

Potential Energy Diagrams: Exothermic Reactions and Catalysis

This worksheet asks you to analyze and label a potential energy diagram for an exothermic reaction, including reactants, products, enthalpy change and activation energy ([Outcome](#)). It also addresses how a catalyst changes the reaction pathway without changing the net energy released ([Outcome](#), [Outcome](#)).

Exercises

1. Labelling the diagram

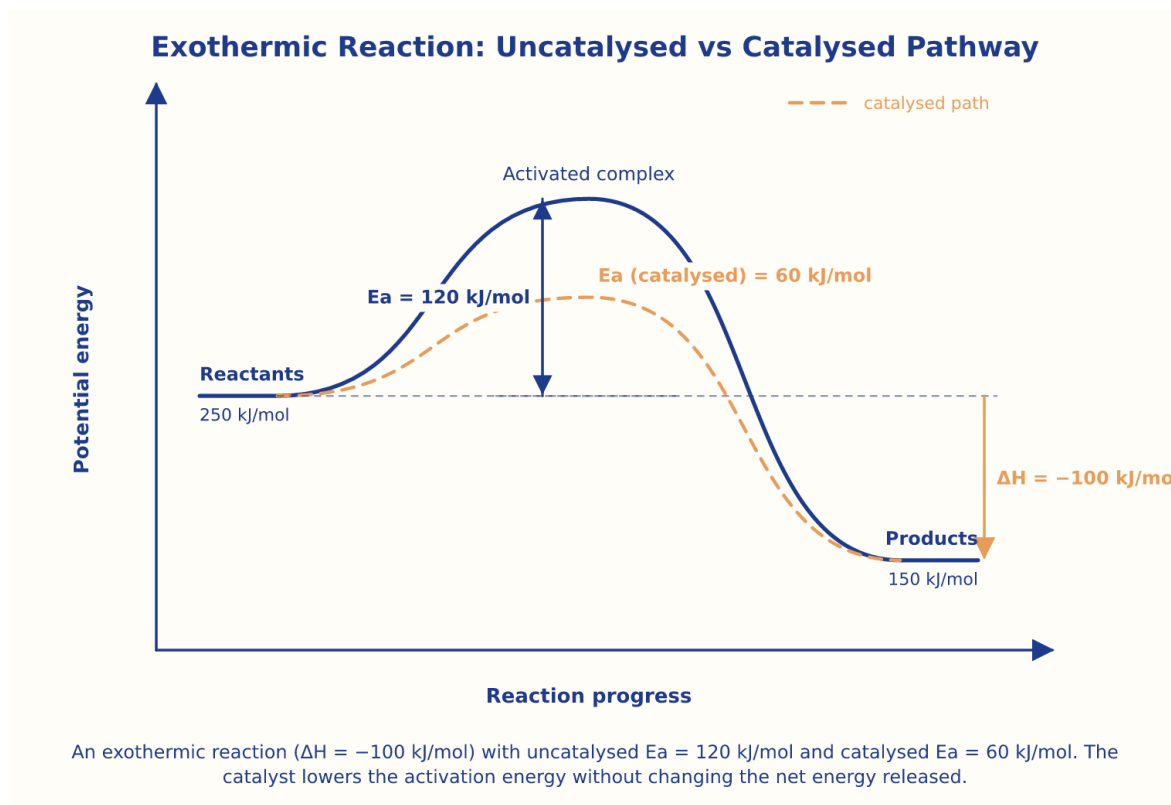


Figure 1: Potential energy diagram of an exothermic reaction: Reactants at 250 kJ/mol, Products at 150 kJ/mol, $E_a = 120 \text{ kJ/mol}$, $E_a (\text{catalysed}) = 60 \text{ kJ/mol}$, $\Delta H = -100 \text{ kJ/mol}$.

Using the potential energy diagram described above, answer the following.

- What is the potential energy of the reactants, in kJ/mol? _____
- What is the potential energy of the products, in kJ/mol? _____
- Is this reaction endothermic or exothermic? Justify your answer using the relative positions of reactants and products ([Outcome](#)). _____

2. Calculating enthalpy change

Using the values from the diagram, calculate ΔH for the uncatalysed reaction. Show your work.

