

What is Enthalpy?

Worksheet

Enthalpy is the sum of internal energy and the work done by/on the system at constant pressure:

$H = U + PV$. The change in enthalpy ΔH determines if a reaction is exothermic ($\Delta H < 0$, releases heat) or endothermic ($\Delta H > 0$, absorbs heat).

$$\Delta H = H_{\text{products}} - H_{\text{reactants}}$$

ΔH = Change in enthalpy (kJ/mol)

H_{products} = Enthalpy of products (kJ/mol)

$H_{\text{reactants}}$ = Enthalpy of reactants (kJ/mol)

Questions

1. Which reaction is exothermic?

- A) $\Delta H = +45 \text{ kJ/mol}$
- B) $\Delta H = -78 \text{ kJ/mol}$
- C) $\Delta H = +120 \text{ kJ/mol}$
- D) $\Delta H = +30 \text{ kJ/mol}$

2. A reaction has $\Delta H = -150 \text{ kJ/mol}$. How much heat is released?

- A) 150 kJ/mol absorbed
- B) 150 kJ/mol released
- C) 0 kJ/mol
- D) 300 kJ/mol released

3. Reactants = 210 kJ/mol, Products = 180 kJ/mol. Calculate ΔH .

- A) -30 kJ/mol
- B) $+30 \text{ kJ/mol}$
- C) $+390 \text{ kJ/mol}$
- D) -390 kJ/mol

4. Melting and boiling are endothermic. Why?

- A) Energy is released
- B) Energy must be absorbed to break bonds
- C) Temperature decreases
- D) Reactants disappear

5. The combustion of methane: $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$. Reactants = 50 kJ/mol, Products = -200 kJ/mol . Calculate ΔH .

6. Melting ice: $\text{H}_2\text{O(s)} \rightarrow \text{H}_2\text{O(l)}$. Solid = -300 kJ/mol , Liquid = -250 kJ/mol . Find ΔH .

7. A reaction has reactants at 180 kJ/mol and products at 140 kJ/mol. Is it exothermic or endothermic?

8. Define: What is enthalpy?

9. Define: What does $\Delta H < 0$ mean?

10. Define: What does $\Delta H > 0$ mean?

Answer Key

1. B) $\Delta H = -78 \text{ kJ/mol}$ — Exothermic means $\Delta H < 0$ (negative). Only -78 kJ/mol is negative.
2. B) 150 kJ/mol released — Negative ΔH means heat is released. Magnitude = 150 kJ/mol .
3. A) -30 kJ/mol — $\Delta H = 180 - 210 = -30 \text{ kJ/mol}$ (exothermic).
4. B) Energy must be absorbed to break bonds — Phase changes require energy input to overcome intermolecular forces.
5. $\Delta H = H_{\text{products}} - H_{\text{reactants}}$ $\Delta H = (-200) - (50) = -250 \text{ kJ/mol}$ Negative $\Delta H \rightarrow$ exothermic (releases heat)
6. $\Delta H = (-250) - (-300) = +50 \text{ kJ/mol}$ Positive $\Delta H \rightarrow$ endothermic (absorbs heat)
7. $\Delta H = 140 - 180 = -40 \text{ kJ/mol}$ Negative value $\rightarrow$ exothermic (releases 40 kJ/mol)
8. The total heat content of a system; change in enthalpy ΔH tells you if heat is released or absorbed.
9. Exothermic reaction — heat is released to surroundings.
10. Endothermic reaction — heat is absorbed from surroundings.

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