Chemical Energetics

Thursday, 2 May 2024 10:07 AM

Energy Change

Endothermic
↳ absorb thermal heat
↳ lowers temp

Ice cream → melting

Exothermic
↳ release thermal heat
↳ increase temp

Candles → burning

Reaction Phases

1 **Bond breaking**
→ energy absorbed from surrounding
∴ endothermic

2 **Bond making**
→ releases energy to the surrounding
∴ exothermic

Bond Energy

→ amount of energy absorbed to break 1 mole of a chemical bonds | endothermic
→ amount of energy released when 1 mole of that bond is formed | exothermic

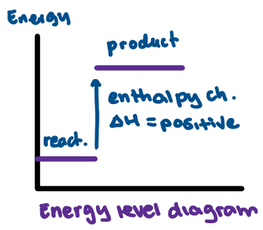
Activation Energy E_a

→ minimum amount of energy that colliding reactant particles must possess to react with each other

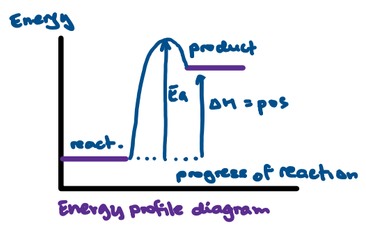
Enthalpy Change ΔH

Endothermic : ΔH > 0

- Energy absorbed during bond breaking > energy released
- Products contain more energy than reactants
- Temperature of surroundings decrease



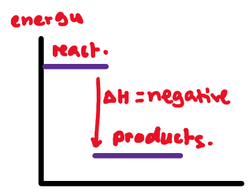
Energy level diagram



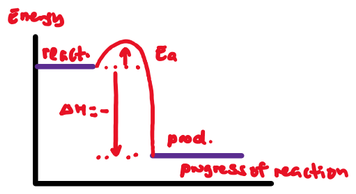
Energy profile diagram

Exothermic : ΔH < 0

- Energy released during bond breaking > energy absorbed
- Products contain less energy than reactants
- Temperature of surroundings increase



Energy level diagram



Energy profile diagram

Practice

$O_2 \rightarrow 2O$ Endo Bond breaking

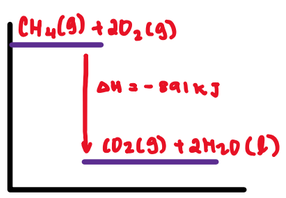
$CH_4 \rightarrow C + 4H$ Endo Bond break

$2H + O \rightarrow H_2O$ Exo Bond make

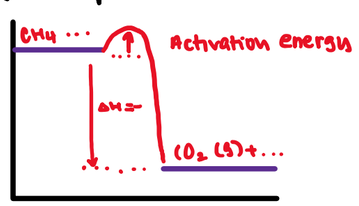
$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ $\Delta H = -891\ kJ$

↳ reactants more energy than product

↳



Energy Level



Energy Profile

Overall Enthalpy Change

ΔH = total energy absorbed (↳ breaking) − total energy released (↳ making)

Endo : energy absorbed bond breaking > energy released bond making

Exo : energy absorbed bond breaking < energy released bond making

Mole Conc. / Stoichiometry

$2NaOH(aq) + 1H_2SO_4(aq) \rightarrow 1Na_2SO_4(aq) + 2H_2O(l)$ $\Delta H = -114$

2 mole + 1 mole = 1 mole + 2 mole

-114 kJ released

energy absorbed in bond breaking is less than energy released in bond making

IF
1 mole + 0.5 mole
∴ ΔH $\frac{-114}{2}$
↳ ΔH = −57 kJ

$H_2(g) + Br_2(g) \rightarrow 2HBr(g)$ $\Delta H = -72.8\ kJ$

Find overall enthalpy change , 200 dm^3 of HBr

no. moles of HBr produced : $\frac{200}{24}$

= 8.3333 mol

overall ΔH:

$8.3333 \times \frac{-72.8}{2}$

= −303 kJ

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

H−H : 436 kJ
O=O : 496 kJ
O−H : 460 kJ

1. Overall ΔH [−472 kJ]
2. Overall ΔH when 30g of H_2 is reacted [−3540 kJ]
3. Exo / Endo? [EXO]

1. $2(436) + 496 \rightarrow 4(460)$

= 1368 = 1840

1368 + (−1840) = −472

2. no. moles of H_2 : $\frac{30}{2}$

= 15

overall ΔH :

$15 \times \frac{-472}{2}$ = −3540 kJ

3. Exothermic