

Potential Energy Diagrams: Exothermic Reactions and Catalysts

You will analyze and interpret potential energy diagrams for chemical reactions, identifying activation energy, enthalpy change, and the effect of catalysts on reaction pathways ([Outcome](#), [Outcome](#)). This sheet develops your ability to explain energy changes in chemical reactions and to recognize how catalysts function without altering the net energy released ([Topic](#), [Outcome](#)).

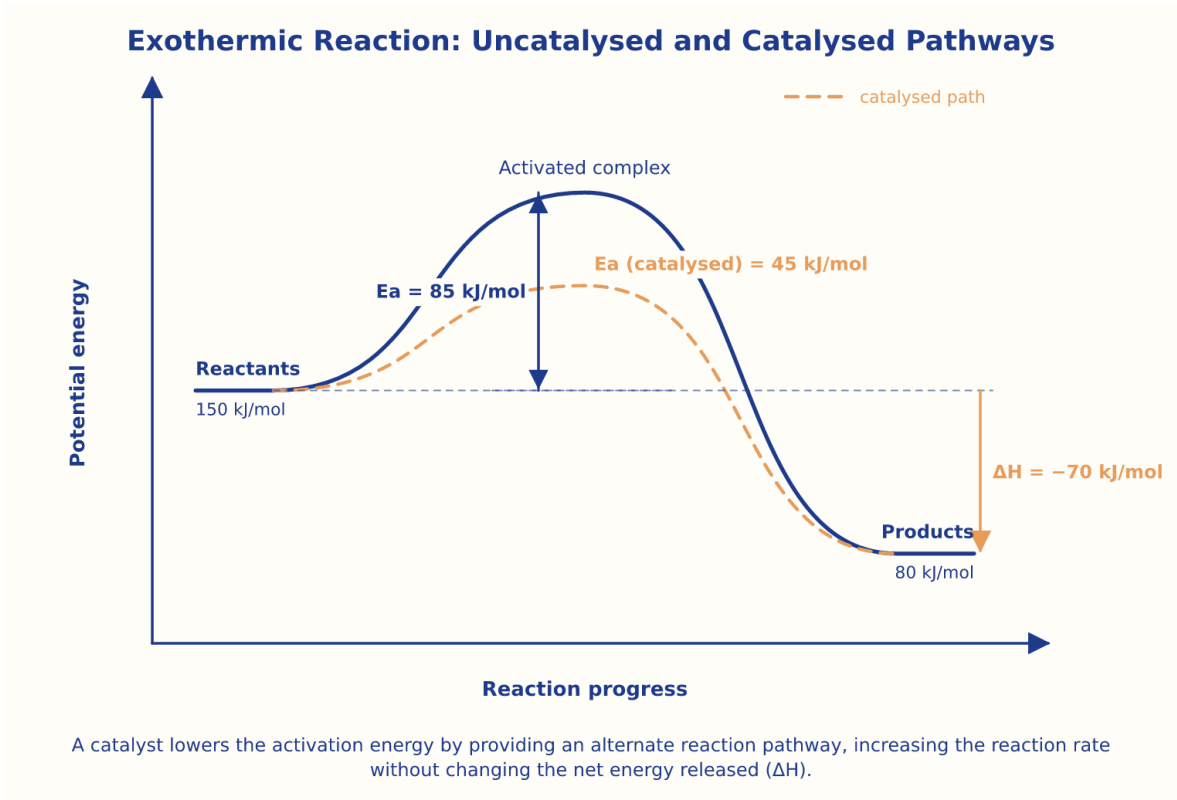


Figure 1: Potential energy diagram of an exothermic reaction: Reactants at 150 kJ/mol, Products at 80 kJ/mol, E_a = 85 kJ/mol, E_a (catalysed) = 45 kJ/mol, ΔH = -70 kJ/mol.

Exercises

- Multiple choice.** For the uncatalyzed reaction shown in the diagram, what is the activation energy?
A) 45 kJ/mol
B) 70 kJ/mol
C) 80 kJ/mol
D) 85 kJ/mol
- Short answer.** Using the diagram, calculate the enthalpy change (ΔH) for this reaction. Show your work.
Work:

- Matching.** Match each term on the left with its value from the diagram on the right.

Term	Value
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Potential energy of reactants	A) 45 kJ/mol
Potential energy of products	B) 80 kJ/mol
Activation energy (catalyzed)	C) 150 kJ/mol
Activation energy (uncatalyzed)	D) 85 kJ/mol

4. **Short answer.** Explain why the catalyzed pathway has a lower activation energy than the uncatalyzed pathway. Does the catalyst change the overall energy released by the reaction?

