Where Heat Goes

Classify energy changes and draw an enthalpy diagram

CHE.10.2 "Enrichment: Classify chemical reactions and phase changes as exothermic or endothermic based on enthalpy values. Use a graphical representation to illustrate the energy changes involved."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the two rules about the sign of ΔH in the passage. Then circle each ΔH value in the table and write E or X beside its row to show endothermic or exothermic.

Reading the Energy Change

1. A sealed lunch container can keep soup warm or chill a drink, but heat still moves between a system and its surroundings. Chemists call the heat gained or lost at constant pressure the enthalpy change, ΔH. A positive ΔH means the system absorbs heat and the change is endothermic. A negative ΔH means it releases heat and is exothermic.

2. To compare different processes, measure ΔH per mole of the named substance. A chemical reaction rearranges atoms, while a phase change keeps the substance's chemical identity. The table records energy changes for both kinds of process. Each value refers to one mole of the substance named in that row, not one mole of every substance involved.

ENTHALPY CHANGES FOR FOUR PROCESSES

Process	Named substance	ΔH (kJ per mole of named substance)
Burning methane	methane	−890
Decomposing calcium carbonate	calcium carbonate	+178
Melting ice	water	+6.01
Condensing water vapor	water	−40.7

3. Energy diagrams put enthalpy on the vertical axis and progress on the horizontal axis. Draw a starting level for reactants or an initial phase and an ending level for products or a final phase. The vertical distance between levels gives the magnitude of ΔH; their order shows its sign. Such diagrams do not show how fast a change happens.

2 ANSWER WITH EVIDENCE

Use the passage

1. Is burning methane exothermic or endothermic? On an energy diagram, would its products be above or below its reactants?

2. Is decomposing calcium carbonate exothermic or endothermic? How far apart would its reactant and product levels be on an energy diagram?

3. Classify melting ice and condensing water vapor. For each one, state whether its final phase would be above or below its initial phase on an energy diagram.

4. Which releases more energy per mole of its named substance, burning methane or condensing water vapor? How much more?

3 YOUR TURN

Your own words

An invented material called vella melts with a ΔH of +25 kJ per mole. On the grid, draw an energy diagram with labeled axes, starting and ending levels, and a labeled ΔH arrow. Write one sentence classifying the change and stating whether vella absorbs or releases heat.



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PART 1 · READ AND MARK

Underline the two rules about the sign of ΔH in the passage. Then circle each ΔH value in the table and write E or X beside its row to show endothermic or exothermic. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Is burning methane exothermic or endothermic? On an energy diagram, would its products be above or below its reactants?	**Exothermic. Its products would be below its reactants because ΔH is negative.**
2	Is decomposing calcium carbonate exothermic or endothermic? How far apart would its reactant and product levels be on an energy diagram?	**Endothermic. The product level would be 178 kJ per mole of calcium carbonate above the reactant level.**
3	Classify melting ice and condensing water vapor. For each one, state whether its final phase would be above or below its initial phase on an energy diagram.	**Melting ice is endothermic, so the final phase is above the initial phase. Condensing water vapor is exothermic, so the final phase is below the initial phase.**
4	Which releases more energy per mole of its named substance, burning methane or condensing water vapor? How much more?	**Burning methane releases more, by 849.3 kJ per mole of the named substance.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The diagram has enthalpy (kJ/mol) on the vertical axis and progress of the change on the horizontal axis. The ending level, labeled liquid vella, is 25 kJ/mol above the starting level, labeled solid vella; an upward arrow between them is labeled ΔH = +25 kJ/mol. Melting vella is endothermic, so it absorbs heat.

Accept energy diagrams with any relative starting value if the ending level is 25 kJ/mol higher. For the comparison question, both processes release heat, and the difference between their listed magnitudes is 849.3 kJ per mole.