Nature and Properties of Light

Module 1-1

of

Course 1, *Fundamentals of Light and Lasers*

OP-TEC

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This text was developed by the National Center for Optics and Photonics Education (OP-TEC), University of Central Florida, under NSF ATE grant 1303732. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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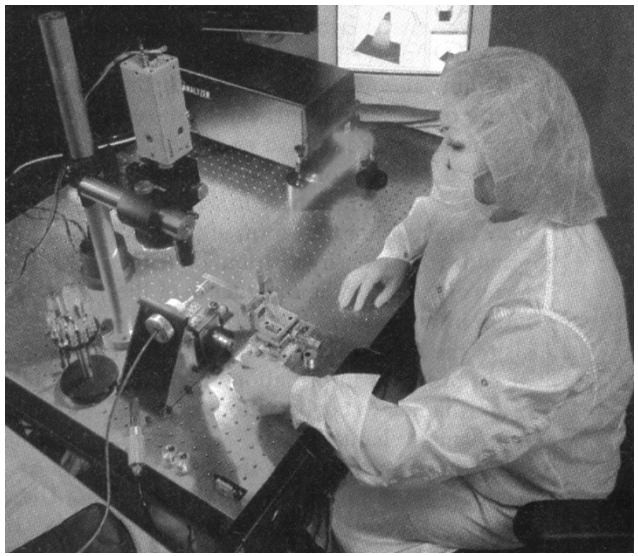


Photonics technician assembling components

Source: *Laser Focus World*, May 1999, 291. Reprinted by permission.

