ScienceNet - Physical Sciences - Lasers/ Optics/ Photonics

Question No. 19019 :
Hi, I would like to know what is luminous intensity. Thank you.
Scientists use various units to measure the brightness of a light source and the amount of energy in a beam of light coming from that source. The amount of light produced in a certain direction by a glowing object or light source is called the luminous intensity of that source. The more luminous intensity a light has, the brighter the light appears.

Luminous intensity is sometimes called candle power. For many years, the luminous intensity produced by a certain size candle made from the oil of sperm whales served as the standard. The unit was called a candle. However, the sperm whale candle did not provide an easily used standard for the measurement of light and scientists found this unit too difficult to standardise. In 1948, the International Commission on Illumination adopted the candela as a standard (SI) unit to measure luminous intensity. (One candela is slightly less than 1 candle.) The candela has replaced the standard candle or lamp as a unit of luminous intensity in calculations involving artificial lighting and is sometimes called the "new candle."

Luminous intensity is the quantity of visible light that is emitted in unit time per unit solid angle. The unit for the quantity of light flowing from a source in any one second (the luminous power, or luminous flux) is called the lumen. The lumen is evaluated with reference to visual sensation. The sensitivity of the human eye is greatest for light having a wavelength of 555 nanometres (10-9 metre); at this wavelength there are 685 lumens per watt of radiant power, or radiant flux (the luminous efficiency), whereas at other wavelengths the luminous efficiency is less. The unit of luminous intensity is one lumen per steradian, which is the unit of solid angle. This unit of luminous intensity is also called the standard candle, or candela, one lumen per steradian. [To understand a steradian, imagine a small, uniform light placed at the centre of a hollow sphere. Beams of light spread uniformly in all directions and illuminate the inside surface of the sphere. If the area illuminated on the inside of the sphere equals one square foot, then the angle of the light measured near the centre of the sphere equals one steradian.]

The intensity of a light source in candelas does not indicate how bright the light will be when it reaches the surface of an object, such as a book or a desk. Before we can measure illumination (the light falling on a surface), we must measure the light traveling through the space between the source and the object. We can measure a beam of light with a unit called the lumen. To see how the lumen is measured, imagine a light source placed at the centre of a hollow sphere. On the inside surface of the sphere, an area is marked off equal to the square of the radius of the sphere. For example, if the radius is 1 foot, the area marked off is 1 square foot. If the light source has a luminous intensity of 1 candela, the marked area will receive a luminous flux (rate of light falling on it) of 1 lumen.

In the customary system of measurement, engineers measure illumination in units called foot-candles. An illumination of 1 foot-candle is produced by 1 lumen of light shining on an area of 1 square foot. The metric system uses a unit called the lux. An illumination of 1 lux is produced by 1 lumen of light shining on an area of 1 square meter. The intensity of light falling on a surface varies inversely (oppositely) with the square of the distance between the source and the surface. That is, if the distance increases, the illumination decreases by the square of the distance. This relationship is called the inverse square law. If a surface that receives 1 lux of light at a distance of 1 meter from a source is moved 2 meters from the source, that surface will then receive 1/2-squared, or 1/4, lux of light. This happens because light spreads out from its source.