

Name: _____ Date: _____

Answer Key: 5th Grade Thermal Energy Lab Challenge

Particle motion, thermal equilibrium, and insulation effectiveness — using high-level synthesis to predict how energy migrates through diverse physical systems.

1. An engineer is designing a new winter coat using specialized synthetic fibers that trap tiny pockets of air. Why does trapping air help keep a person warm?

Answer: A) Air is a poor conductor that slows down the transfer of body heat to the outside.

Air is an excellent insulator (poor conductor). By trapping it in small pockets, the coat prevents heat from leaving the body via conduction and stops large convection currents.

2. When a hot ceramic mug is placed on a cold marble countertop, the molecules in the marble begin to vibrate faster. This specific process of heat transfer is called ____.

Answer: C) Conduction

Conduction occurs when thermal energy is transferred through direct contact between particles, such as the bottom of the mug touching the surface of the counter.

3. If two objects reach thermal equilibrium, it means that heat is no longer flowing between them because they have reached the same temperature.

Answer: A) True

Thermal equilibrium is the state where there is no net flow of thermal energy between two objects because their temperatures have equalized.

4. During a sea breeze, cool air over the ocean sinks and moves toward the land to replace rising warm air. Which thermodynamic principle best explains this circular movement?

Answer: B) Convection currents

Convection is the transfer of heat by the actual movement of the heated parts of a liquid or gas, creating cycles based on density differences.

5. In a closed system, such as a thermos, the total amount of energy remains constant even if it changes form. This demonstrates the ____.

Answer: C) First Law of Thermodynamics

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The First Law of Thermodynamics, also known as the Law of Conservation of Energy, states that energy cannot be created or destroyed, only transformed.

6. A chef uses a wooden spoon instead of a copper spoon to stir boiling sugar. What is the most likely scientific reason for this choice?

Answer: B) Wood is a thermal insulator with low conductivity.

Wood is a poor conductor of heat, meaning it does not transfer the thermal energy from the boiling liquid to the chef's hand as quickly as a metal like copper would.

7. The Law of Entropy suggests that in an isolated system, the degree of disorder or randomness tends to increase over time.

Answer: A) True

The Second Law of Thermodynamics states that entropy (disorder) in a system increases as energy moves from being concentrated to being spread out.

8. Dark-colored asphalt feels much hotter on a sunny day than light-colored concrete because the asphalt is more efficient at absorbing ____.

Answer: D) Thermal radiation

Radiation is the transfer of energy through electromagnetic waves. Dark surfaces absorb more of this radiant energy (sunlight) than light surfaces, which reflect it.

9. If you could view the molecules of a block of ice as it starts to melt into liquid water, what change would you observe in their behavior?

Answer: B) The molecules would gain kinetic energy and slide past each other.

Adding heat increases the kinetic energy of the water molecules, allowing them to break the rigid bonds of ice and move more freely as a liquid.

10. Why is it impossible for a machine to be 100% efficient, according to the Second Law of Thermodynamics?

Answer: A) Some energy is always lost as waste heat to the environment.

The Second Law implies that during any energy transfer, some energy is 'lost' as thermal energy (heat) that cannot be used to do work, increasing the entropy of the universe.