

Name: _____ Date: _____

Feeling the Heat: Tiny Particles and Towering Laws for 8th Grade

Entropy calculation, thermal equilibrium analysis, and enthalpy synthesis. Students perform high-level evaluation of energy transformations in complex closed systems.

1. An engineer designs a prototype cooling system where 450 J of work is performed on a gas while it simultaneously releases 150 J of thermal energy to its surroundings. Based on the First Law of Thermodynamics, what is the change in the internal energy (ΔU) of the system?

- A. +300 J
- B. +600 J
- C. -300 J
- D. -600 J

2. In a closed system undergoing a spontaneous process, it is possible for the total entropy of the system and its surroundings to decrease if the temperature remains constant.

- A. True
- B. False

3. A scientist is testing a substance that exhibits 'superfluidity' near 0 Kelvin. This state of near-zero disorder is primarily governed by the _____ Law of Thermodynamics.

- A. First
- B. Second
- C. Third
- D. Zeroth

4. Which scenario best synthesizes the concept of thermal equilibrium across three different objects (A, B, and C)?

- A. If A is hotter than B, and B is hotter than C, heat will skip B to move directly to C.
- B. If A is in thermal equilibrium with B, and B is in equilibrium with C, then A and C are in equilibrium.
- C. Heat flows from C to A only if B acts as a vacuum insulator between them.
- D. Equilibrium occurs only when all three objects have the exact same mass and volume.

5. When designing a heat shield for a spacecraft, an engineer must account for _____, which is the only method of heat transfer that does not require a physical medium like air or metal.

- A. Conduction
- B. Convection
- C. Radiation
- D. Advection

6. A 'Heat Death' scenario of the universe suggests that eventually, all energy will be distributed uniformly, resulting in maximum entropy and no more work being possible.

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- A. True
- B. False

7. Analyze a Stirling engine: it converts thermal energy into mechanical work. Why can such an engine never be 100% efficient, even if friction were completely eliminated?

- A. Because energy is created during the combustion process.
- B. The First Law forbids the conversion of heat into work.
- C. Some energy is always exhausted as waste heat to satisfy the Second Law.
- D. The Third Law states work cannot be done above absolute zero.

8. In a weather system, the movement of large air masses due to density differences caused by temperature variations is a primary example of _____.

- A. Specific Heat
- B. Thermal Conduction
- C. Convection
- D. Latent Heat

9. A perfectly insulated thermos is an example of an open system because it allows for the exchange of matter but not energy.

- A. True
- B. False

10. You place a 50g block of copper at 80°C into a container of 50g of water at 20°C. Which statement accurately predicts the outcome based on thermodynamics?

- A. The final temperature will be exactly 50°C because the masses are equal.
- B. The water's temperature will rise more than the copper's drops due to water's density.
- C. The final temperature will be closer to 20°C because water has a higher specific heat capacity.
- D. The entropy of the copper block will increase as it cools down.