5. **Calculation.** A chemist wants to compare the two reaction pathways. How much lower is the activation energy for the catalyzed reaction than for the uncatalyzed reaction?

Difference = _____ kJ/mol

6. **Analysis.** Figure 1 This reaction is exothermic. Which of the following statements correctly explains why?

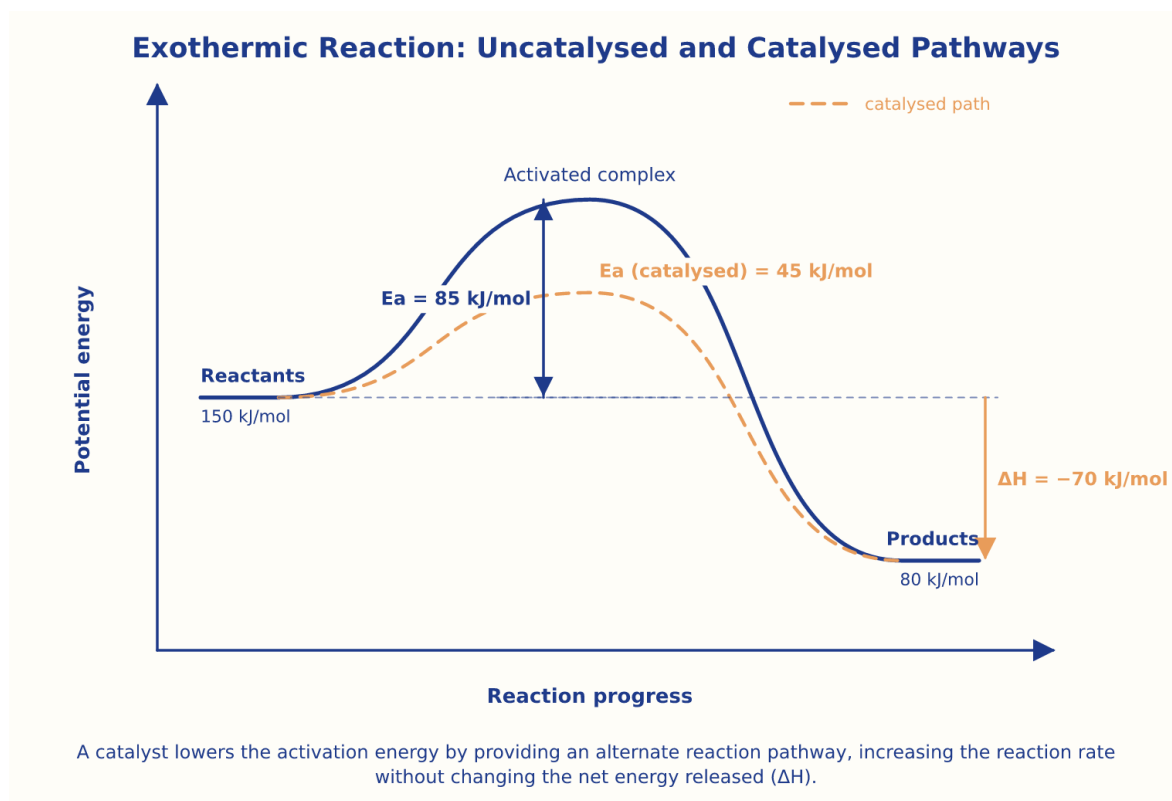


Figure 1: Potential energy diagram of an exothermic reaction: Reactants at 150 kJ/mol, Products at 80 kJ/mol, $E_a = 85 \text{ kJ/mol}$, $\Delta H = -70 \text{ kJ/mol}$, $E_a (\text{catalysed}) = 45 \text{ kJ/mol}$.

- A) The activation energy is greater than 70 kJ/mol.
 B) The potential energy of the products is lower than the potential energy of the reactants.
 C) The catalyst provides an alternate pathway with lower activation energy.
 D) The potential energy of the reactants is 150 kJ/mol.

Answer Key

1. D) 85 kJ/mol
2. 9D, Ò !#s ´ ¢öÖöÂà Work: 9D, Ò R‡ &öGV7G2' !" R‡&V 7F çG2' Ò f !" S Ò !#s ´ ¢öÖöÂà
3. Potential energy of reactants: C) 150 kJ/mol | Potential energy of products: B) 80 kJ/mol | Activation energy (catalyzed): A) 45 kJ/mol | Activation energy (uncatalyzed): D) 85 kJ/mol
4. The catalyst provides an alternate reaction pathway that requires less energy to initiate the reaction. The catalyst does not change the overall energy released; 9D, &VÖ –ç2 !#s ´ ¢öÖöÂà `or both pathways.
5. $85 - 45 = 40$ kJ/mol
6. B) The potential energy of the products is lower than the potential energy of the reactants.