

Name: _____ Date: _____

Answer Key: Nail Thermodynamics with 6th Grade Physics

Calculate thermal equilibrium and bridge energy conservation laws as you solve real-world challenges in heat transfer and entropy systems.

1. A deep-sea volcanic vent releases superheated water into the cold ocean floor. Which process primarily moves this thermal energy upward through the liquid water column?

Answer: C) Fluid convection currents

Convection occurs in fluids (liquids and gases) where heated particles become less dense and rise, creating a cycle that transfers energy.

2. Imagine you are holding a cold iron rod and a wooden stick. The iron rod feels colder because it has a higher _____, meaning it moves heat away from your hand faster.

Answer: B) Thermal conductivity

Thermal conductivity measures how easily heat flows through a material. Metals conduct heat away from the skin much faster than wood.

3. According to the Second Law of Thermodynamics, a closed system will naturally move toward a state of higher disorder, known as entropy.

Answer: A) True

The Second Law dictates that energy spreads out and systems become more disordered (increased entropy) unless energy is added to organize them.

4. A scientist places a 50°C copper block in a bucket of 20°C water. After one hour, both are 28°C. What state have the water and copper reached?

Answer: B) Thermal equilibrium

Thermal equilibrium is reached when two objects in contact stop exchanging net heat because they have reached the same temperature.

5. Energy can be completely destroyed if a machine is 100% efficient.

Answer: B) False

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The First Law of Thermodynamics (Law of Conservation of Energy) states that energy cannot be created or destroyed, only transformed.

6. In a steam engine, high-pressure steam pushes a piston. The work done by the piston and the heat lost to the surroundings must equal the _____ energy originally in the steam.

Answer: B) Total internal

Internal energy is the sum of all microscopic energy in a system; thermodynamics tracks how this energy shifts between heat and work.

7. Which of these scenarios best demonstrates the Third Law of Thermodynamics regarding the behavior of particles?

Answer: B) Particles reaching minimum motion near 0 Kelvin

The Third Law states that as a system approaches absolute zero (0 K), the entropy (disorder/motion) approaches a constant minimum.

8. A vacuum flask (Thermos) prevents heat loss by having a space with no air between two glass walls. This specifically blocks heat transfer via conduction and _____.

Answer: A) Convection

Convection requires a fluid (liquid or gas) to move energy. A vacuum contains no matter, so convection currents cannot form.

9. In space, a satellite stays warm because it absorbs thermal energy from the Sun through radiation, even though there is no air.

Answer: A) True

Radiation is the only form of heat transfer that can travel through a vacuum, as it moves via electromagnetic waves.

10. If you add 200 Joules of heat to a system and the system performs 150 Joules of work on its surroundings, what is the net change in internal energy?

Answer: C) 50 Joules increased

Using the First Law ($\Delta U = Q - W$), 200 J (added heat) minus 150 J (work done) leaves a net increase of 50 J in internal energy.