ANSWER KEY. Final answers are in bold.

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6.1 Endothermic and Exothermic Processes

AP Chemistry | ANSWER KEY

Answer in complete sentences. Use the terms system, surroundings, absorbs, and releases when they help.

1. Classify each process as **endothermic** or **exothermic**.

(a) Liquid ethanol evaporates from your skin.
(b) Water vapor condenses on a cold bathroom mirror.
(c) Natural gas burns in a furnace.
(d) Liquid water freezes in an ice tray.

(a) endothermic (b) exothermic (c) exothermic (d) exothermic

Evaporating pulls particles apart, which absorbs energy. Condensing, freezing, and burning release energy.

2. A student dissolves solid NH_4NO_3 in water in a foam cup. The temperature of the water falls from 22.4°C to 17.1°C.

(a) Identify the system and the surroundings.
(b) Is dissolving NH_4NO_3 endothermic or exothermic?
(c) In which direction does energy flow?

(a) **System: the NH_4NO_3 as it dissolves. Surroundings: the water, the cup, and the thermometer.**

(b) The water got colder, so the surroundings lost energy. **Dissolving NH_4NO_3 is endothermic.**

(c) **Energy flows from the surroundings (the water) into the system.**

3. A student puts a thermometer in the water around a reaction and says, “The temperature went up, so the system gained energy.” Explain the error in this claim.

The thermometer measures the surroundings, not the system. Warmer surroundings gained energy, so the system released it and the process is exothermic.

4. Instant hot packs contain solid $CaCl_2$ and water. When the pack is activated, it warms up. Use the attractions that break and form to explain why dissolving $CaCl_2$ is exothermic.

Separating the ions from each other and the water molecules from each other absorbs energy. Forming the new attractions between the ions and the water molecules releases more energy than was absorbed, so the net result is energy released to the surroundings (exothermic).

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5. A student says, “Freezing cannot be exothermic because ice is cold.” Explain the error.

As water freezes, the particles move closer together and attractions form, which releases energy to the surroundings. Exothermic describes the direction of energy flow, not whether something feels hot or cold.

6. Magnesium ribbon is placed in hydrochloric acid and the test tube becomes warm to the touch:

$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$

(a) Did the surroundings gain or lose energy?
(b) Is the reaction endothermic or exothermic?
(c) Did the system absorb or release energy?

(a) **The surroundings gained energy (they got warmer).**

(b) **Exothermic.** (c) **The system released energy to the surroundings.**

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