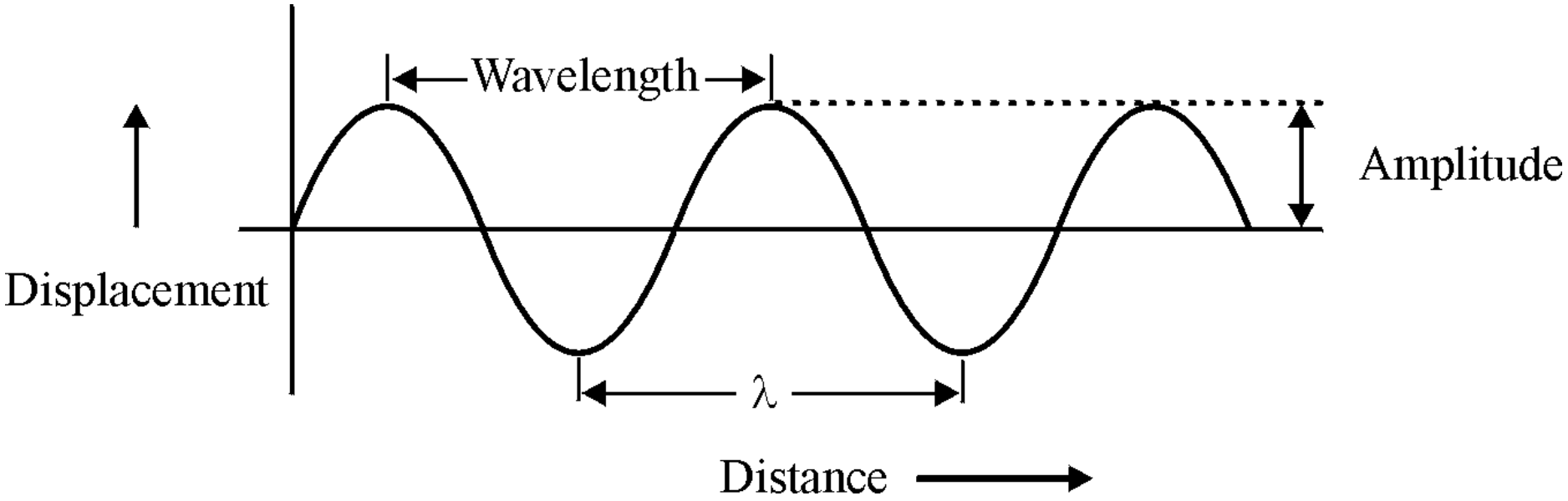


Figure 1-1 *Displacement versus distance along a wave at an instant of time*

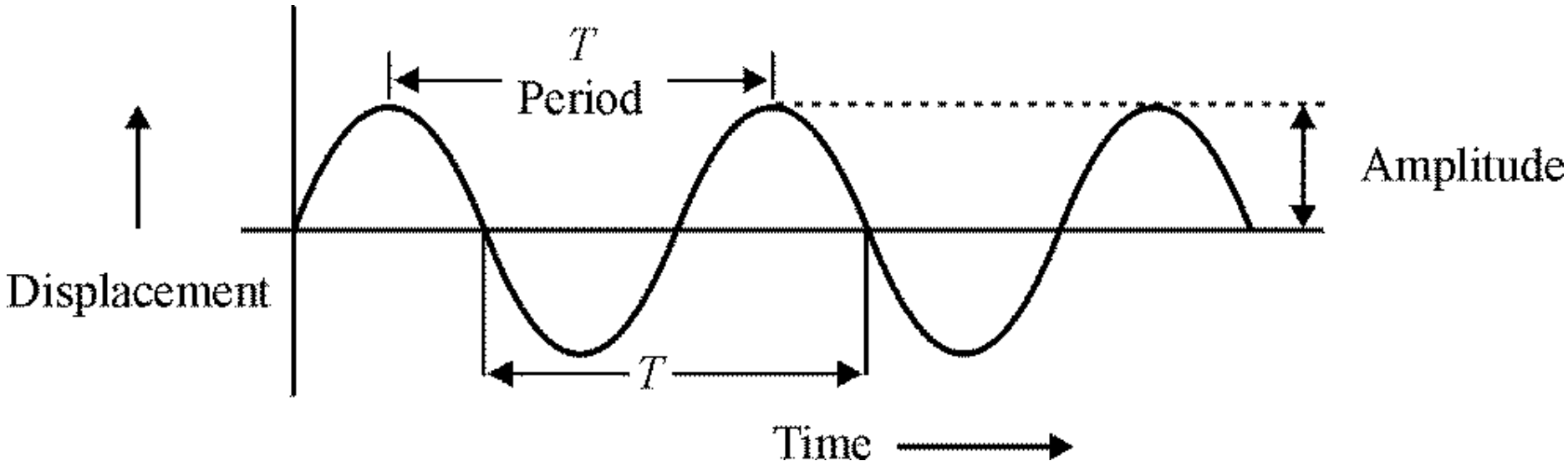


Figure 1-2 *Displacement versus time at one position along the wave*

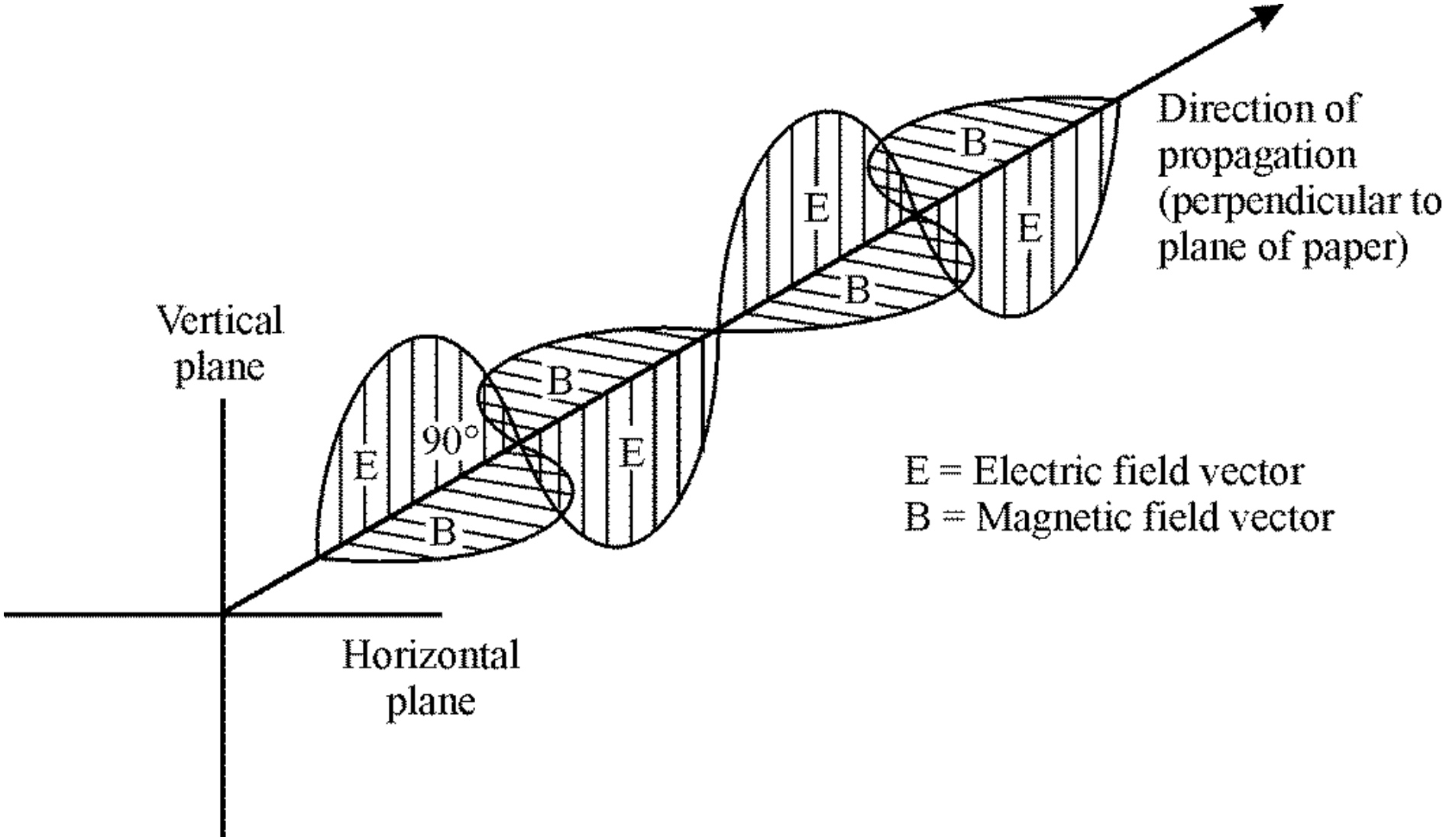


Figure 1-3 *Three-dimensional model of an electromagnetic wave*

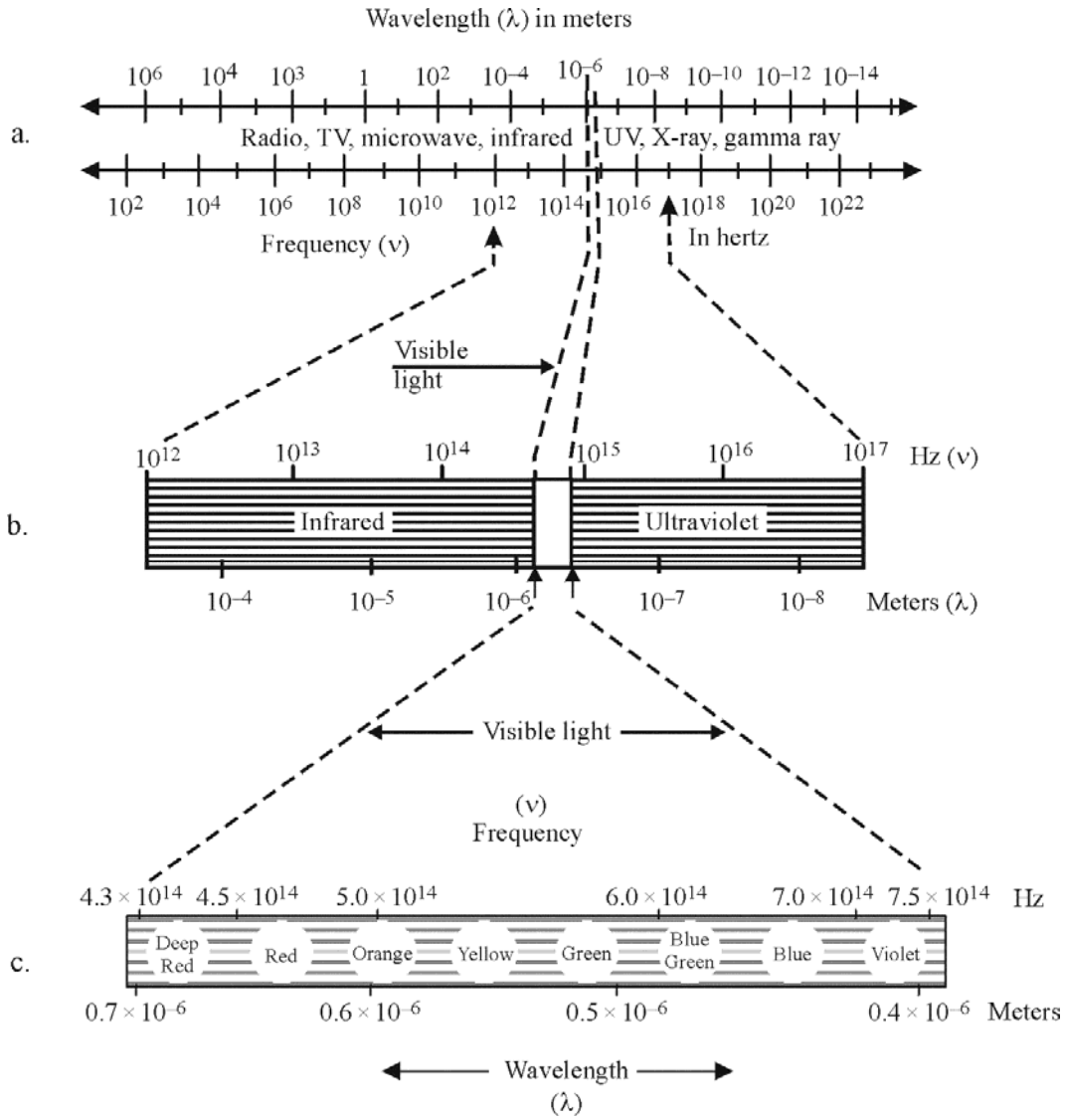


Figure 1-4 *The electromagnetic spectrum and its principal regions*

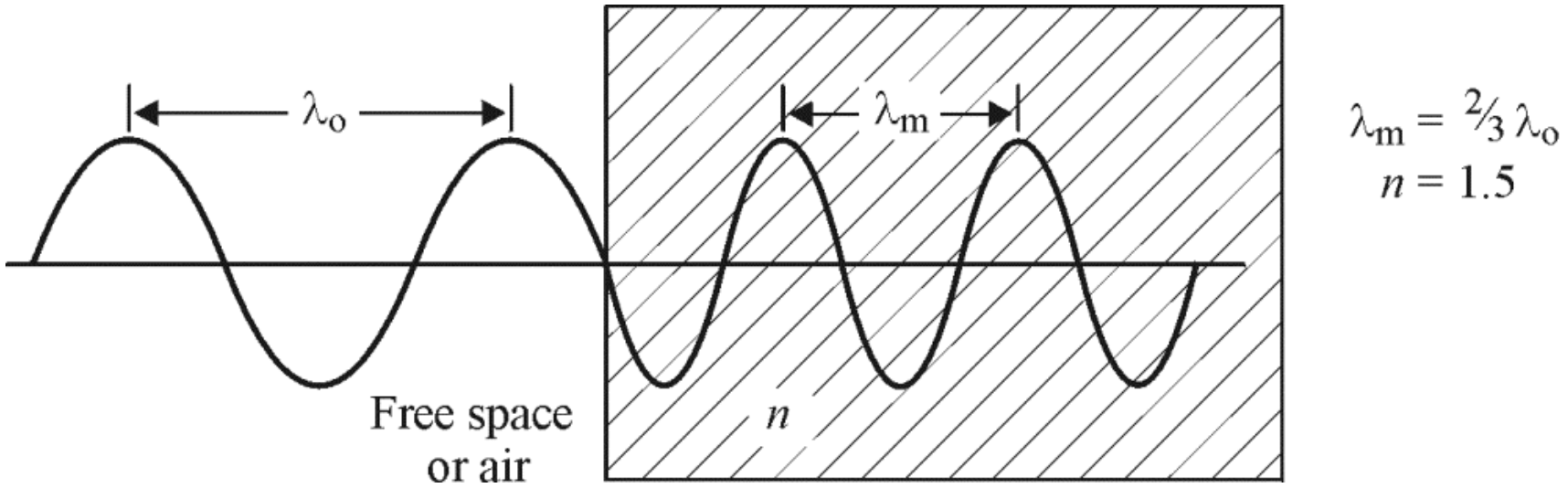


Figure 1-5 *Wavelength reduction of light passing through a material of refractive index n*

