Name: _____ **Date:** _____

Answer Key: Wave Interference and Wavefront Analysis: 11th Grade Physics Quiz

Junior physics students calculate beat frequencies, analyze thin-film interference, and determine refractive indices during this formal summative assessment.

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1. An observer moving at a high velocity toward a stationary monochromatic light source will perceive a change in the light's color toward the blue end of the spectrum. Which physical principle explains this shift?

Answer: C) Relativistic Doppler effect causing frequency compression

As the observer moves toward the source, they encounter wavefronts more frequently, resulting in a higher perceived frequency (shorter wavelength), known as a blue shift.

2. A piano tuner hears 4 beats per second when striking a 440 Hz tuning fork and a slightly out-of-tune piano string simultaneously. If the string is too sharp, its frequency is _____ Hz.

Answer: B) 444

The beat frequency is the absolute difference between two frequencies. Since the string is 'sharp' (higher in pitch), 440 + 4 = 444 Hz.

3. According to Huygens' Principle, every point on a wavefront can be considered a secondary source of spherical wavelets.

Answer: A) True

Huygens' Principle is a fundamental pedagogical model used to explain how waves propagate and why they undergo diffraction.

4. A thin film of oil (n = 1.45) floats on water (n = 1.33). When viewed from above, certain colors are missing from the reflected light. This phenomenon is primarily caused by:

Answer: A) Destructive interference based on path length difference

Thin-film interference occurs as light reflects off the top and bottom boundaries of the film; if the path difference is a half-integer of the wavelength, destructive interference occurs.

5. In a Young's Double Slit experiment, if the distance between the two slits is decreased while keeping the light source the same, the spacing between the fringes on the screen will _____.

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Answer: B) Increase

The formula for fringe spacing ($y = \lambda L/d$) shows an inverse relationship between slit separation (d) and fringe distance (y).

6. Diffraction is much more noticeable in sound waves than in light waves in everyday life because sound waves have much larger wavelengths.

Answer: A) True

Waves diffract most effectively when they encounter obstacles of a similar size to their wavelength. Audible sound wavelengths (cm to meters) match daily objects better than nanometer-scale light waves.

7. When a light ray enters a diamond (n=2.42) from air (n=1.00) at an angle, which of the following remains constant?

Answer: C) Frequency

Frequency is determined by the source. When moving between media, velocity and wavelength change proportionally, but frequency remains constant.

8. Consider a standing wave in an open-ended organ pipe. The locations where the air molecules experience the maximum displacement are called _____.

Answer: B) Antinodes

Antinodes are the points of maximum amplitude in a standing wave, whereas nodes are points of zero displacement.

9. Light waves must travel through a medium like the luminiferous ether to propagate through the vacuum of space.

Answer: B) False

The Michelson-Morley experiment disproved the existence of the ether; light, as an electromagnetic wave, travels via self-propagating electric and magnetic fields.

10. A technician uses an oscilloscope to analyze a sound wave and notices the period of the wave has halved. What has happened to the pitch?

Answer: C) It has increased by an octave

Frequency is the reciprocal of the period ($f=1/T$). Halving the period doubles the frequency, which corresponds to an increase of one octave in musical pitch.

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