$\Delta H = \text{Products} - \text{Reactants}$

Work: _____

9D, Ò òòòòòò ´ ¢öÖöÀ

State whether this value agrees with the 9D, v—`en in the figure(Outcome).

3. Activation energy, catalysed and uncatalysed

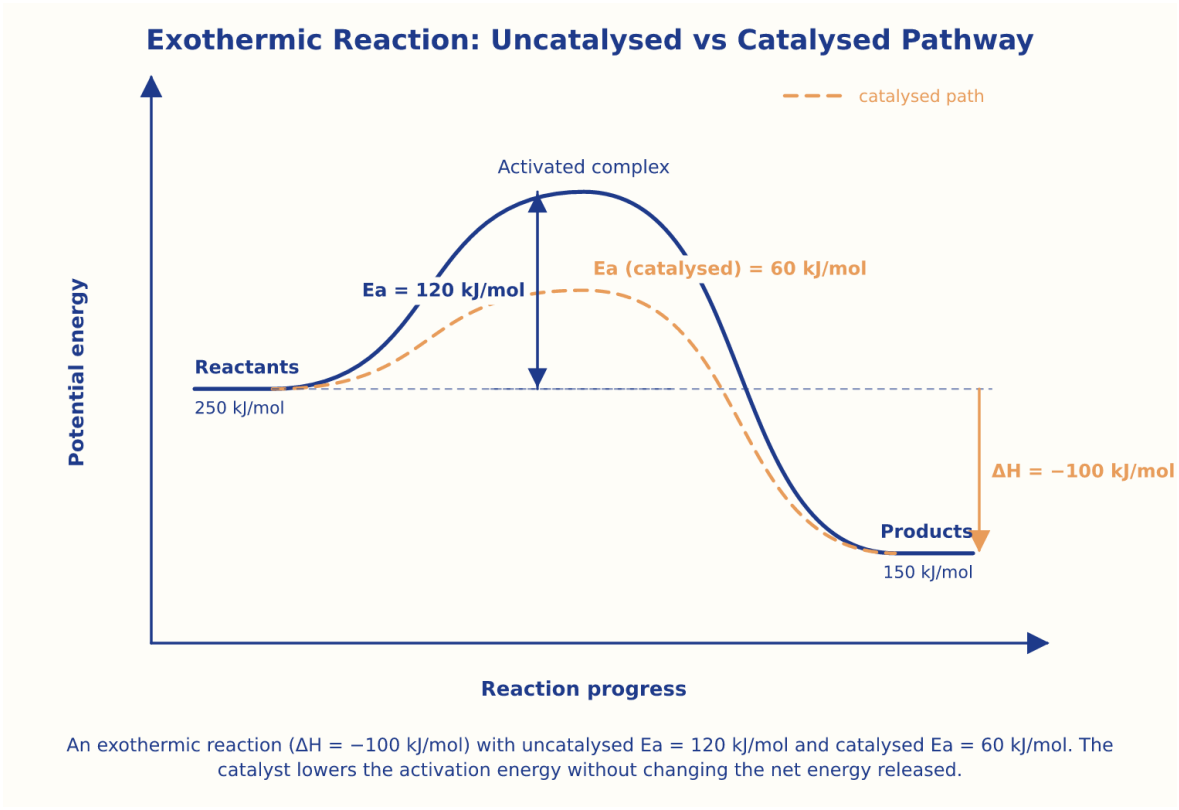


Figure 1: Potential energy diagram of an exothermic reaction: Reactants at 250 kJ/mol, Products at 150 kJ/mol, $E_a = 120 \text{ kJ/mol}$, 9D, Ò !# ´ ¢öÖöÀÂ 6 F Ç—6VB F, v—F, V Ö c ´ ¢öÖöÀ

- a) State the activation energy (E_a) for the uncatalysed pathway. _____ kJ/mol
- b) State the activation energy (E_a) for the catalysed pathway. _____ kJ/mol
- c) Calculate how much lower the activation energy is when the catalyst is used. _____ kJ/mol
- d) Define activation energy in your own words (Outcome).

