What is Entropy?

Worksheet

Entropy quantifies the number of microstates (molecular arrangements) available to a system. Higher entropy means more disorder. In spontaneous reactions, the total entropy change (system + surroundings) is positive: S_universe > 0.

S_universe = S_system + S_surroundings

Questions

1. Which has higher entropy: ice or water?

A) Ice
B) Water
C) Equal entropy
D) Depends on temperature

2. In a spontaneous reaction, S_universe is:

A) Negative
B) Positive (>0)
C) Zero
D) Undefined

3. Dissolving salt in water. System entropy S_system is:

A) Negative
B) Zero
C) Positive
D) Variable

4. Which process is entropy-driven?

A) Crystallization of salt
B) Gas spreading throughout room
C) Ice forming
D) Organized sand on beach

5. Ice melts to water at 0C. Does entropy increase?

6. Gas dissolving in water at room temperature. Is it spontaneous?

7. Why does spilled perfume spread through a room spontaneously?

8. Define: What is entropy?

9. Define: Does ice have high or low entropy?

10. Define: Does gas have high or low entropy?

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Answer Key

1. B) Water - Water is liquid more molecular motion and disorder higher entropy than solid ice.
2. B) Positive (>0) - Second Law: spontaneous reactions always have S_universe > 0.
3. C) Positive - Solid salt dissociates ions spread in solution disorder increases S_system > 0.
4. B) Gas spreading throughout room - Gas expanding to fill space has S >> 0 - highly spontaneous and entropy-driven.
5. Solid ice has ordered crystal structure (low S) Liquid water has more random molecular motion (high S) S_system > 0 (entropy of system increases) Reaction is spontaneous S_universe > 0
6. Gas molecules expand into solution (many more microstates) S_system >> 0 (large positive entropy increase) Spontaneous process (S_universe > 0)
7. Perfume molecules escape (high S_system) Molecules occupy larger volume many more microstates Process has S_universe > 0 spontaneous Reverse (perfume gathering) has S < 0 never observed
8. A measure of disorder/randomness; related to the number of molecular microstates.
9. Low entropy - crystal lattice is highly ordered.
10. High entropy - molecules move freely, many possible arrangements.

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