

Name: _____ Date: _____

Answer Key: Wave Mechanics: Coherent Sources vs Dissipative Media Quiz for College Physics

Evaluate proficiency in wave interference and acoustic impedance through complex problem-solving and rigorous quantitative analysis of oscillatory systems.

1. In the context of the Thin Film Interference occurring in a soap bubble, why does the center of the film appear black just before it pops?

Answer: B) A 180-degree phase shift at the first interface and negligible path length lead to destructive interference.

As the film's thickness becomes much smaller than the wavelength of light, the path difference becomes negligible, but the phase shift upon reflection at the first boundary results in destructive interference.

2. In a dispersive medium, the phase velocity of a wave is always equal to its group velocity regardless of the frequency.

Answer: B) False

In dispersive media, the refractive index depends on the frequency, causing the phase velocity and group velocity to differ; they are only equal in non-dispersive media like a vacuum.

3. The phenomenon where the frequency of a wave detected by an observer changes because the source and observer are moving relative to each other is known as the _____.

Answer: B) Doppler Effect

The Doppler Effect describes the shift in frequency or wavelength of a wave in relation to an observer who is moving relative to the wave source.

4. Consider an acoustic wave traveling from water into steel. Which property of the wave remains invariant during this transition?

Answer: C) Frequency

Frequency is determined by the source of the vibration and does not change when a wave moves from one medium to another, whereas velocity and wavelength adjust based on the medium's properties.

5. In quantum mechanics, the probability density of finding a particle is proportional to the square of the _____ of its wave function.

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Answer: C) Amplitude

Based on the Born interpretation, the square of the absolute amplitude of the wave function (ψ) provides the probability density.

6. Transverse waves can be polarized, whereas longitudinal waves cannot.

Answer: A) True

Polarization requires the oscillation to be perpendicular to the direction of propagation, which is only possible for transverse waves.

7. What occurs when the driving frequency of an external force matches the natural frequency of a system, such as in an LCR circuit or a bridge?

Answer: C) Resonance

Resonance is the condition where a system oscillates with maximum amplitude due to the input frequency matching the system's inherent natural frequency.

8. The Rayleigh Criterion defines the minimum angular spread required to resolve two light sources, a limit primarily dictated by the phenomenon of _____.

Answer: C) Diffraction

Diffraction at the aperture of an optical system spreads light from a point source into an Airy disk, limiting the ability to distinguish two close objects.

9. In a vacuum, high-frequency gamma rays travel significantly faster than low-frequency radio waves.

Answer: B) False

All electromagnetic waves travel at the speed of light (c) in a vacuum, regardless of their frequency or wavelength.

10. Which mathematical principle allows us to decompose a complex, non-sinusoidal periodic wave into a sum of simple sine and cosine waves?

Answer: B) Fourier Analysis

Fourier Analysis (or Fourier Series) is the fundamental method used in physics and engineering to break down complex waveforms into their constituent harmonic frequencies.