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Answer Key: Will Time Slow Down? Launch Into 7th Grade Modern Physics

Analyze relativistic effects and quantum behavior to strengthen conceptual models of how the universe functions at high speeds and tiny scales.

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1. If a cosmic explorer travels at 90% the speed of light to a distant star system, what will they observe regarding their own clock compared to a clock left on Earth?

Answer: B) Their clock ticks slower relative to the Earth clock.

According to Special Relativity, time dilation occurs at high velocities; time passes more slowly for an object in motion relative to a stationary observer.

2. Modern physics suggests that light can behave as both a continuous wave and as discrete packets of energy called _____.

Answer: C) Photons

Photons are the fundamental particles of light, demonstrating the 'particle' side of wave-particle duality in quantum mechanics.

3. True or False: General Relativity describes gravity as a force that pulls objects, rather than a curvature of the fabric of space and time.

Answer: B) False

General Relativity redefined gravity not as a direct pull, but as the geometric warping of spacetime caused by mass and energy.

4. Why must engineers account for relativity when designing and maintaining the Global Positioning System (GPS) satellites?

Answer: C) To correct for time differences caused by speed and gravity.

Satellite clocks move faster due to weaker gravity (general relativity) and slower due to high orbital speeds (special relativity); these must be balanced for accurate GPS location.

5. In the subatomic world, the _____ Principle states that we cannot know both the exact position and the exact momentum of a particle at the same time.

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Answer: C) Heisenberg

Werner Heisenberg's Uncertainty Principle is a fundamental concept in quantum mechanics, limiting how precisely we can measure pairs of physical properties.

6. True or False: According to the principle of mass-energy equivalence, even a small amount of mass can be converted into a massive amount of energy.

Answer: A) True

The equation $E=mc^2$ shows that because the speed of light (c) is such a large number, even a tiny mass converts to enormous energy.

7. Which unusual quantum phenomenon allows a particle to pass through a solid energy barrier that it classically shouldn't be able to cross?

Answer: A) Quantum Tunneling

Quantum tunneling is a result of the wave-like nature of particles, allowing them to 'leak' through barriers that would stop a macroscopic object.

8. When a very massive star collapses into a point of nearly infinite density, it creates a _____, where gravity is so strong even light cannot escape.

Answer: C) Black Hole

Black holes are regions of spacetime where gravity is so intense due to high mass concentration that the escape velocity exceeds the speed of light.

9. True or False: Particles at the quantum level have definite, fixed paths just like a marble rolling across a floor.

Answer: B) False

Unlike classical objects, quantum particles are described by probability clouds; we can only predict the likelihood of where they might be.

10. What happens to the length of an object, such as a high-speed train, as it approaches the speed of light from the perspective of a stationary observer?

Answer: C) It appears to shorten in the direction of motion.

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This is known as length contraction; objects moving at relativistic speeds appear shorter to a stationary observer along the axis of travel.