Name: _____ **Date:** _____

Answer Key: Solve the Invisible Pulse: Your 9th Grade Wave Mechanics Forensic

Analyze acoustic impedance in medical imaging and calculate photonic energy shifts in astronomical spectrographs to bridge the gap between abstract physics and real-world application.

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1. In medical ultrasonography, why is a specialized gel applied to the skin before the transducer emits high-frequency sound waves?

Answer: B) To minimize reflection caused by the change in acoustic impedance between air and skin

Acoustic impedance describes how much resistance a medium offers to sound. Without gel, the air-to-skin boundary reflects most of the energy, preventing it from entering the body.

2. A photon of ultraviolet light carries more energy than a photon of infrared light because its frequency is higher.

Answer: A) True

According to the Planck-Einstein relation (E=hf), energy is directly proportional to frequency. Ultraviolet light has a higher frequency and shorter wavelength than infrared.

3. When a light wave moves from a vacuum into a denser medium like diamond, its speed decreases and its _____ changes, while its frequency remains constant.

Answer: C) Wavelength

The wave speed formula is $v = f\lambda$. Since frequency is determined by the source and remains constant, a decrease in speed must result in a proportional decrease in wavelength.

4. An astronomer notices a 'redshift' in the light from a distant galaxy. This phenomenon is an application of which wave principle?

Answer: C) The Doppler Effect

The Doppler Effect applies to all waves; as a light source moves away from the observer, the observed wavelength increases (shifts toward the red end of the spectrum).

5. Sound waves can travel through the vacuum of outer space if their amplitude is high enough.

Answer: B) False

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Sound is a mechanical wave that requires a physical medium (atoms/molecules) to transmit energy via collisions. Energy cannot transfer this way in a vacuum.

6. In an auditorium, why are soft panels often placed on the back walls to prevent a 'muddy' sound?

Answer: B) To reduce reverberation caused by multiple reflections

High reverberation occurs when sound reflects off hard surfaces multiple times, causing overlapping sounds that reduce clarity. Soft materials absorb the energy instead of reflecting it.

7. The property of a light wave that determines its color is its _____, while the property that determines its brightness is its amplitude.

Answer: A) Frequency

Frequency (and wavelength) determines where a wave falls on the electromagnetic spectrum, which our eyes perceive as color in the visible range.

8. In a fiber optic cable used for high-speed internet, light stays inside the glass core due to which specific phenomenon?

Answer: C) Total Internal Reflection

Total internal reflection occurs when light strikes a boundary at an angle greater than the critical angle, causing 100% of the light to reflect back into the denser medium.

9. Polarization is a property that can be observed in sound waves as well as light waves.

Answer: B) False

Polarization only occurs in transverse waves where the oscillation is perpendicular to the direction of travel. Sound is longitudinal (parallel), so it cannot be polarized.

10. Noise-canceling headphones utilize the principle of _____ interference to create a wave that is 180 degrees out of phase with ambient noise.

Answer: B) Destructive

Destructive interference occurs when the crest of one wave meets the trough of another, effectively summing the amplitudes to zero and canceling the signal.