

What is Entropy and the Second Law of Thermodynamics?

Worksheet

Entropy is disorder; the second law says $S_{\text{universe}} > 0$ for spontaneous processes - disorder always increases overall.

Questions

1. Second law: entropy of isolated system
 - A) always decreases
 - B) stays constant
 - C) always increases
 - D) sometimes increases
2. Melting ice has what entropy change?
 - A) $S < 0$
 - B) $S = 0$
 - C) $S > 0$
 - D) undefined
3. A perfectly ordered crystal at 0 K has
 - A) maximum entropy
 - B) minimum entropy
 - C) undefined entropy
 - D) negative entropy
4. Reversible process: entropy change?
 - A) $S < 0$
 - B) $S = 0$
 - C) $S > 0$
 - D) depends on system
5. Ice melts at room temperature. Is this spontaneous? Why?
6. Gas expands into vacuum. S positive or negative?
7. At 298 K, $H = 40 \text{ kJ/mol}$, $S = 150 \text{ J/(molK)}$. Is melting spontaneous?
8. Define: What is entropy?
9. Define: State the second law of thermodynamics.
10. Define: Why is ice melting irreversible?

Answer Key

1. C) always increases - Entropy increases for all spontaneous processes.
2. C) $S > 0$ - Solid liquid: disorder increases, $S > 0$.
3. B) minimum entropy - Third law: perfect crystal at 0 K has $S = 0$ (minimum).
4. B) $S = 0$ - Reversible: $S_{\text{universe}} = 0$ (equilibrium).
5. $S > 0$: solid ordered liquid disordered $S_{\text{universe}} > 0$ spontaneous (favourable entropy)
6. Gas molecules spread over larger volume $S = +ve$ (higher disorder)
7. $G = H - TS = 402980.150 - 4044.7 = 4.7 \text{ kJ}$ $G < 0$ spontaneous
8. A measure of disorder or randomness (symbol S) in a system.
9. Entropy of an isolated system always increases; $S_{\text{universe}} > 0$.
10. Entropy increases: solid (ordered) liquid (disordered).

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