Name: _____ **Date:** _____

Answer Key: Frozen Volcanos and Boiling Glaciers: Advanced Heat Quiz for Grade 7

Challenge your class to troubleshoot thermal systems and predict energy behaviors using the foundational laws of thermodynamics as a rigorous bell-ringer.

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1. An oceanographer notices that deep seafloor vents release superheated water, yet the surrounding deep-sea water remains near freezing. Which thermodynamic principle primarily explains why the entire ocean doesn't reach a uniform temperature instantly?

Answer: A) Specific heat capacity of water slows energy distribution.

While heat flows from hot to cold (2nd Law), the high specific heat capacity of water means it requires a massive amount of energy to change the temperature of the surrounding bulk water, leading to localized gradients.

2. If an experimental Stirling engine takes in 800 J of thermal energy and produces 250 J of mechanical work, the remaining 550 J of energy must be _____ according to the First Law of Thermodynamics.

Answer: C) exhausted as waste heat

The First Law (Conservation of Energy) states that $\Delta U = Q - W$. If not all heat (Q) is converted to work (W), the remainder stays in the system's internal energy or is released as waste heat.

3. The Second Law of Thermodynamics implies that a perfectly efficient 'perpetual motion machine' is impossible because some energy will always dissipate as unusable heat, increasing total entropy.

Answer: A) True

The Second Law states that entropy in an isolated system always increases; therefore, no machine can be 100% efficient as some energy is always 'lost' to the environment as heat.

4. A scientist cools a sample of crystalline silicon to 0.001 Kelvin. According to the Third Law of Thermodynamics, what is happening to the silicon's molecular state?

Answer: B) The entropy is trending toward a specific minimum value.

The Third Law states that as temperature approaches absolute zero, the entropy of a system (disorder) approaches a constant minimum value.

5. A thermal imaging camera detects a 'cold spot' on a building's exterior wall. This likely indicates where _____ is failing to occur from the warm interior to the exterior surface.

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Answer: B) Conduction

Conduction is the transfer of heat through solid materials. A cold spot on the outside suggests insulation is effectively blocking the conduction of heat from the inside.

6. Why does a pressurized aerosol can feel cold to the touch after you spray it for several seconds?

Answer: C) Internal energy decreases as the gas does work to expand.

This demonstrates the First Law. As the gas expands rapidly, it does work on the surroundings. This work comes from its internal energy, causing the temperature to drop.

7. Heat can spontaneously flow from a cold object to a hot object as long as the total energy remains constant.

Answer: B) False

The Second Law explicitly forbids spontaneous heat flow from cold to hot; work must be added to the system (like in a heat pump) to move energy against the gradient.

8. In the design of a specialized 'vacuum flask' for space travel, engineers eliminate gas molecules between two walls to prevent heat loss via conduction and _____.

Answer: A) Convection

Convection requires a fluid (gas or liquid) to move. By creating a vacuum, there is no medium for convective currents to transport heat.

9. Compare two systems: An oven baking bread and a star forming in a nebula. Both follow the First Law of Thermodynamics because:

Answer: C) The sum of heat added and work done equals the change in internal energy.

The First Law ($\Delta U = Q - W$) is a universal law of conservation that applies to all physical systems, regardless of scale, from ovens to stars.

10. According to the Second Law, as a teenager tidies their messy room, the total entropy of the entire universe actually increases.

Answer: A) True

While 'order' is created in the room, the biological work done by the person releases heat and metabolic waste, which increases the total disorder (entropy) of the universe.

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