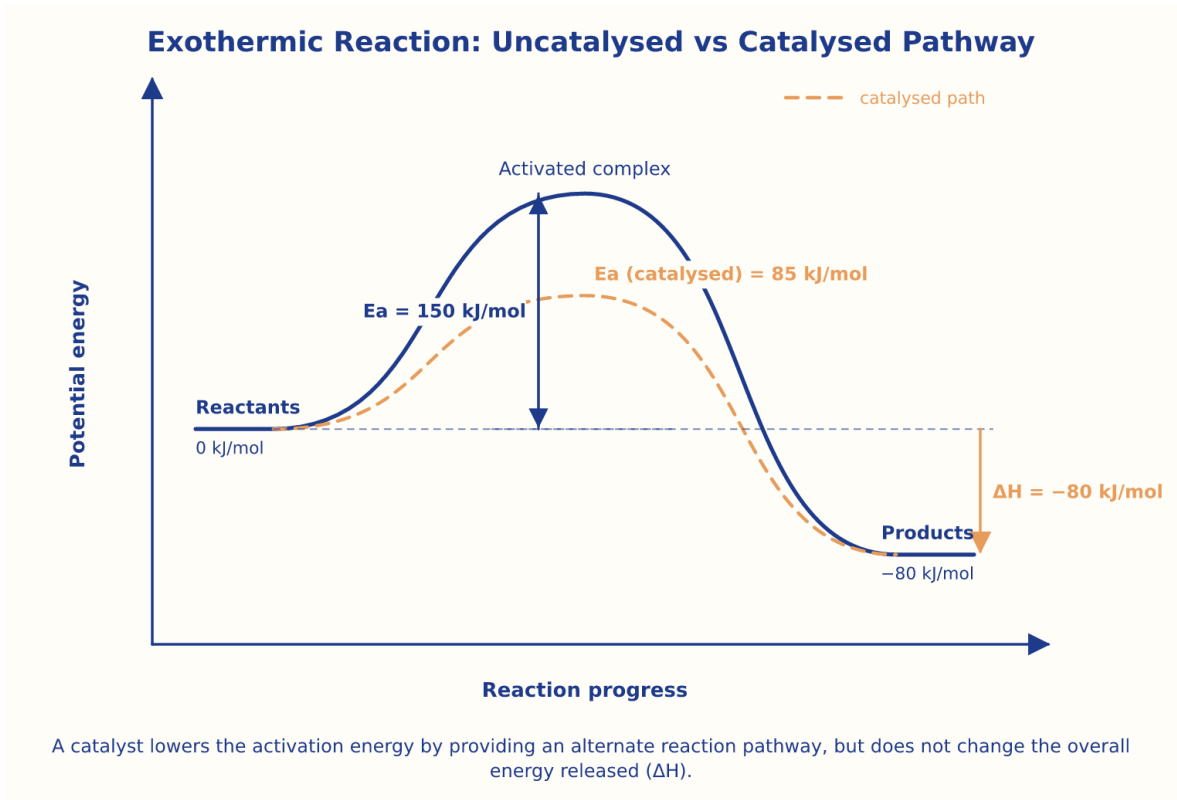


Figure 1: Potential energy diagram of an exothermic reaction: Reactants at 0 kJ/mol, Products at -80 kJ/mol, E_a = 150 kJ/mol, ΔH = -80 kJ/mol.

Exercises

- Multiple choice.** In the diagram shown, what is the activation energy for the uncatalyzed reaction?
 - 80 kJ/mol
 - 85 kJ/mol
 - 150 kJ/mol
 - 230 kJ/mol
- Short answer.** Identify the enthalpy change (ΔH) for this reaction and explain what the sign tells you about whether the reaction is exothermic or endothermic.

ΔH = _____

This reaction is _____ because _____.
- Matching.** Draw a line to connect each label on the left with its correct description on the right.

Label	Description
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Reactants	The minimum energy needed to break bonds and start the reaction
Products	The substances that enter the reaction at 0 kJ/mol
Activation energy (uncatalyzed)	The substances formed after the reaction, at " 80 kJ/mol
Activation energy (catalyzed)	The energy barrier lowered by adding a catalyst to 85 kJ/mol

4. **Calculation.** By how many kilojoules does a catalyst lower the activation energy for this reaction?