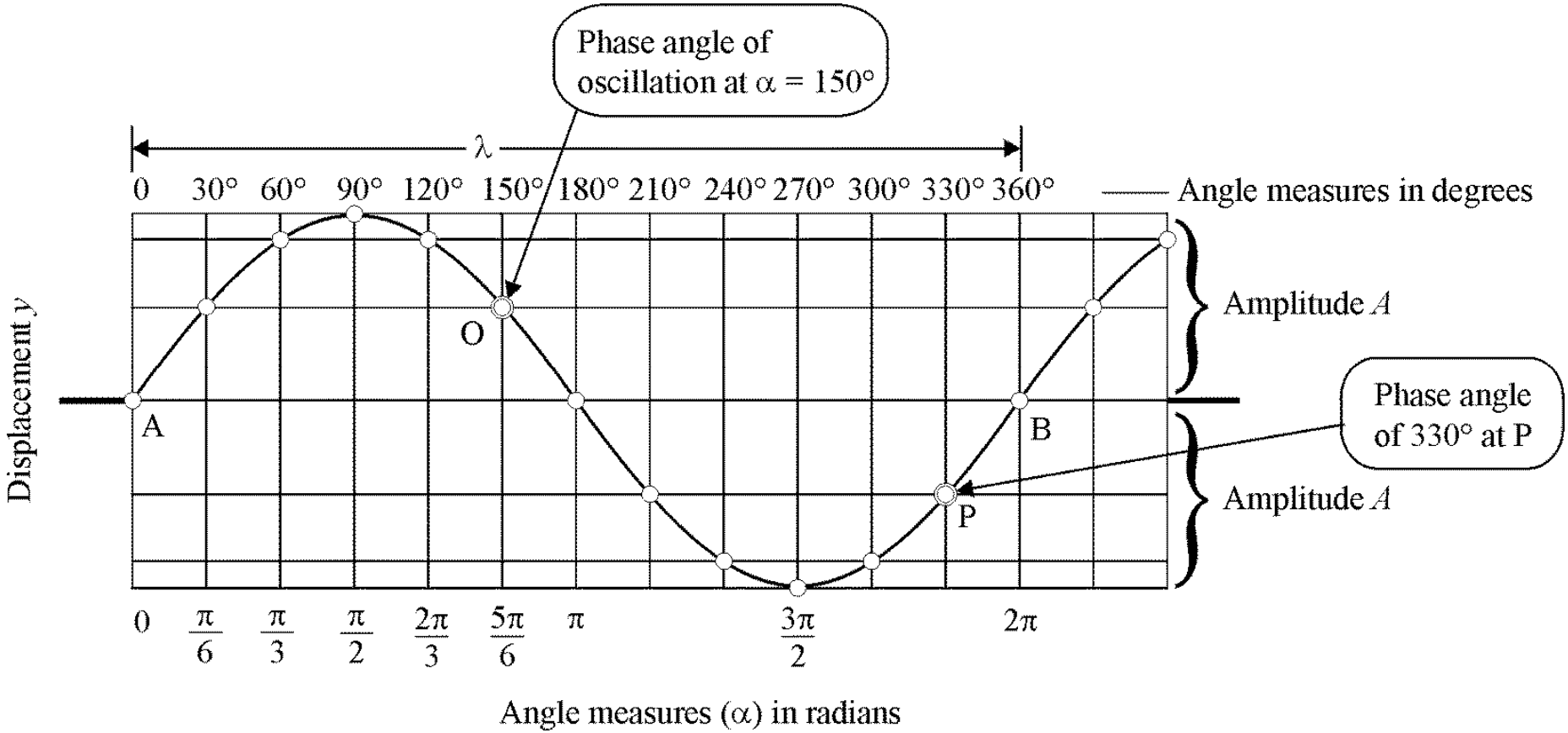


Figure 1-6 *Sine wave representation*

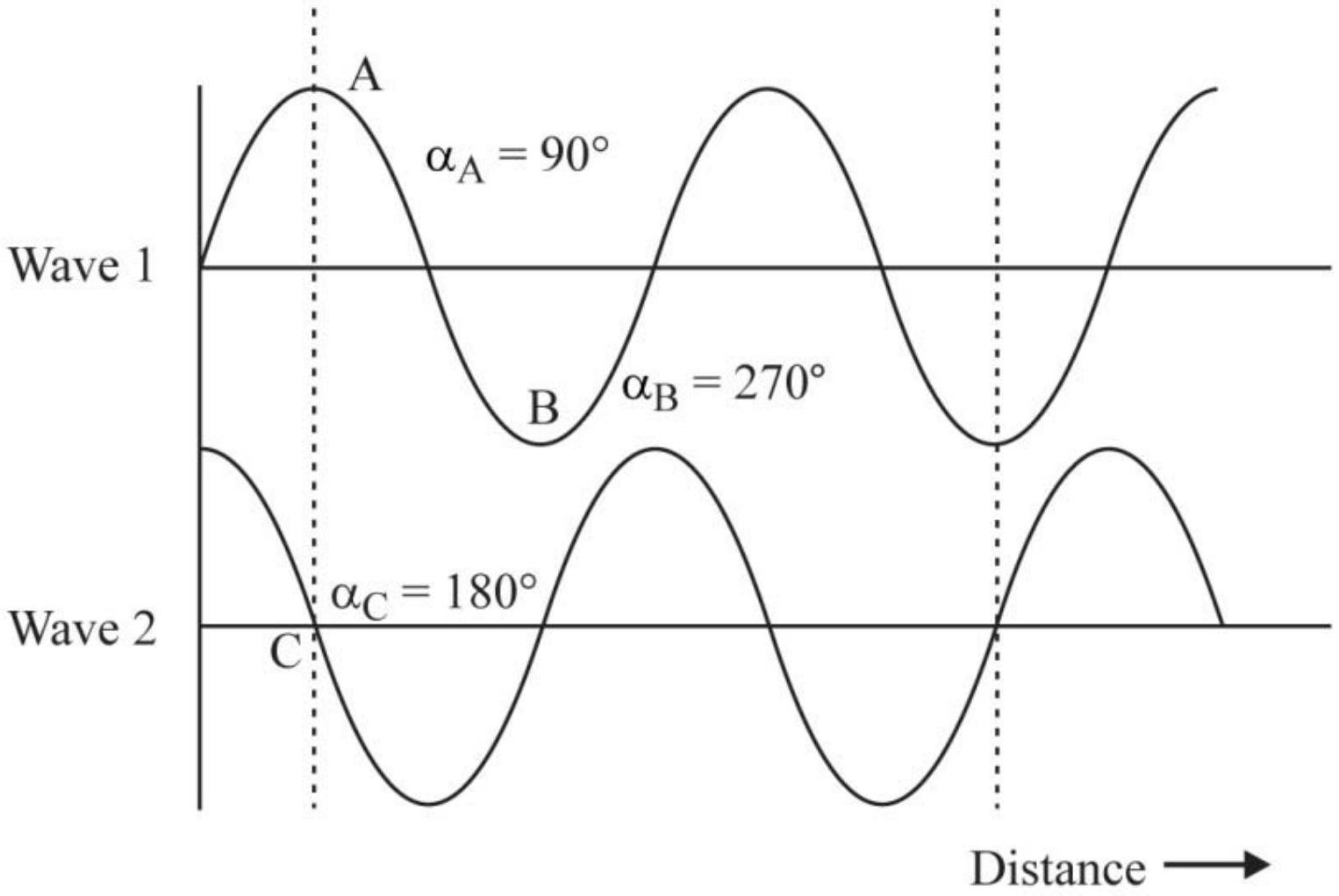
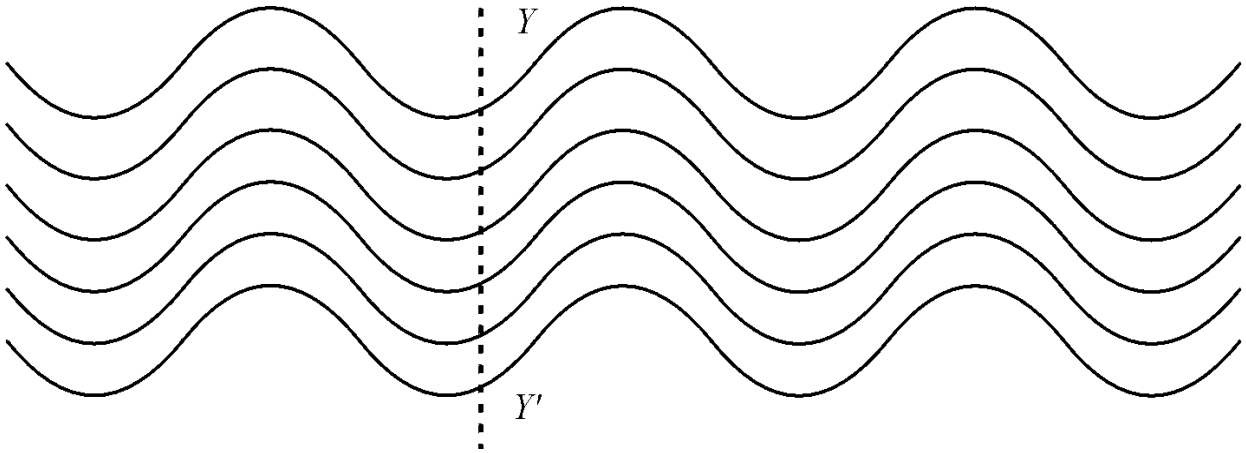


Figure 1-7 *Phase difference between several points on two sine waves*

(a) Coherent light. Each of the five waves has the ***same*** *phase angle along the vertical line YY', and all have the* ***same*** *wavelength.*



(b) Incoherent light. Each of the four curves has a ***different*** *wavelength and their phases are* ***different*** *along any vertical line YY'.*

