CAIE Chemistry IGCSE

5.1 Exothermic and endothermic reactions

Flashcards

What does the term exothermic mean?

What does the term exothermic mean?

Exothermic - a reaction that transfers thermal energy into the surroundings, increasing the temperature of the surroundings.

What does the term endothermic mean?

What does the term endothermic mean?

Endothermic - a reaction that takes in thermal energy from the surroundings, decreasing the temperature of the surroundings

Give an example of a type of reaction that is exothermic

Give an example of a type of reaction that is exothermic

- Combustion
- Neutralisation

Give an example of a type of reaction that is endothermic

Give an example of a type of reaction that is endothermic

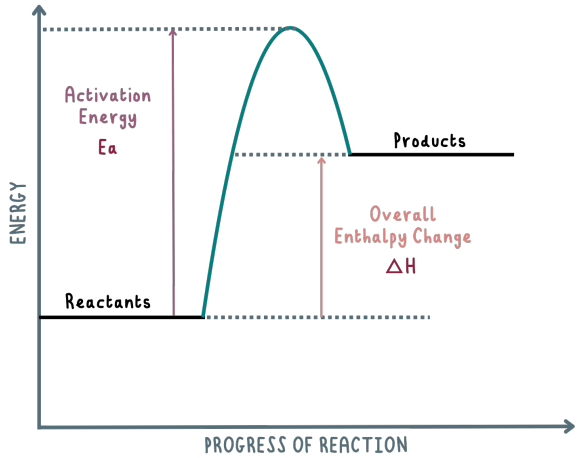
- Thermal decomposition
- Reaction between citric acid and sodium hydrogen carbonate

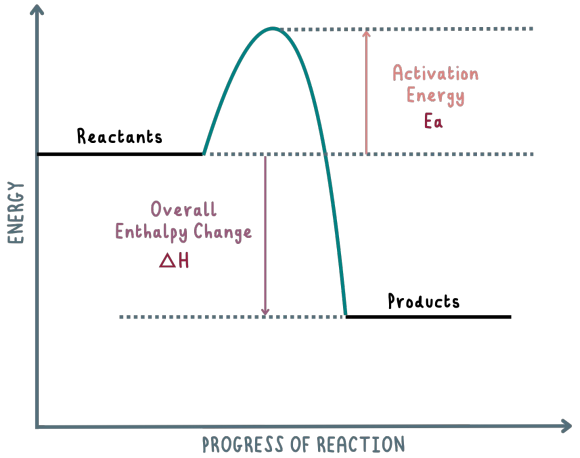
What is a reaction profile?

What is a reaction profile?

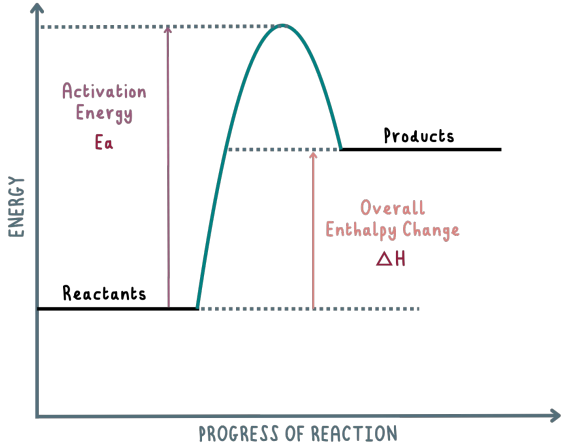
A graph which shows the relative energies of reactants and products, as well as the activation energy of the reaction.

