

Glossary

Chapter 15—Light and Optics

continuous spectrum (p. 355) A complete visual spectrum with no frequency gaps, emitted only by an ideal luminous object.

line spectrum (p. 356) A spectrographic display of lines representing electromagnetic emissions in discrete frequencies or wavelengths.

spectrograph (p. 356) A photograph, printout, or other display of a spectrum produced by a spectroscope.

light-year (ly) (p. 357) The distance light travels in one year, approximately 9.6 trillion km (6 trillion mi); the unit of distance (not time) best applied to objects far outside our solar system.

intensity (p. 357) The rate at which a light source radiates energy, measured in candelas (cd), which is an SI base unit. Also called brightness.

candela (cd) (p. 357) The SI base unit of light intensity. See Appendix B for a formal definition.

inverse-square law (p. 357) A mathematical relationship in which the magnitude of one quantity varies with the inverse of the square of another. It applies to many areas of physics, such as gravitational force, light illumination, electrostatic force, and electromagnetism.

incandescence (p. 358) Light produced by materials that are heated until they glow.

fluorescence (p. 358) The emission of visible light by a substance that is exposed to high-frequency electromagnetic energy.

phosphorescence (p. 358) The continuing emission of visible light after a substance has been exposed to high-frequency electromagnetic energy.

coherent light (p. 359) In-phase, monochromatic light waves from a single source.

cold light (p. 359) Visible light produced by chemical reactions at temperatures far below those required for incandescence.

primary hue (p. 361) Any single color of a small set of distinct colors that can be mixed to produce the other colors in a color system.

additive primary color (p. 361) One of the three distinct colors of light sensed by the human visual system (red, green, and blue) that, when mixed in various ratios, can produce all other colors of the visible spectrum.

subtractive primary color (p. 362) One of several distinct colors of pigment (e.g., cyan, magenta, yellow) that, when combined in various ratios, produce all colors in the associated color system by the absorption of incident or transmitted light.

complementary color (p. 362) A color produced by the mixing of any pair of additive or subtractive primary colors.

saturation (p. 362) The apparent brightness, or intensity, of a color.

value (p. 362) The darkness or lightness of a color.

color system (p. 364) All possible colors that can be produced by the combination of a specific set of primary colors. A color system is identified by its primary colors.

beam (p. 364) A continuous stream of photons moving in the same direction.

ray (p. 364) *a.* Mathematically, a line segment with an arrowhead showing direction. *b.* In optics, a representation of the path a light photon takes.

diffuse reflection (p. 365) The most common type of reflection in which photons reflect off an uneven surface in all directions. An image of the light source cannot be formed from a diffuse reflection.

specular reflection (p. 365) Reflection of photons off a microscopically smooth surface in the same direction. An image of the light source can be formed from specular reflection.

incident ray (p. 365) A light ray approaching a reflective surface or a boundary between different refractive media.

reflected ray (p. 365) A light ray moving away from the point of reflection.

law of reflection (p. 365) Law stating that the angle of an incident ray equals the angle of the reflected ray. Both angles are measured in relation to the normal at the point of incidence.

plane mirror (p. 366) A reflective surface having no curvature; a flat mirror.

virtual image (p. 366) An optical illusion perceived by the visual system when processing diverging light rays reflecting off a mirror or passing through a lens. A virtual image is upright and cannot be projected on a screen.

real image (p. 366) An image formed when light rays from a point on an object converge after reflecting off a mirror or passing through a lens. A real image exists apart from any visual system perceiving it. It is upside down and reversed and can be projected on a screen.

concave mirror (p. 367) A specularly reflective surface shaped like the interior of a greatly flattened bowl. The surface bulges away from the object being reflected.

principal optical axis (p. 367) An imaginary line normal to the optical center of a concave or convex mirror or lens. It is used as a reference when describing the characteristics of the optical device.

principal focus (p. 367) The point at which light rays initially parallel to the principal axis converge when focused by a concave mirror or converging lens; the focal point of incident parallel light rays.

focal point (p. 367) The point at which nonparallel incident light rays are focused by a concave mirror or converging lens. The focal point varies depending on the degree of divergence of the incident light rays. For parallel incident light rays, the focal point and principal focus are the same point.

focal length (p. 367) The distance from the center of a lens or mirror to its principal focus.

convex mirror (p. 368) A specularly reflective surface shaped like a dome. The surface bulges toward the object being reflected.

optical density (p. 368) A measure of a transparent material's ability to transmit light; similarly, a measure of a material's ability to absorb light.

index of refraction (n) (p. 368) The ratio of the speed of light in a vacuum to the speed of light in a given medium; a measure of a medium's optical density.

total internal reflection (p. 369) Reflection of a light ray approaching the boundary between two media from within the optically denser medium. Total internal reflection occurs when the incident angle exceeds the critical angle for the two media.

critical angle of incidence (p. 369) The angle of incidence that produces an angle of refraction of 90° for a light ray traveling from a medium with a higher index of refraction to one with a lower index; that is, the refracted light ray is parallel to the boundary surface between the media.

fiber optics (p. 370) Technology using bundles of long, fine, transparent glass fibers that transmit light along their lengths by total internal reflection.

light dispersion (p. 371) The angular separation of the various frequencies in a beam of light by refraction, as with a prism. The dispersion angle is greater for higher frequencies.

lens (p. 371) A disk of transparent material that refracts light so that the light converges or diverges.

converging lens (p. 371) A lens that is thicker at its optical center than at its edges. It focuses light rays to a point.

diverging lens (p. 371) A lens that is thicker at its edges than at its center. It spreads light rays apart.

meniscus lens (p. 373) A lens that has one convex side and one concave side. It is preferred for glasses because it provides a larger area of corrected vision.

charge-coupled device (CCD) (p. 374) A light-sensitive, semiconducting surface used in cameras in place of photographic film.