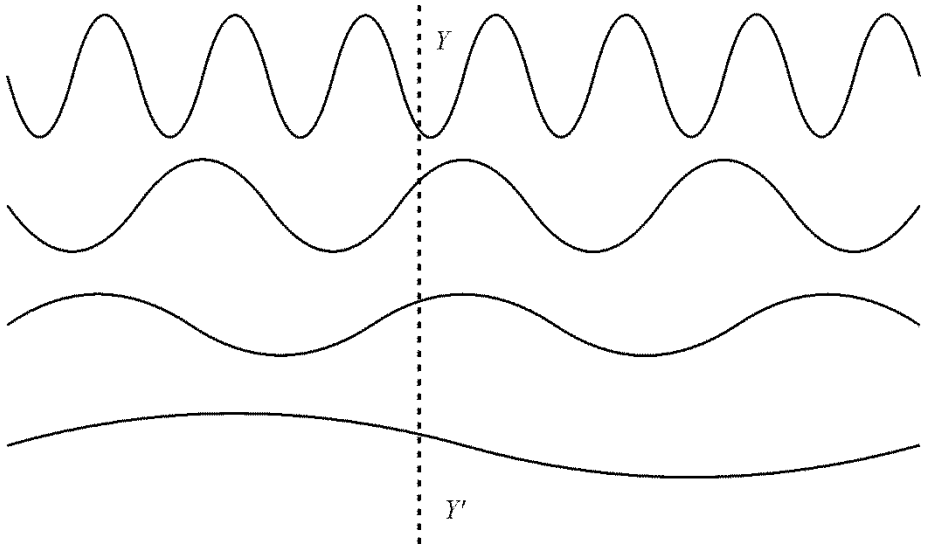


Figure 1-8 *Comparing coherent and incoherent light*

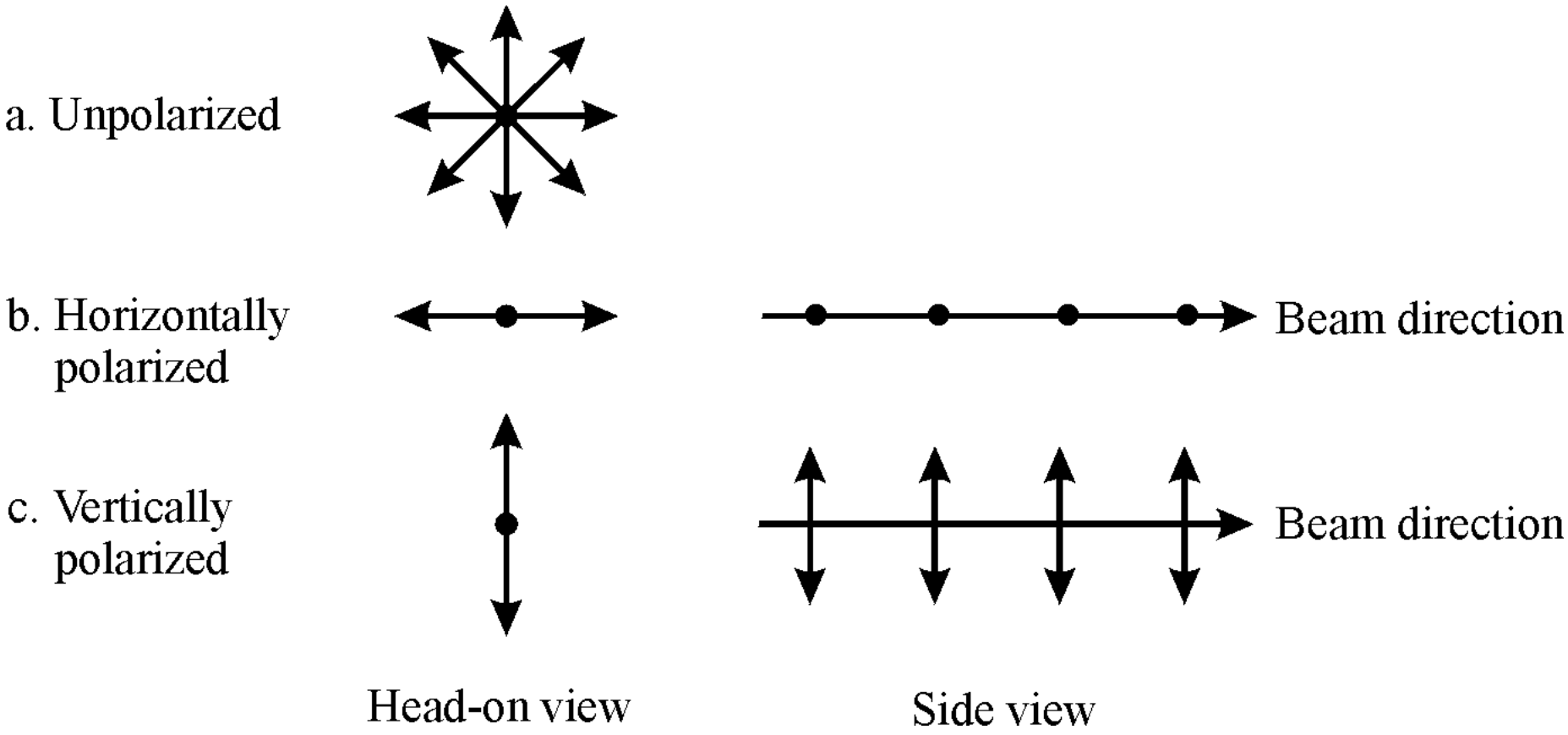


Figure 1-9 *Representation of polarized light*

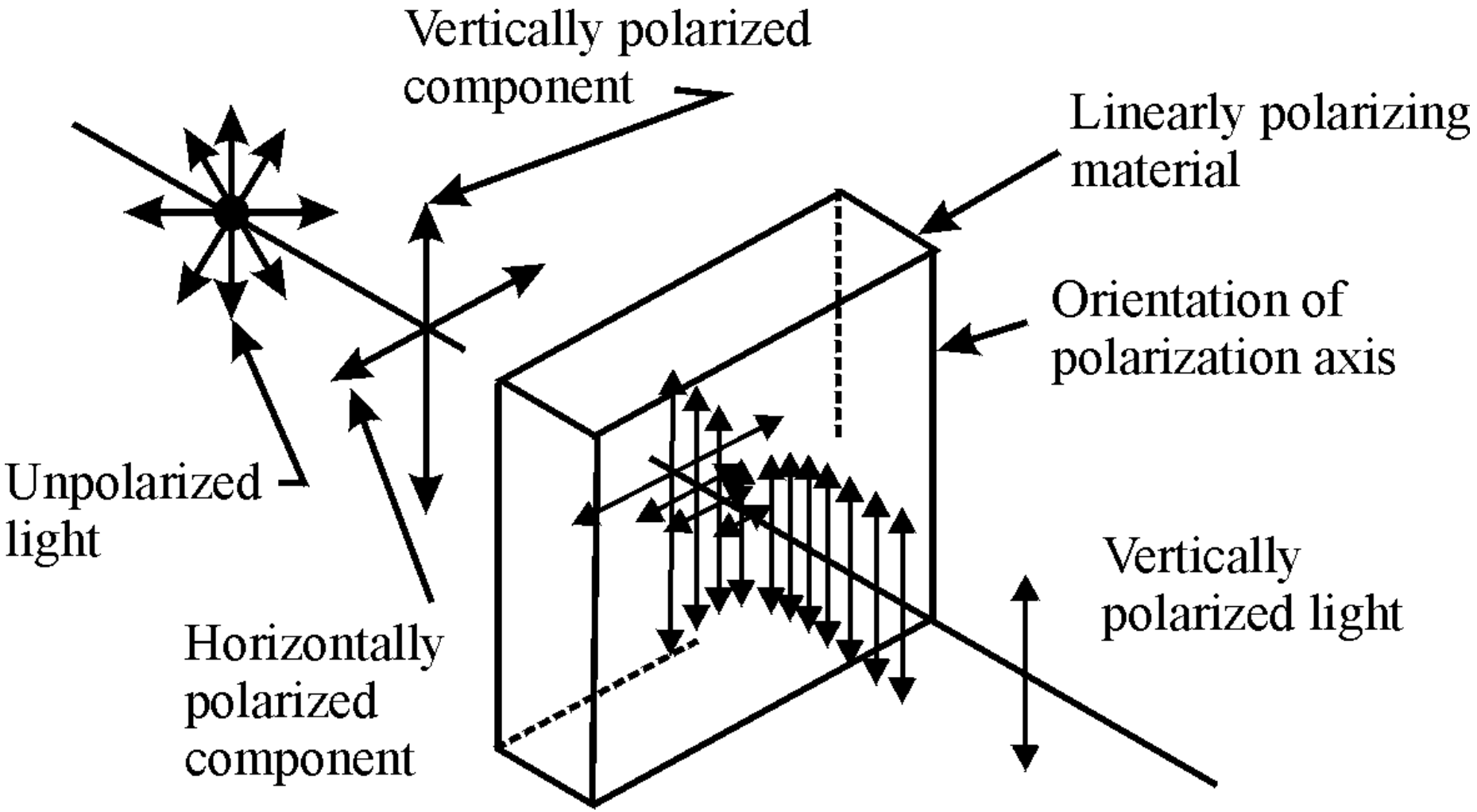


Figure 1-10 *Polarization by absorption*

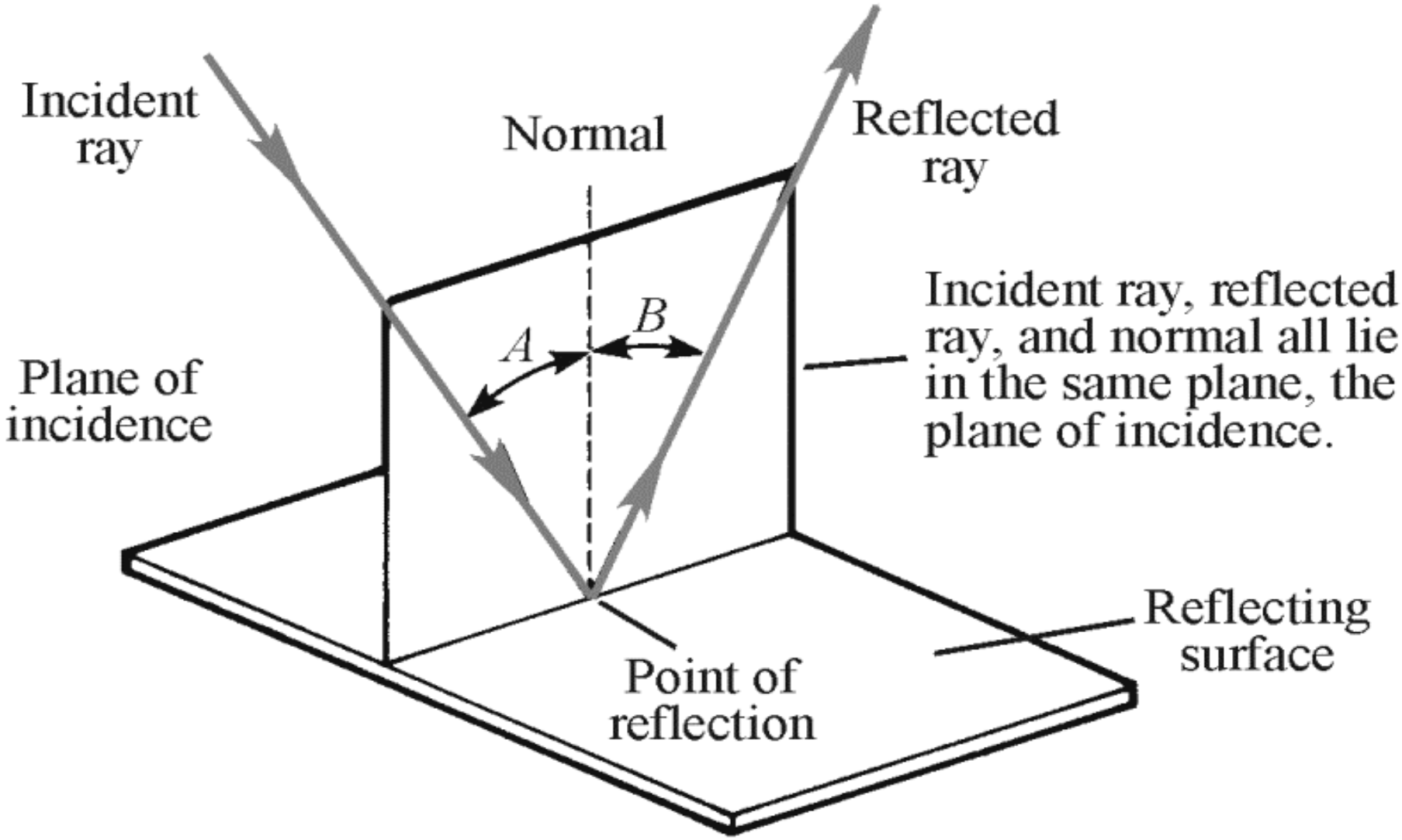
