**Concepts and Principles**

- **Diffraction** is the deviation of light from a straight-line path when the light passes through an aperture or around an obstacle. Diffraction is due to the wave nature of light.

- **Rayleigh’s criterion**, which is a limiting condition of resolution, states that two images formed by an aperture are just distinguishable if the central maximum of the diffraction pattern for one image falls on the first minimum of the diffraction pattern for the other image. The limiting angle of resolution for a slit of width \( a \) is \( \theta_{\text{min}} = \frac{\lambda}{a} \), and the limiting angle of resolution for a circular aperture of diameter \( D \) is given by \( \theta_{\text{min}} = \frac{1.22\lambda}{D} \).

- **A diffraction grating** consists of a large number of equally spaced, identical slits. The condition for intensity maxima in the interference pattern of a diffraction grating for normal incidence is
  \[
  d \sin \theta_{\text{bright}} = m\lambda \quad m = 0, \pm 1, \pm 2, \pm 3, \ldots
  \]
  where \( d \) is the spacing between adjacent slits and \( m \) is the order number of the intensity maximum.

- When polarized light of intensity \( I_{\text{max}} \) is emitted by a polarizer and then is incident on an analyzer, the light transmitted through the analyzer has an intensity equal to \( I_{\text{max}} \cos^2 \theta \), where \( \theta \) is the angle between the polarizer and analyzer transmission axes.

- The **Fraunhofer diffraction pattern** produced by a single slit of width \( a \) on a distant screen consists of a central bright fringe and alternating bright and dark fringes of much lower intensities. The angles \( \theta_{\text{dark}} \) at which the diffraction pattern has zero intensity, corresponding to destructive interference, are given by
  \[
  \sin \theta_{\text{dark}} = \frac{m\lambda}{a} \quad m = \pm 1, \pm 2, \pm 3, \ldots
  \]

- **In general, reflected light is partially polarized.** Reflected light, however, is completely polarized when the angle of incidence is such that the angle between the reflected and refracted beams is 90°. This angle of incidence, called the **polarizing angle** \( \theta_p \), satisfies **Brewster’s law**:
  \[
  \tan \theta_p = \frac{n_2}{n_1}
  \]
  where \( n_1 \) is the index of refraction of the medium in which the light initially travels and \( n_2 \) is the index of refraction of the reflecting medium.

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Chapter 38
Diffraction and Polarization