Label the following reaction profiles as exothermic or endothermic:

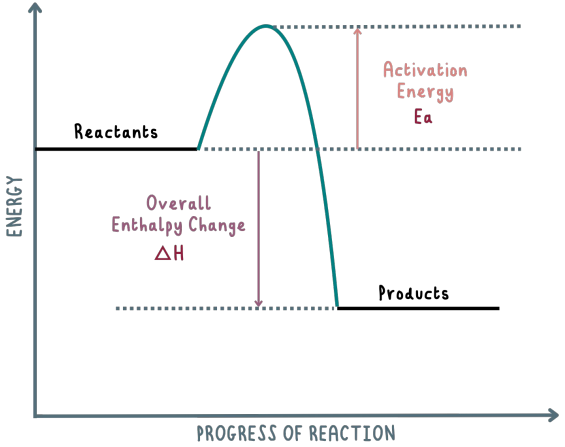




Label the following reaction profiles as exothermic or endothermic:



Endothermic



Exothermic

What is the enthalpy change, ΔH, of a reaction? (extended only)

What is the enthalpy change, ΔH, of a reaction? (extended only)

- The enthalpy change, ΔH, of a reaction is the transfer of thermal energy during a reaction.
- The enthalpy change, ΔH, of an exothermic reaction is negative and an endothermic reaction is positive

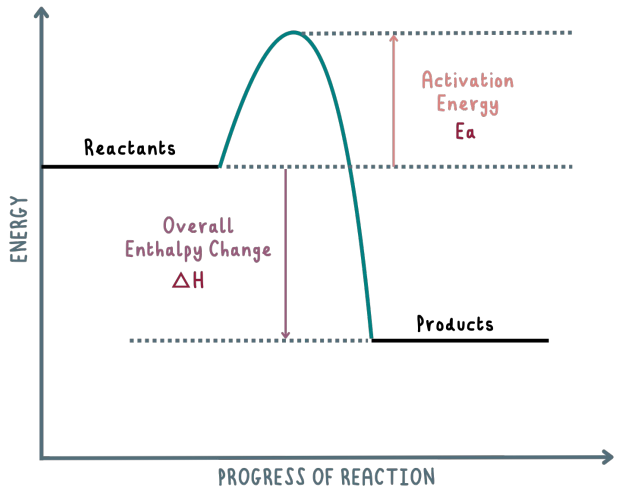
Define activation energy E_a
(extended only)

Define activation energy E_a (extended only)

The activation energy, E_a , is the minimum amount of energy that colliding particles need to have to react

Draw and label a reaction pathway diagram to show an exothermic reaction (extended only)

Draw and label a reaction pathway diagram to show an exothermic reaction (extended only)

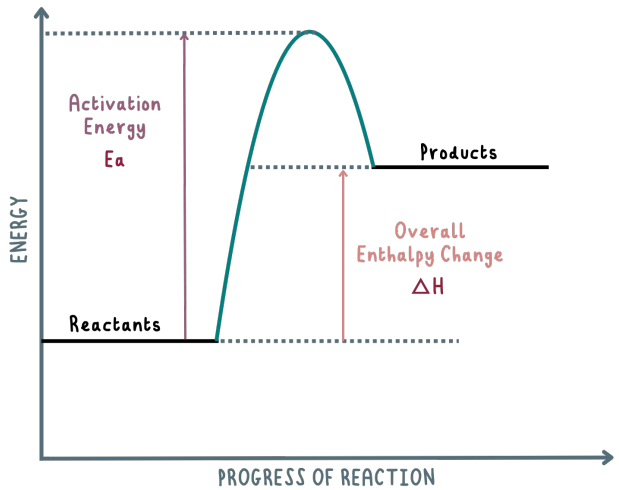


- Products must be on lower energy level than reactants
- Overall enthalpy change must be negative (arrow pointing downwards)

Draw and label a reaction pathway diagram to show an endothermic reaction

(extended only)

Draw and label a reaction pathway diagram to show an endothermic reaction (extended only)



- Products must be on higher energy level than reactants
- Overall enthalpy change must be positive (arrow pointing upwards)

How is the activation energy of a reaction shown on a reaction pathway diagram?

(extended only)

How is the activation energy of a reaction shown on a reaction pathway diagram? (extended only)

The activation energy, E_a , is shown on reaction pathway diagrams with an arrow, beginning at the energy of the reactants up to the maximum energy reached in the reaction (the peak of the pathway).

