

Advanced Principles of Optics

Optics · Answer Key · 10 Questions

1. In the context of the Fresnel-Arago laws, what condition must be met for two independent beams of light to exhibit interference?

- A) They must be polarized in orthogonal planes
- B) They must be derived from the same source and maintain a constant phase relationship**
- C) They must have different frequencies to prevent stationary wave patterns
- D) They must be strictly incoherent to satisfy the superposition principle

2. What physical phenomenon describes the variation of the refractive index of a material with respect to the frequency of light?

- A) Birefringence
- B) Diffraction
- C) Dispersion**
- D) Polarization

3. Which fundamental limit defines the minimum resolvable detail of an optical system due to the wave nature of light?

- A) Rayleigh criterion**
- B) Brewster's angle
- C) Snell's law
- D) Planck's constant

4. In a uniaxial crystal, what is the specific name for the ray that does not obey the standard laws of refraction and exhibits a velocity dependent on its direction of propagation?

- A) Ordinary ray
- B) Extraordinary ray**
- C) Evanescent ray
- D) Paraxial ray

5. What is the effect called where the plane of polarization of linearly polarized light is rotated as it passes through a material in the presence of a magnetic field?

- A) Faraday effect**
- B) Zeeman effect
- C) Stark effect
- D) Pockels effect

6. According to the Huygens-Fresnel principle, what is the physical origin of the secondary wavelets that contribute to the formation of a wavefront?

- A) Quantized photons
- B) The oscillations of induced dipoles within the medium**
- C) Reflections from the optical aperture
- D) Changes in the gravitational potential

7. Which condition must be satisfied for total internal reflection to occur at an interface between two media with refractive indices n_1 and n_2 (where $n_1 > n_2$)?

- A) The angle of incidence is less than the critical angle
- B) The incident light is unpolarized
- C) The angle of incidence exceeds the critical angle defined by $\arcsin(n_2/n_1)$**
- D) The medium must be a vacuum

8. What does the Jones calculus represent in the study of polarized light?

- A) The energy distribution of a blackbody
- B) The transformation of light intensity through scattering
- C) The state of polarization using complex vectors and matrices**
- D) The quantum entanglement of twin photons

9. In the Fraunhofer diffraction pattern of a circular aperture, what is the mathematical function that describes the intensity distribution?

- A) Gaussian function
- B) Airy disk (Bessel function of the first kind)**
- C) Lorentzian function
- D) Exponential decay

10. What is the physical significance of the Goos-Hänchen shift in total internal reflection?

- A) A lateral displacement of the reflected beam along the interface**
- B) The complete loss of light intensity at the critical angle
- C) The conversion of light into thermal energy
- D) The shift in frequency of the reflected photons