4. Effect of the catalyst on 9D€

A student claims that adding a catalyst makes the reaction release more energy overall. Explain, using the concept from Outcome, why this claim is incorrect. Refer to the 9D, `alue for both the catalysed and uncatalysed pathways in your answer.

5. Matching terms to definitions

Match each term on the left to its correct definition on the right by writing the matching letter in the blank.

Term	Match	Definition
Activation energy (E_a)	_____	A) The energy difference between products and reactants

Enthalpy change (ΔH)	_____	B) A substance that provides an alternate pathway with lower E_a
Catalyst	_____	C) The energy barrier that must be overcome for a reaction to occur
Exothermic reaction	_____	D) A reaction in which the products have lower potential energy than the reactants

6. Multiple choice

Which statement correctly describes the effect of a catalyst on the reaction shown in the diagram?

- A) The catalyst lowers the potential energy of the products.
- B) The catalyst raises the potential energy of the reactants.
- C) The catalyst lowers the activation energy but does not change ΔH .
- D) The catalyst increases the value of ΔH by the reaction.

Circle your answer: A B C D

Answer key

1. a) 250 kJ/mol b) 150 kJ/mol c) Exothermic, because the products have lower potential energy than the reactants ([Outcome](#))

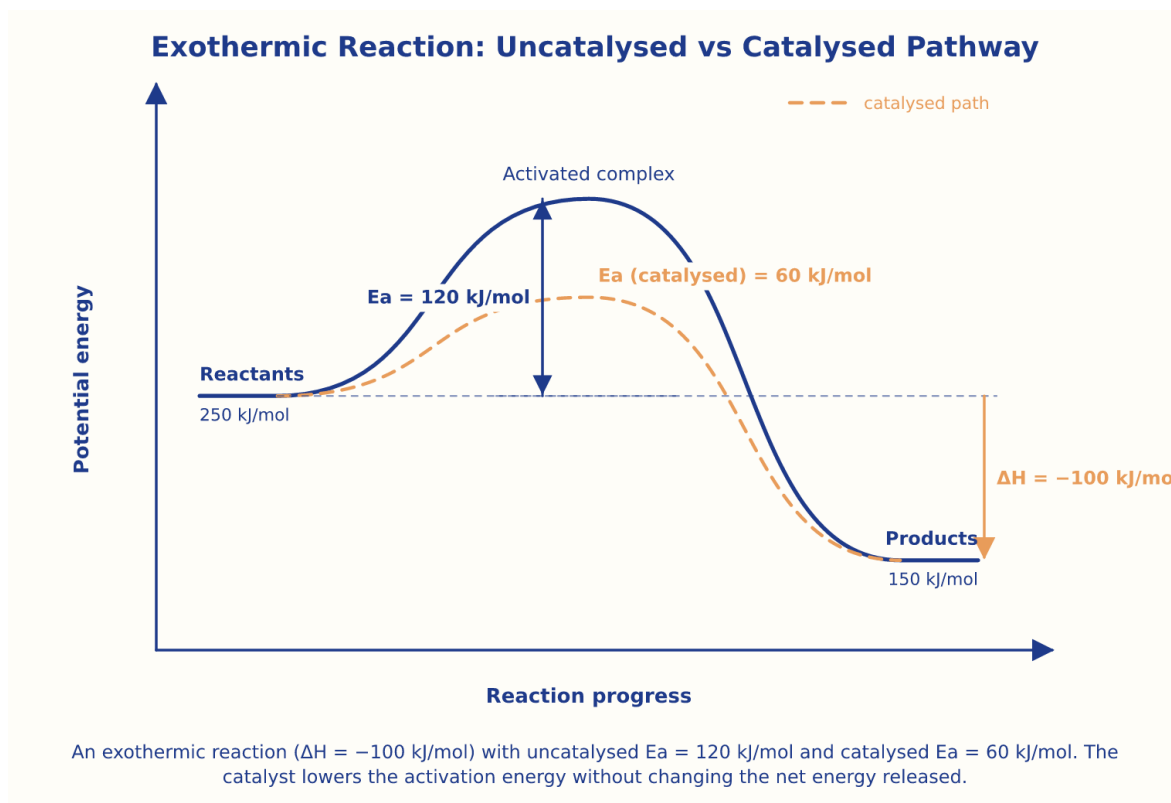


Figure 1: Potential energy diagram of an exothermic reaction: Reactants at 250 kJ/mol, Products at 150 kJ/mol, $E_a = 120 \text{ kJ/mol}$, $\Delta H = -100 \text{ kJ/mol}$. The catalyst lowers the activation energy without changing the net energy released.