What is bond breaking?
(extended only)

What is bond breaking? (extended only)

- For a chemical reaction to occur, the bonds in a reactant must be broken.
- This requires energy to be taken in from the surroundings, so <u>bond breaking is endothermic</u>

What is bond making?

(extended only)

What is bond making?(extended only)

- For a chemical reaction to occur, the bonds in a product must be made.
- This releases energy into the surroundings, so bond making is exothermic

Explain what it means when the enthalpy change, ΔH, of a reaction is negative (extended only)

Explain what it means when the enthalpy change, ΔH, of a reaction is negative (extended only)

The enthalpy change of a reaction is negative (exothermic) when: Energy released making bonds > Energy taken in breaking bonds

Explain what it means when the enthalpy change, ΔH, of a reaction is positive (extended only)

Explain what it means when the enthalpy change, ΔH, of a reaction is positive (extended only)

The enthalpy change of a reaction is positive (endothermic) when: Energy taken in breaking bonds > Energy released making bonds

How can the enthalpy change of a reaction be calculated from bond energies? (extended only)

How can the enthalpy change of a reaction be calculated from bond energies? (extended only)

1. Add up the bond energies for every bond in the reactants – totalling the ‘energy in’
2. Add up the bond energies for every bonds in the products – totalling ‘energy out’
3. Use the following formula to calculate the enthalpy change

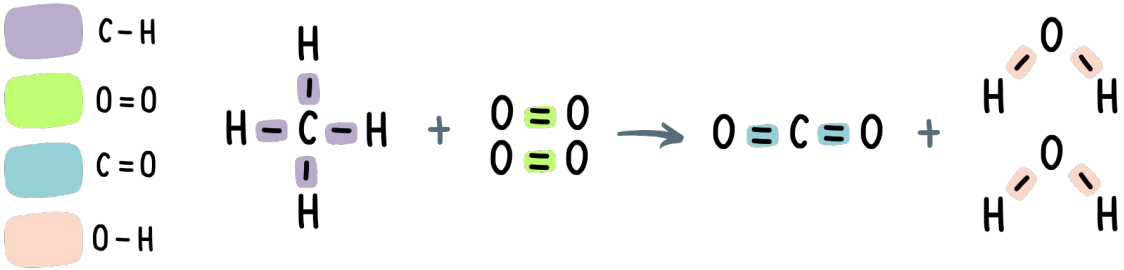
   ΔH : energy in – energy out

Calculate the enthalpy change the following reaction, using bond energies. (extended only)

$$CH_4 + 2\ O_2 \rightarrow CO_2 + 2H_2O$$

Bond	Bond energy
C-H	413 kJ/mol
O=O	498 kJ/mol
C=O	800 kJ/mol
O-H	464 kJ/mol

Calculate the enthalpy change the following reaction, using bond energies. (extended only)



Bond	Bond energy
C-H	413 kJ/mol
O=O	498 kJ/mol
C=O	800 kJ/mol
O-H	464 kJ/mol

Reactants (energy in): (4 x 413) + (2 x 498) = 2648 kJ/mol

Products (energy out): (2 x 800) + (4 x 464) = 3456 kJ/mol

ΔH : 2648 – 3456 = -808 kJ/mol so the reaction is exothermic

Calculate the enthalpy change the following reaction, using bond energies. (extended only)

$H_2 + I_2 \rightarrow 2HI$

Bond	Bond energy
H-H	436 kJ/mol
I-I	151 kJ/mol
H-I	297 kJ/mol

Calculate the enthalpy change the following reaction, using bond energies. (extended only)

Bond	Bond energy
H-H	436 kJ/mol
I-I	151 kJ/mol
H-I	297 kJ/mol

Reactants (energy in): (1 x 436) + (1 x 151) = 587 kJ/mol
Products (energy out): (2 x 297) = 594 kJ/mol
ΔH : 587 – 594 = –7 kJ/mol so the reaction is exothermic