Name: _____ **Date:** _____

Answer Key: Searing Science: Sparking Seventh Grade Heat Systems

Examine thermal energy transfer through 10 engineering scenarios that go beyond simple definitions to analyze particle motion and energy conservation.

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1. A deep-sea diver notices that their thick neoprene suit keeps them warm by trapping a layer of water against their skin. Which heat transfer process is being minimized because the water is held still and cannot circulate?

Answer: B) Convection

Convection requires the movement of fluids (liquids or gases). By trapping the water and preventing it from circulating, the suit prevents heat from being carried away by moving water currents.

2. When a blacksmith hammers a piece of iron, the iron gets hot even though no fire is touching it. This is because _____ is being done on the system, increasing its internal energy.

Answer: C) Work

According to the First Law of Thermodynamics, internal energy can be increased by adding heat or by doing work on the system. The physical force of the hammer is mechanical work.

3. According to the Second Law of Thermodynamics, it is possible for a machine to convert 100% of the thermal energy it receives into useful mechanical work without any 'waste' heat.

Answer: B) False

The Second Law dictates that some energy is always lost as waste heat (increasing entropy), meaning no engine can ever be 100% efficient.

4. If you place a block of dry ice (-78°C) into a container of liquid nitrogen (-196°C), in which direction will the thermal energy move spontaneously?

Answer: B) From the dry ice to the liquid nitrogen

Heat always flows spontaneously from the object with the higher temperature to the object with the lower temperature. -78°C is warmer than -196°C.

5. Super-insulating materials used in spacecraft often feature shiny, reflective silver surfaces. These surfaces are specifically designed to block heat transfer by _____.

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Answer: C) Radiation

Thermal radiation travels in electromagnetic waves. Reflective surfaces bounce these waves back rather than absorbing them, preventing heat transfer in the vacuum of space.

6. Absolute Zero is the theoretical temperature at which all molecular motion stops and the entropy of a perfect crystal reaches its minimum value.

Answer: A) True

This is the definition of Absolute Zero (0 Kelvin), as described by the Third Law of Thermodynamics.

7. Imagine an isolated system where a hot copper rod is placed next to a cold copper rod. Over time, the energy spreads out evenly. This increase in the 'disorder' or 'spreading out' of energy is known as:

Answer: D) Entropy

Entropy is a measure of the dispersal of energy. The Second Law states that in an isolated system, entropy always increases as energy becomes less concentrated.

8. A laptop gets hot because the electrical components are transferring energy to the surroundings. This is an example of the First Law of Thermodynamics because the energy is not disappearing, but _____ into heat.

Answer: A) Transformed

The Law of Conservation of Energy (First Law) states that energy cannot be created or destroyed, only changed from one form (electrical) to another (thermal).

9. A thick ceramic mug is a better insulator than a thin copper cup because ceramic has lower thermal conductivity, slowing the rate of conduction.

Answer: A) True

Conduction occurs when particles collide. Metals like copper have high conductivity because their electrons move easily, whereas ceramic particles do not transfer kinetic energy as quickly.

10. Which of these is a real-world application of the Third Law of Thermodynamics in modern science?

Answer: B) Cryogenics and the study of superconductors

The Third Law relates to systems approaching absolute zero. Cryogenics is the branch of physics dealing with very low temperatures and how materials behave near 0 K.

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