2. ΔH , ΔS ! " # \$ % & ' () * + , - . / : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
3. a) 120 kJ/mol b) 60 kJ/mol c) 60 kJ/mol lower d) Activation energy is the minimum energy that reactant particles must have for a reaction to occur ([Outcome](#))

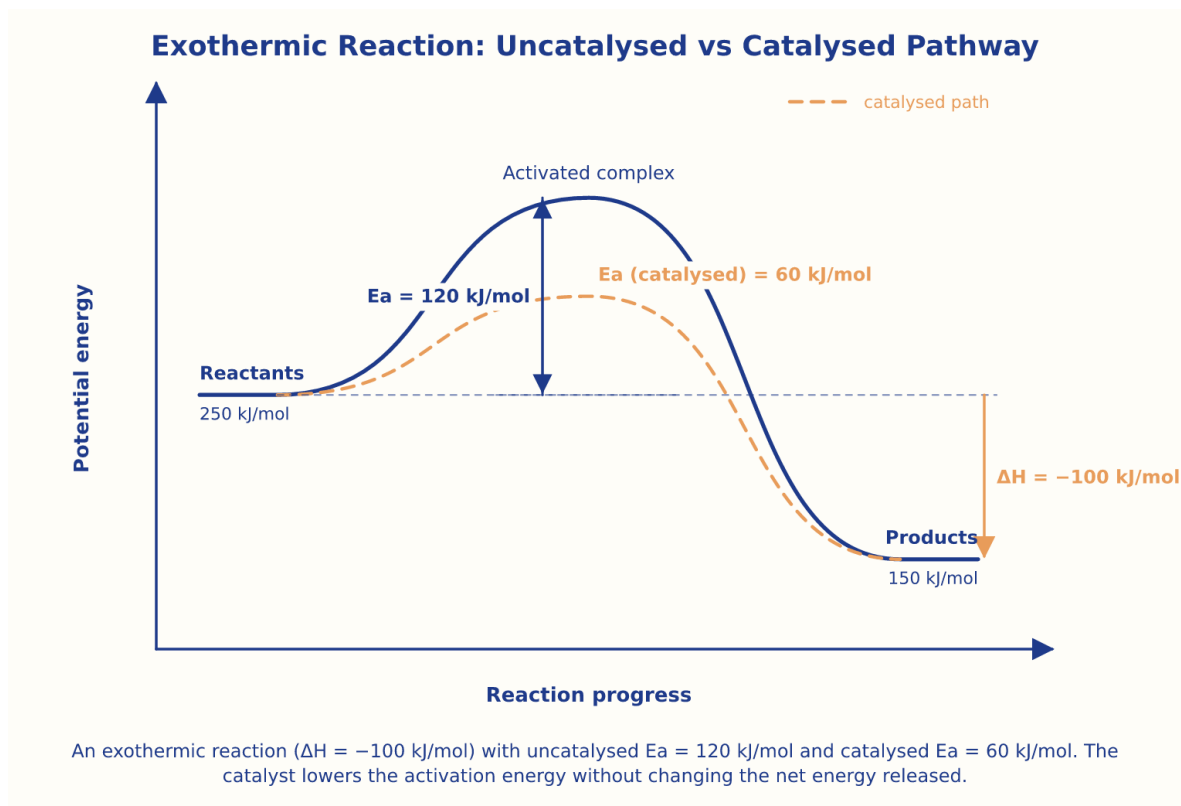


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4. The claim is incorrect. The catalyst lowers the activation energy from 120 kJ/mol to 60 kJ/mol, giving the reaction an alternate pathway, but ΔH is the same for both pathways because the net energy released depends only on the difference between reactant and product potential energy, which the catalyst does not change ([Outcome](#)).
5. Activation energy (E_a) = C; Enthalpy change (ΔH) = B; Exothermic reaction = D
6. C