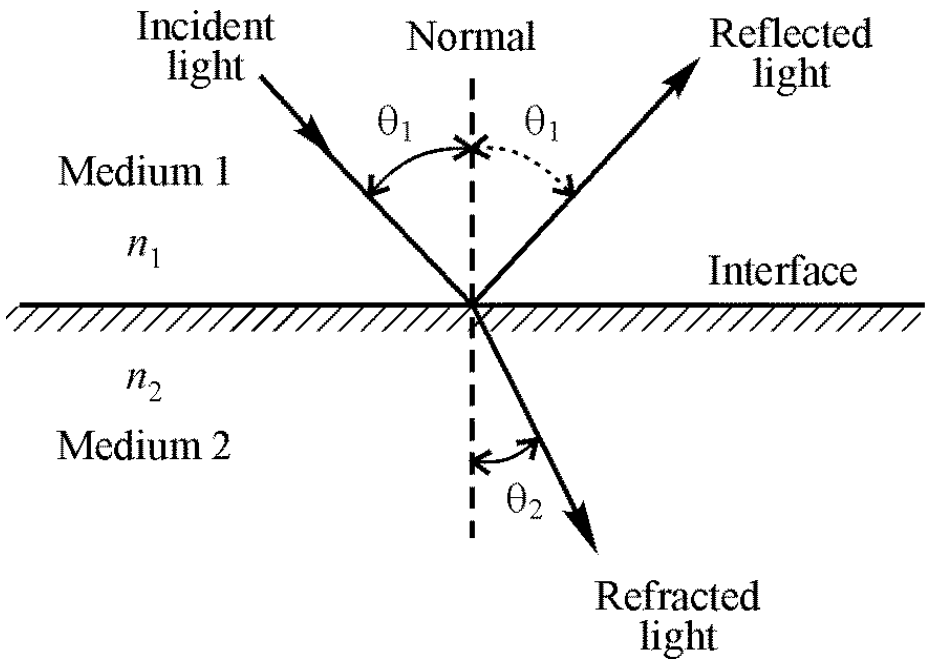


Figure 1-11 *Law of reflection: Angle B equals angle A.*



Snell's law

$$n_1 \sin \theta_1 = n_2 \sin \theta_2 \qquad (1\text{-}13)$$

where

n_1 = index of refraction of medium 1
n_2 = index of refraction of medium 2
θ_1 = angle of incidence (and reflection)
θ_2 = angle of refraction

