Name: _____ **Date:** _____

Photon Frontier: A 10th Grade Optics Odyssey

Synthesize Maxwell's predictions with geometric ray tracing to analyze how light behaves at complex material interfaces and non-spherical boundaries.

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1. A ray of light transitions from zircon (n = 1.92) into liquid carbon disulfide (n = 1.63). If the angle of incidence is increased beyond the critical angle, what phenomenon occurs, and why?

A. Total internal reflection; light cannot enter a less dense medium at high angles.
B. Infinite refraction; the light speeds up and exits parallel to the boundary.
C. Chromatic aberration; the light splits into its constituent spectral colors.
D. Diffraction; the light waves bend around the boundary molecules.

2. In a sophisticated optical system, the mathematical sign convention for a copy-machine lens dictates that a _____ image is formed on the opposite side of the lens from the object.

A. Virtual
B. Real
C. Upright
D. Diverging

3. An observer using a parabolic mirror will experience zero spherical aberration compared to an observer using a standard spherical mirror.

A. True
B. False

4. Fermat's Principle of Least Time states that light traveling between two points takes the path that can be traversed in the least time; this explains why light _____ when entering a prism.

A. Accelerates
B. Polarizes
C. Refracts
D. Reflects

5. Imagine a fiber optic cable with a core of silica and a cladding of a different polymer. For the cable to function via total internal reflection, which statement must be true regarding the indices of refraction?

A. n_core must be equal to n_cladding
B. n_core must be less than n_cladding
C. n_core must be greater than n_cladding
D. The indices are irrelevant if the cable is opaque

6. A virtual image produced by a convex security mirror can be projected onto a screen if the screen is placed at the focal point.

A. True

B. False

7. A student places an object 15 cm in front of a thin converging lens with a focal length of 10 cm. Based on the lens-maker formula principles, what are the characteristics of the resulting image?

A. Virtual, upright, and diminished
B. Real, inverted, and magnified
C. Real, inverted, and diminished
D. Virtual, upright, and magnified

8. When light passes through a microscopic aperture, it deviates from a straight line and spreads out; this wave-based optical behavior is known as _____.

A. Dispersion
B. Specular Reflection
C. Diffraction
D. Birefringence

9. According to the Law of Reflection, if a surface is rough (diffuse reflection), the angle of incidence still equals the angle of reflection for every individual ray.

A. True
B. False

10. Huygens' Principle is often used to derive the laws of optics. This principle conceptualizes every point on a wavefront as a source of:

A. Spherical secondary wavelets
B. Linear particles (corpuscles)
C. Static electric charges
D. Unpolarized magnetic fields