Difference = _____ " _____ = _____ kJ/mol

5. **Conceptual question.** Refer to the diagram. A catalyst lowers the activation energy from 150 kJ/mol to 85 kJ/mol. Does the catalyst change the enthalpy change (9D,' öb F†R &V 7F–öãð W‡ Æ –â •our reasoning.

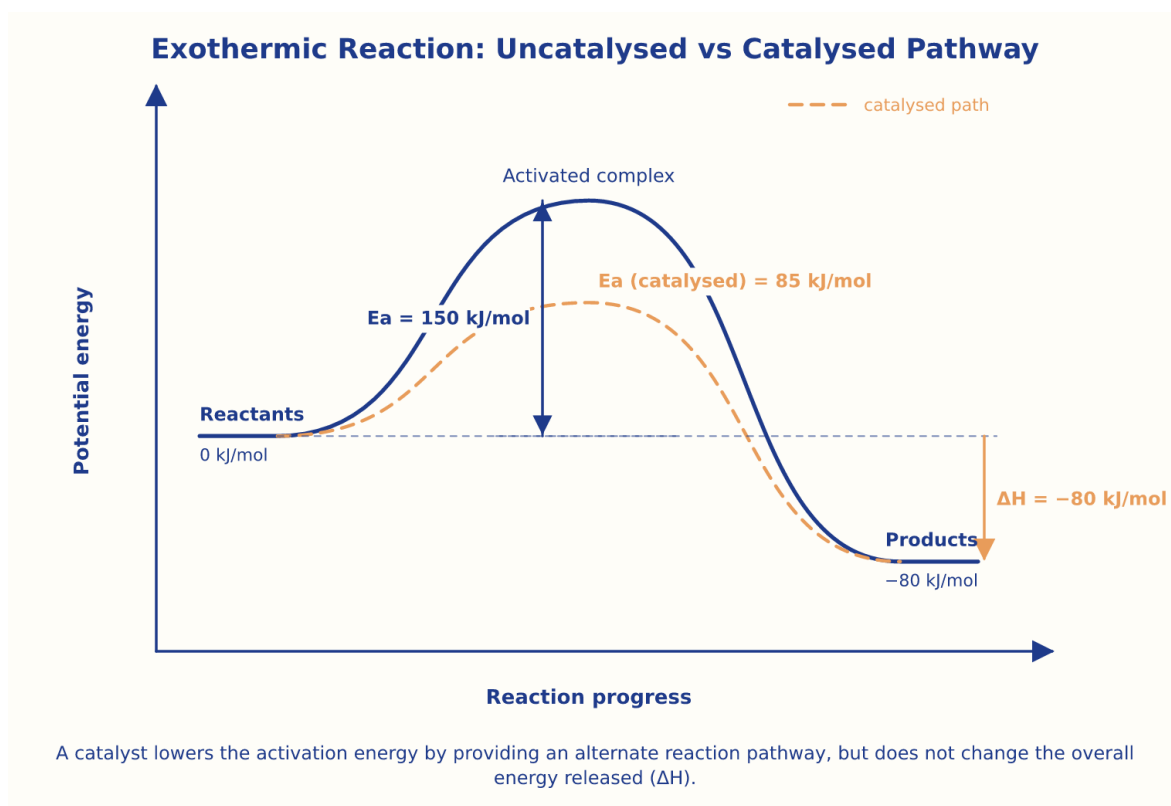


Figure 1: Potential energy diagram of an exothermic reaction: Reactants at 0 kJ/mol, Products at " 80 kJ/mol, $E_a = 150$ kJ/mol, 9D, Ò !#f ´ ¢öÖöÂÂ 6 F Ç—6VB F, v—F, V Ò fR ´ ¢öÖöÀ

Answer: _____

Reason: _____

6. **Analysis.** The diagram shows that reactants must overcome an energy barrier (activation energy) before products can form. Explain why a catalyst allows the reaction to proceed faster without changing the amount of energy released.