Figure 1-12 *Refraction of light at an interface*

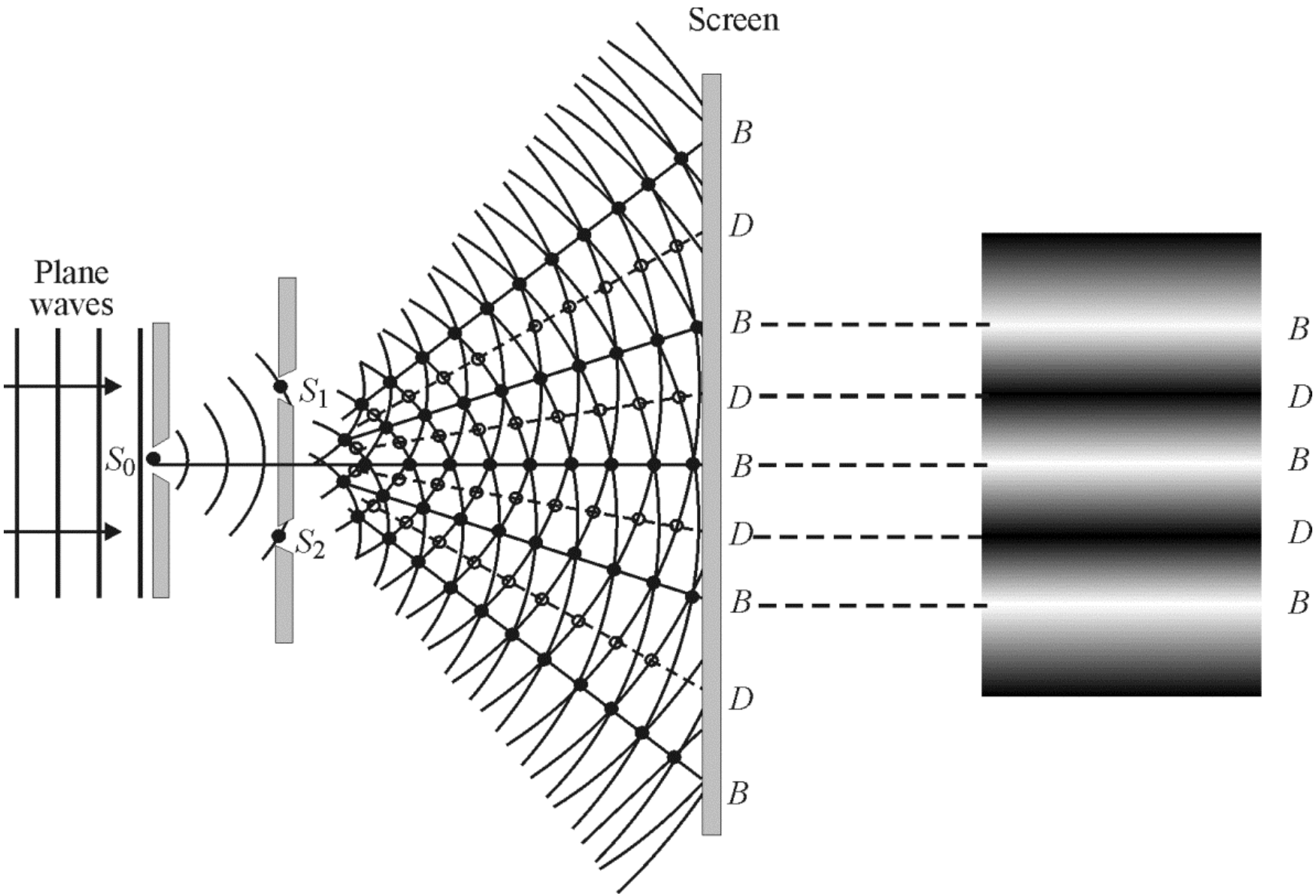
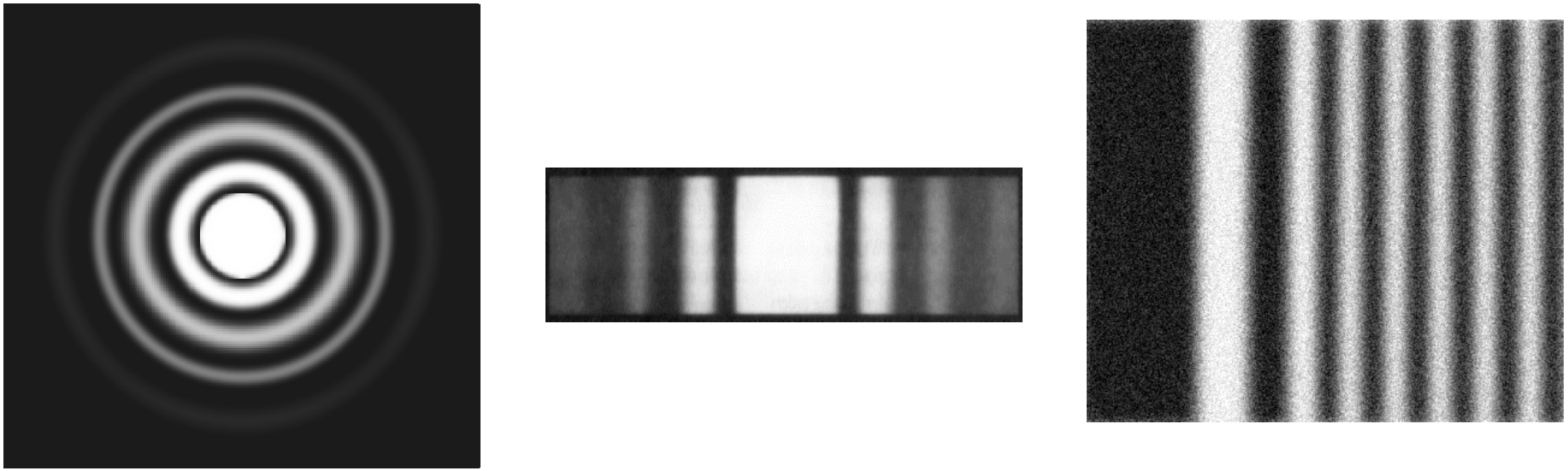


Figure 1-13 *Young's famous double-slit experiment*



(a) Pinhole diffraction (b) Single-slit diffraction (c) Straight-edge diffraction

