Chemical Energetics

ENTHALPY CHANGE

The transfer of **thermal energy** during a reaction is called **enthalpy change (ΔH),** of the reaction.

$$\Delta H = \sum B.E._{broken} - \sum B.E._{formed}$$

EXOTHERMIC REACTIONS

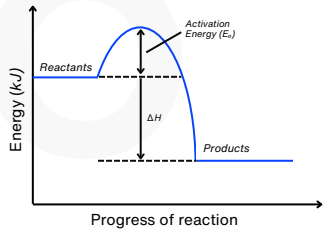
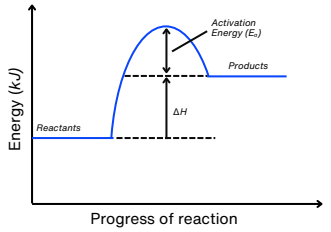
An exothermic reaction transfers thermal energy **to** its surroundings, leading to an **increase** in the temperature of the surroundings.

ENDOTHERMIC REACTIONS

An endothermic reaction transfers thermal energy **from** the surroundings, leading to a **decrease** in the temperature of the surroundings.

ACTIVATION ENERGY

The activation energy E_a, is the **minimum energy** that colliding particles must have in order to react.

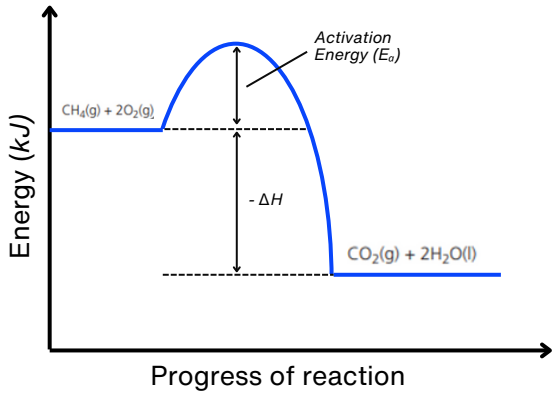
	EXOTHERMIC	ENDOTHERMIC
ΔH	NEGATIVE	POSITIVE
THERMAL ENERGY	RELEASED	ABSORBED
ENERGY OF PRODUCTS	LOWER	HIGHER
TEMPERATURE OF SURROUNDINGS	INCREASES	DECREASES
DIAGRAMS		

QUESTION: Find the enthalpy change of

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

and draw the reaction pathway diagram.

$$B.E.(C-H) = 410 kJmol^{-1}$$
$$B.E.(O=O) = 496 kJmol^{-1}$$
$$B.E.(C=O) = 805 kJmol^{-1}$$
$$B.E.(O-H) = 460 kJmol^{-1}$$



ANSWER:

$$\Delta H = \sum B.E._{broken} - \sum B.E._{formed}$$

$$= 410 \times 4 + 2 \times 496 - 805 \times 2 - 460 \times 4$$

$$= -818\ \text{kJmol}^{-1}$$

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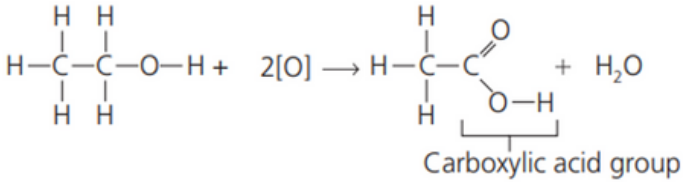
Alcohols, Carboxylic Acids, & Esters

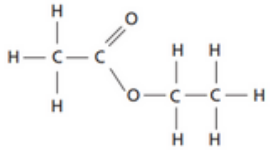
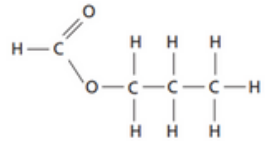
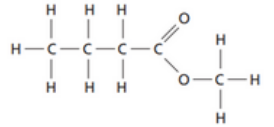
	ALCOHOL	CARBOXYLIC ACIDS
GENERAL FORMULA	$C_nH_{2n}OH$	$C_nH_{2n+1}CO_2H$
SUFFIX	-OL	-OIC ACID
FUNCTIONAL GROUP	-OH	$-CO_2H$
TYPE OF REACTION	OXIDATION, CONDENSATION	REDUCTION, CONDENSATION

OXIDATION OF ALCOHOL

ethanol + oxygen ⟶ ethanoic acid + water

$$CH_3CH_2OH(l) + 2[O] \longrightarrow CH_3COOH(aq) + H_2O(l)$$



ESTER	MADE FROM		STRUCTURE
	ALCOHOL	CARBOXYLIC ACID	
ETHYL ETHANOATE	ETHANOL	ETHANOIC ACID	
PROPYL METHANOATE	PROPAN-1-OL	METHANOIC ACID	
METHYL BUTANOATE	METHANOL	BUTANOIC ACID	

ESTERIFICATION

ethanoic acid + ethanol $\underset{H_2SO_4}{\overset{conc}{\rightleftharpoons}}$ ethyl ethanoate + water

$$CH_3COOH(l) + C_2H_5OH(l) \underset{H_2SO_4}{\overset{conc}{\rightleftharpoons}} CH_3COOC_2H_5(aq) + H_2O(l)$$