Answer Key

1. C) 150 kJ/mol
2. 9D, Ö !#f ' ¢öÖöÃ° This reaction is exothermic because the products have lower potential energy than the reactants, meaning energy is released.
3. Reactants !' The substances that enter the reaction at 0 kJ/mol; Products !' The substances formed after the reaction, at " 80 kJ/mol; Activation energy (uncatalyzed) !' The minimum energy needed to break bonds and start the reaction; Activation energy (catalyzed) !' The energy barrier lowered by adding a catalyst to 85 kJ/mol.
4. Difference = 150 " 85 = 65 kJ/mol
5. Figure 1 No, the catalyst does not change 9D,à The enthalpy change remains " 80 kJ/mol. The catalyst provides an alternate pathway with lower activation energy but does not alter the starting or ending energy levels of the reaction.

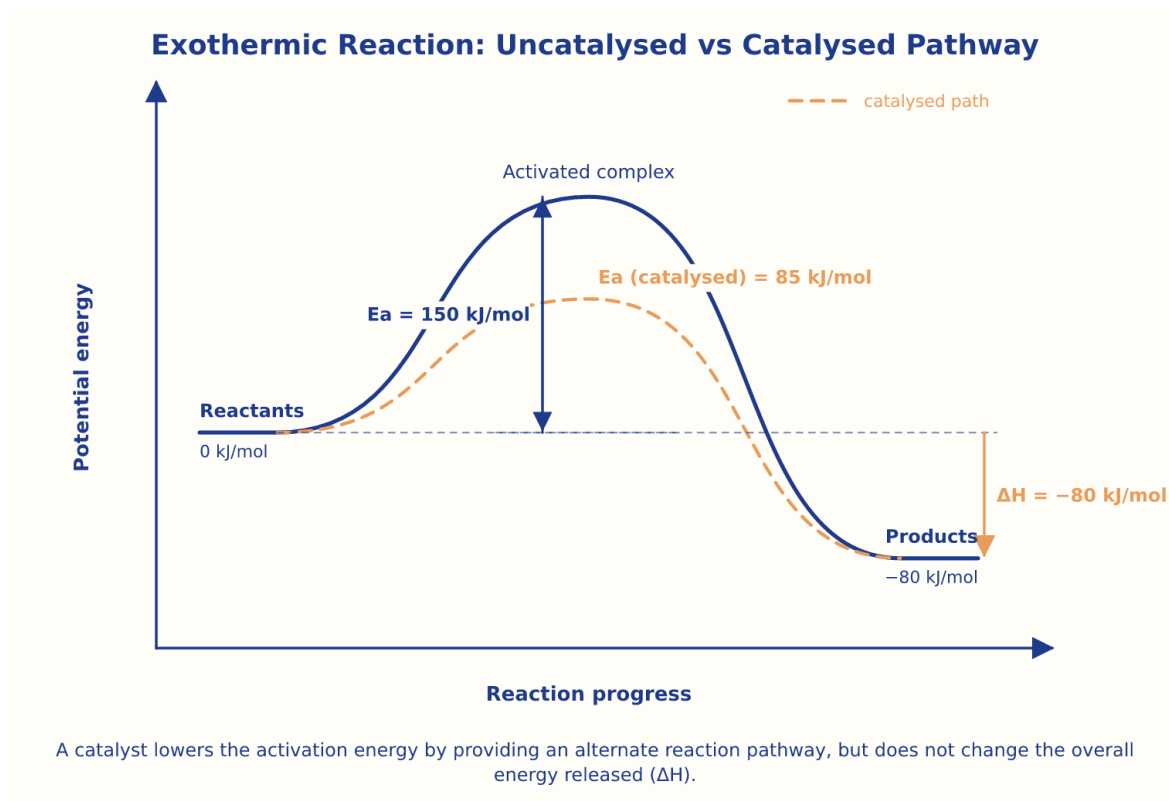


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6. A catalyst provides an alternate reaction pathway that requires less energy to initiate (lower activation energy). Molecules can overcome the lower energy barrier more easily, so more collisions result in successful reactions per unit time. The overall energy released (9D, Ö !#f ' ¢öÖöÃ° stays the same because the reactants and products have not changed, only the route between them.