Figure 1-14 *Sketches of several common diffraction patterns*

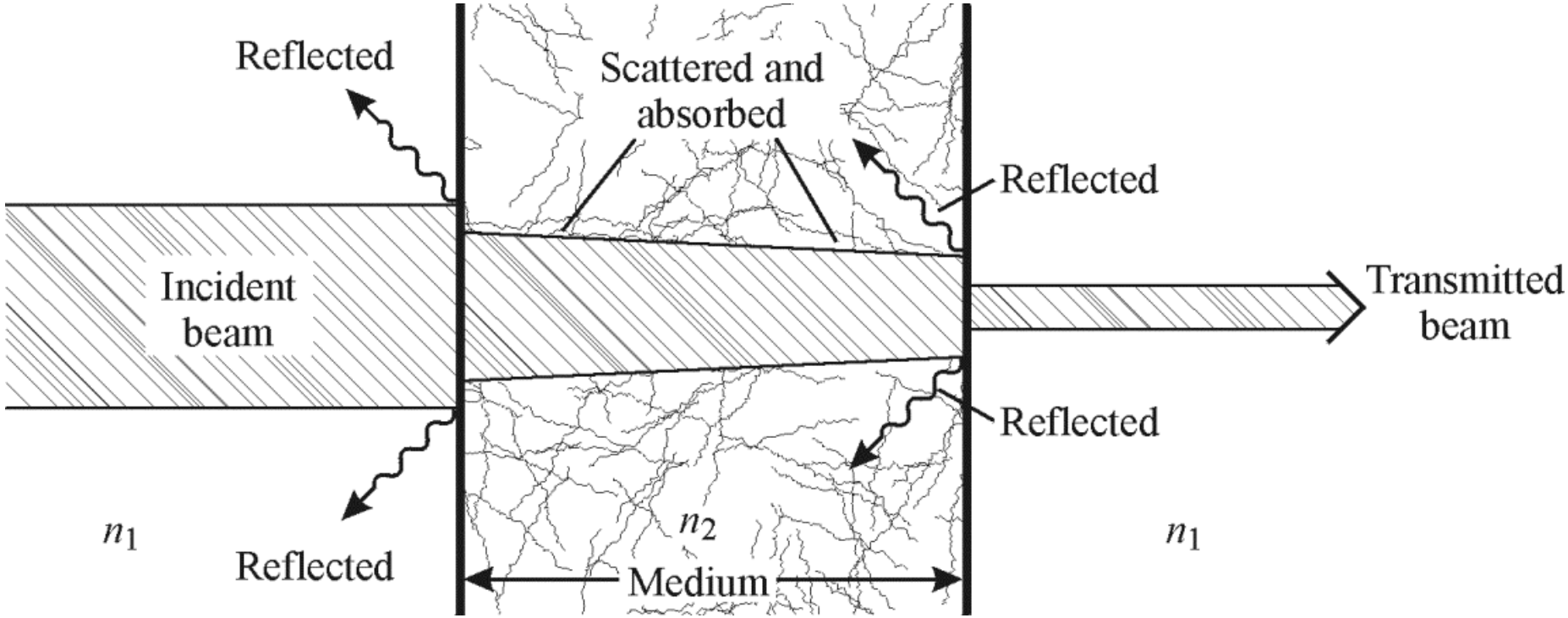


Figure 1-15 *Losses in light energy passing through an optical medium*

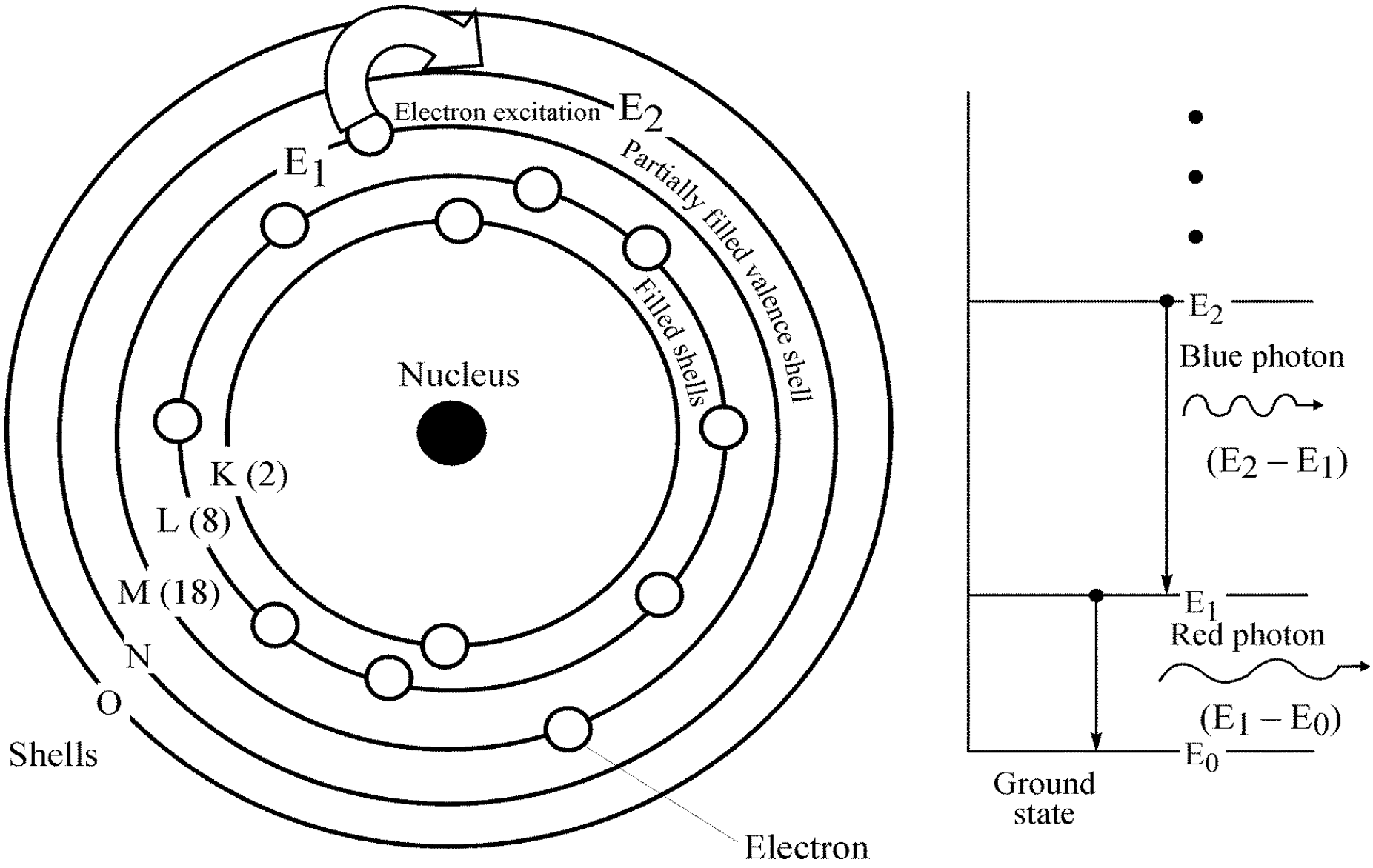


Figure 1-16 *Atomic model*

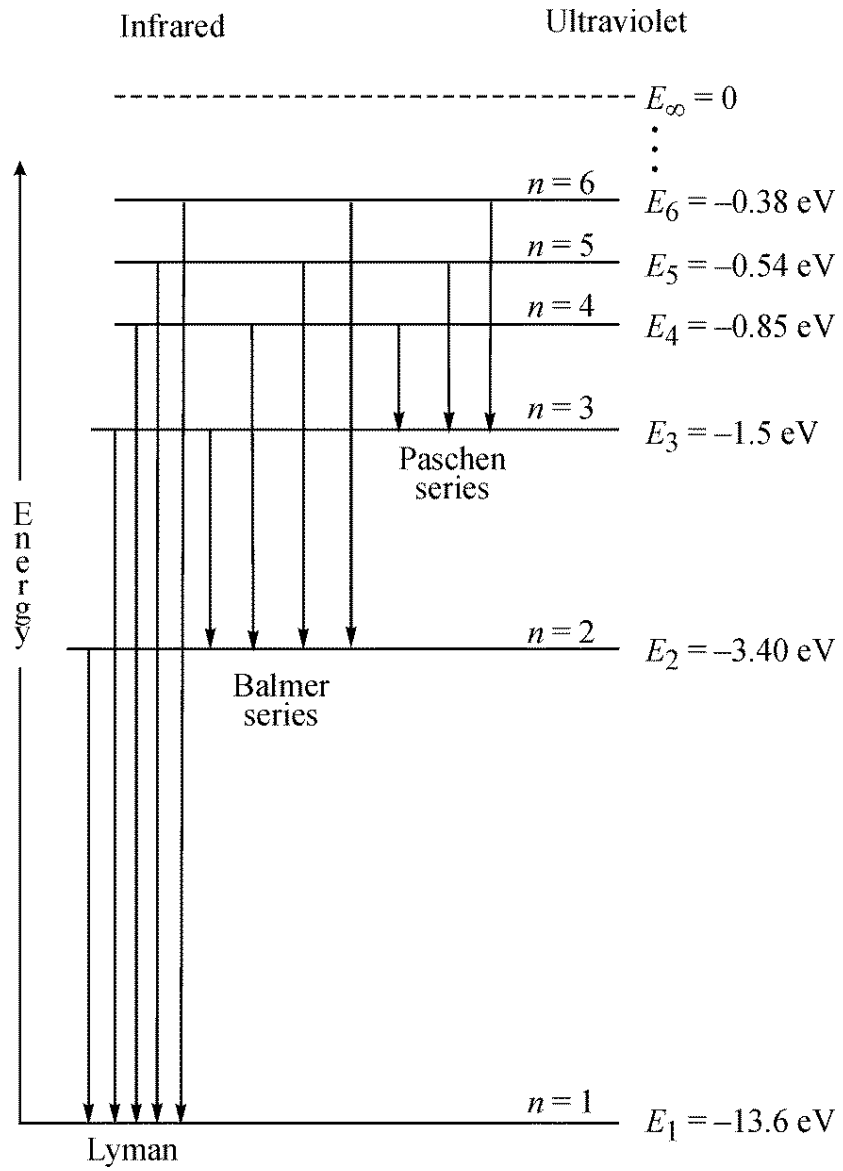


Figure 1-17 *Energy-level diagram for a hydrogen atom*

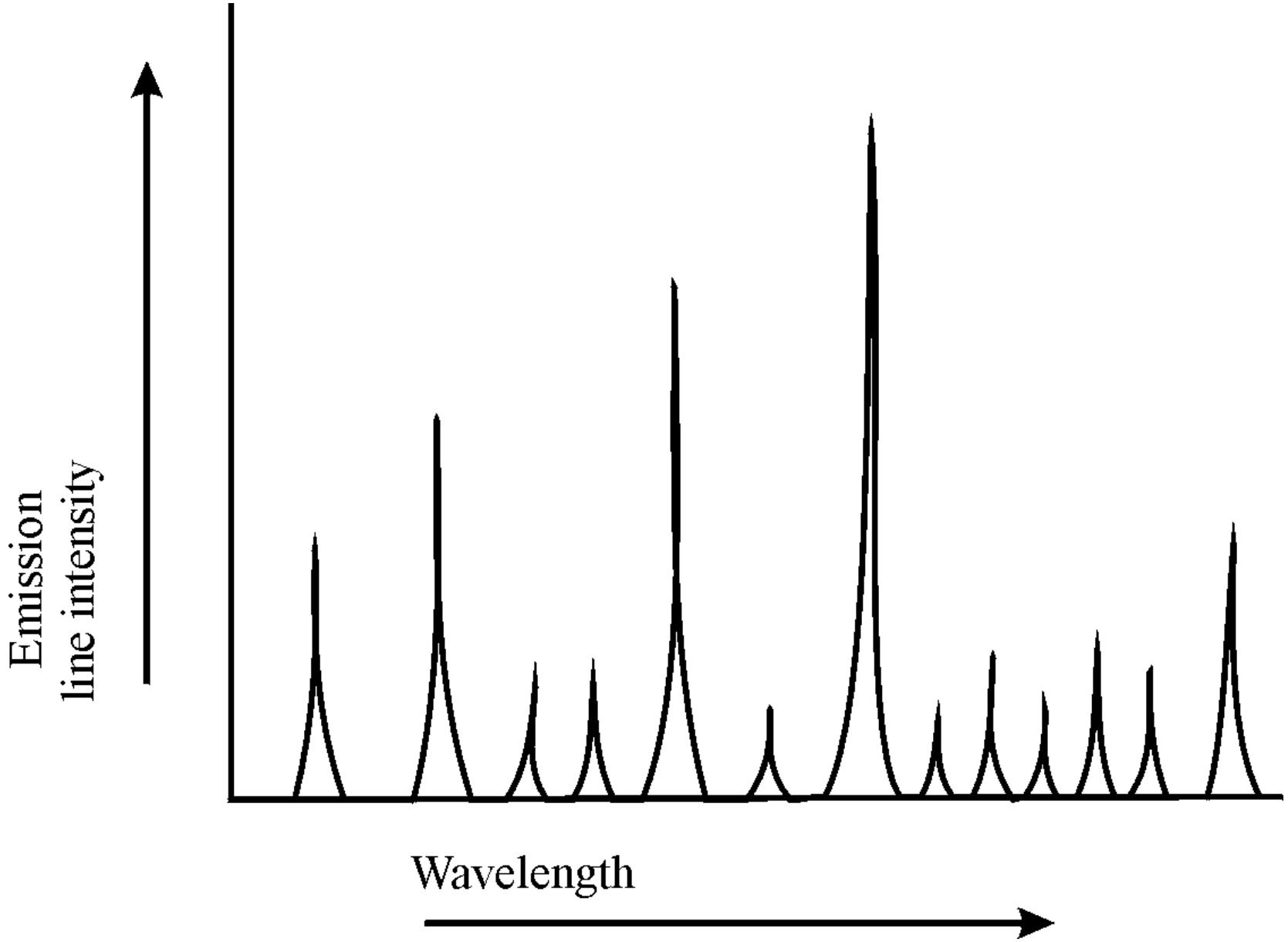


Figure 1-18 *Line spectrum of a monatomic element*

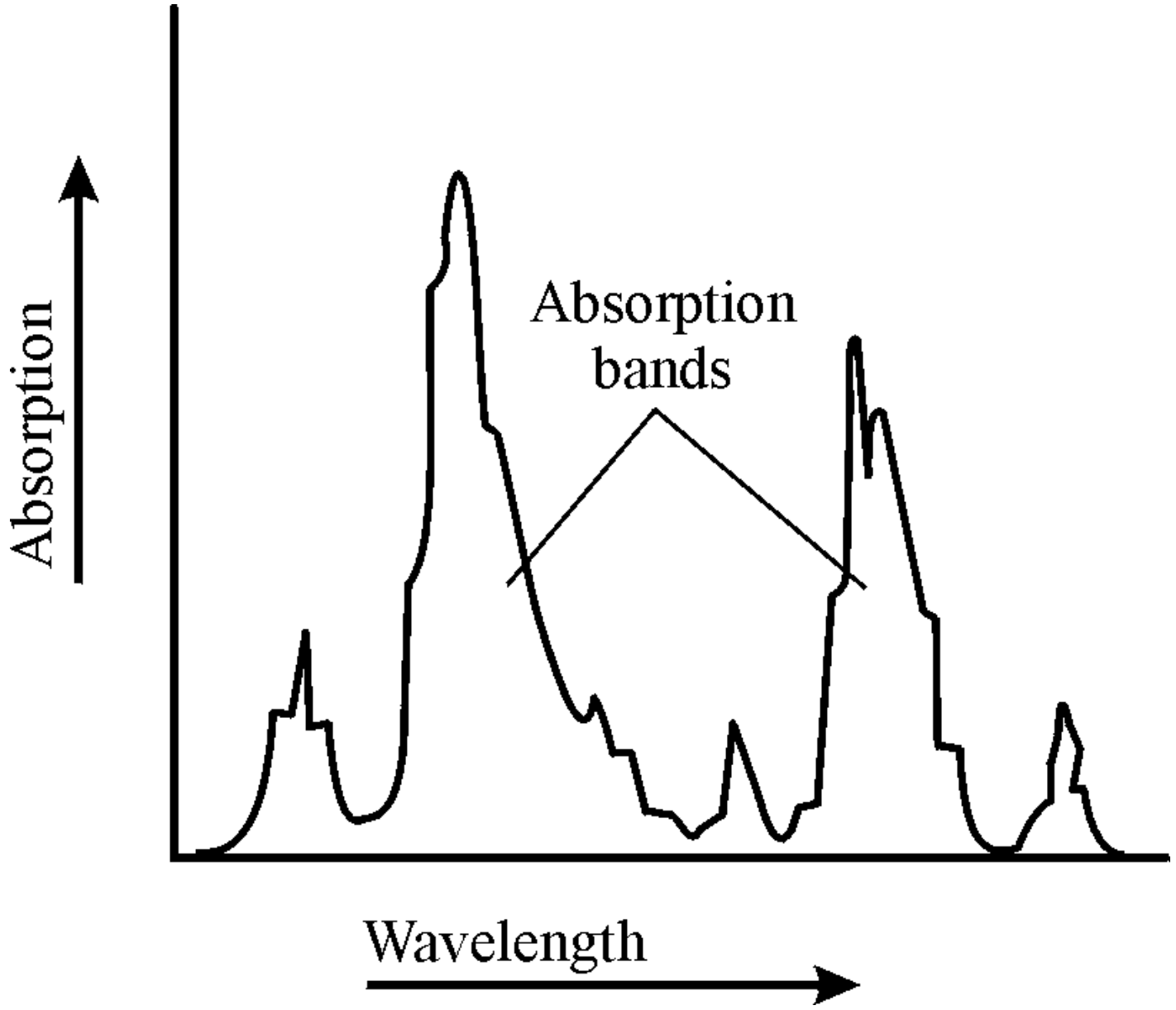


Figure 1-19 *Absorption spectrum of a solid*

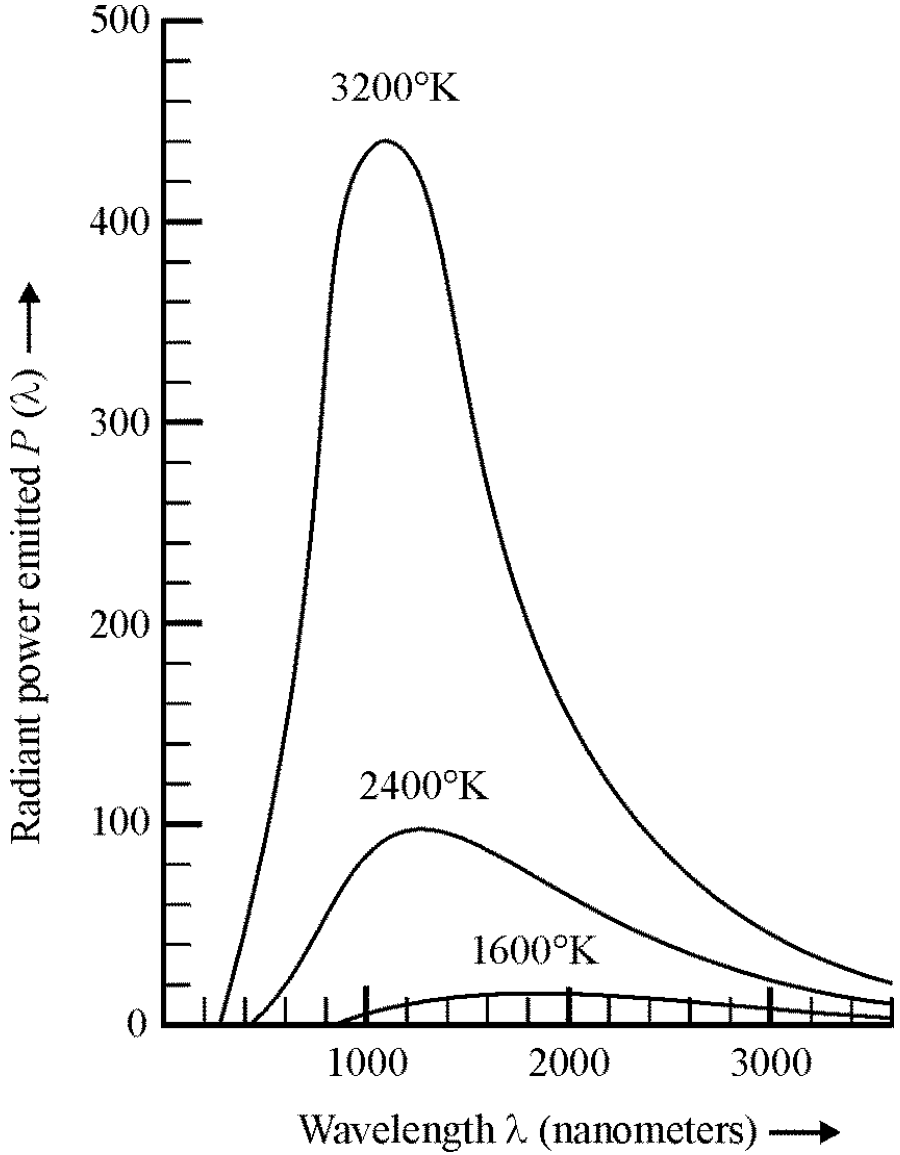


Figure 1-20 *Spectral distribution of blackbody radiation*

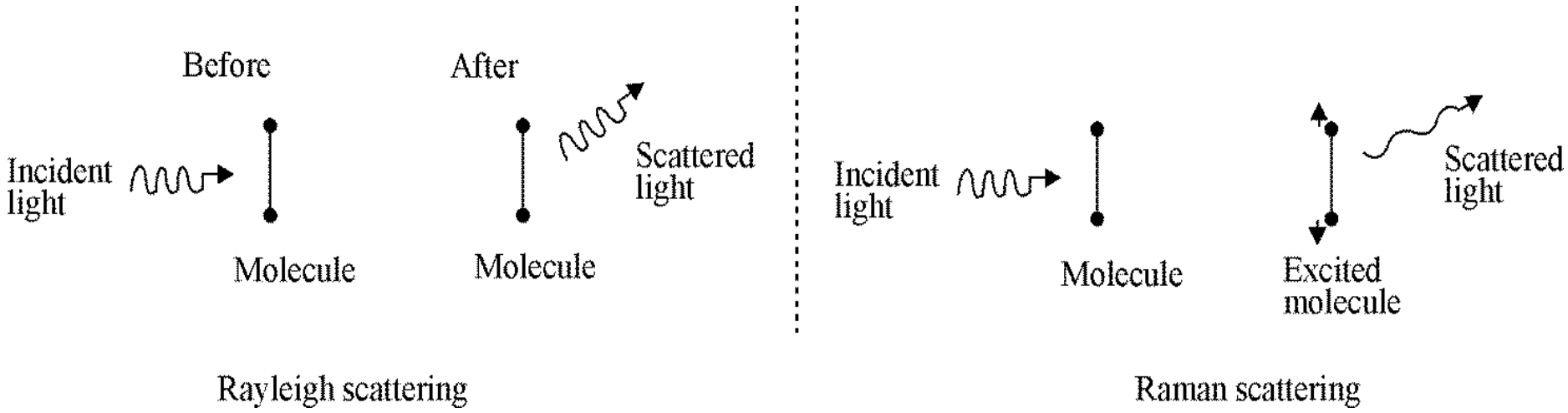


Figure 1-21 *Rayleigh and Raman scattering*