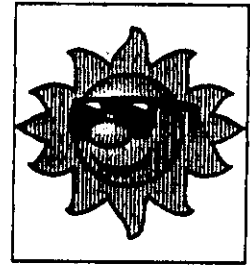


Physics Notes

THE NATURE OF LIGHT



- I) Light is a form of electromagnetic radiation
- A) λ between 400nm (violet) - 700nm (red)
 - B) $v = 3.0 \times 10^8$ m/sec - 186000 miles/sec
 - C) moves in a straight line as a transverse wave
 - 1) light has wave and particle properties
 - 2) ray model of light
 - 3) ray optics - using ray diagrams to study light
 - D) Roemer's method of determining the speed of light by using the difference in Io's (moon of Jupiter) orbit at different times of the year
 - E) Michelson-Morley - 'Strobe' timing effect by using an octagonal mirror along with other mirrors over a 70 km distance in order to measure the speed of light.
 - F) standard length (meter) measured as the distance light travels in 3.3×10^{-9} seconds

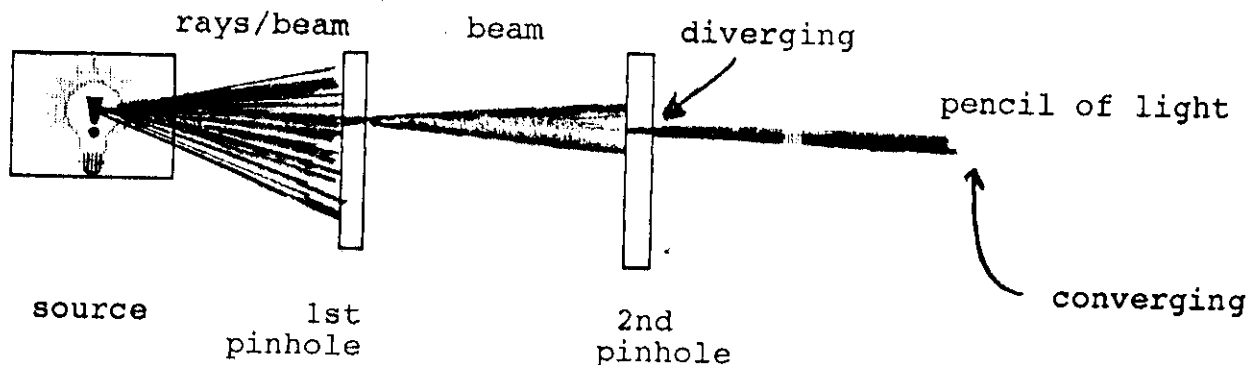
ELECTROMAGNETIC SPECTRUM (overhead)

II) Sources of light

- A) Luminous body emits light waves
- B) Illuminated body reflects light waves
- C) Incandescent - Light produced from heat
- D) Fluorescent - When an electron loses extra (added) energy
 - 1) photon - a packet (bundle/quanta) of energy

III) Transmission and absorption of light

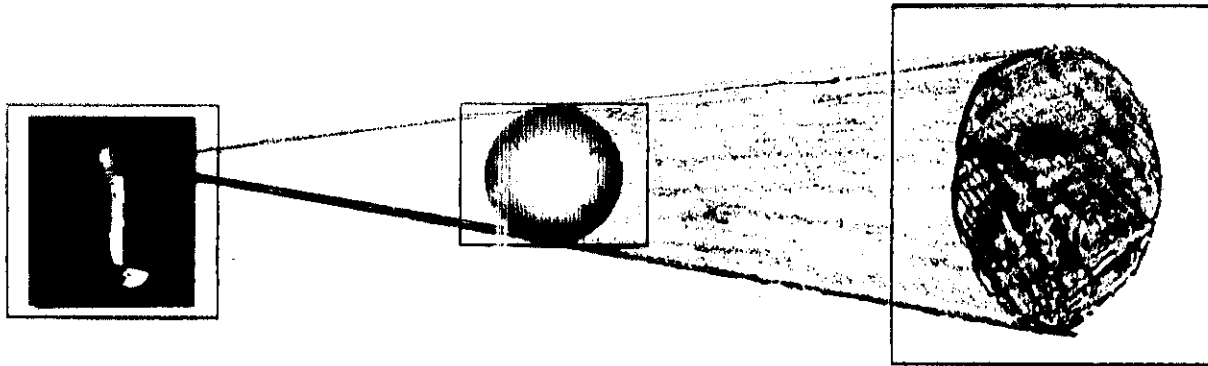
- A) transparent - transmits light waves (clear objects - windshield glass)
- B) Translucent - transmits light but does not allow objects to be seen clearly (frosted glass, lampshades)
- C) opaque - Absorbs or reflects all of the light



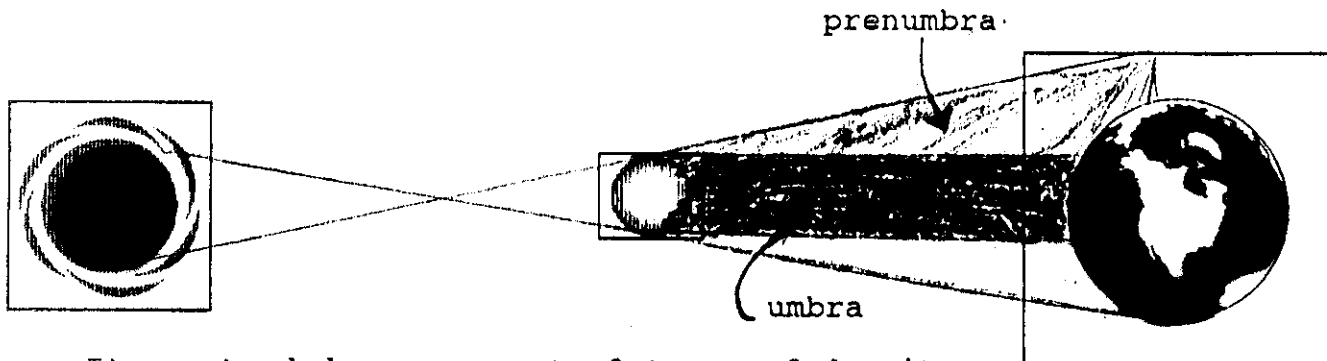
- D) Ray - single line of light from a luminous point source
- E) Beam - A group of closely spaced rays
 - 1) light from the sun is in rays so nearly parallel that it may be considered a parallel beam

F) diverging pencil- when several rays of light come from a point

G) converging pencil - when several rays of light are heading towards a point



H) a point source casts a shadow of uniform density



I) an extended source casts 2 types of density 'shadows'

A) penumbra- luminous source not hidden from observer

(partial eclipse)-lightly shadowed area of nonuniform density

B) umbra - part which all rays of light are excluded (total eclipse)- shadow of uniform density

IV) Light measurements

A) Photometry - Quantitative study of light

B) Luminous Intensity (I) -Intensity of light from a luminous source. unit = candela (cd)

1) 40 watt bulb = 35 cd, 100 watt bulb = 130 cd

40 watt fluorescent = 200 cd

2) candela- $1/683$ watt per steradian (area of light of a sphere divided by distance squared)

C) luminous flux- rate at which light is radiated from a source (P) units= lumens (lm) $P = 4\pi I$

D) The illumination of a surface or illuminance (E) - the rate of intensity of light on a surface propagated from a source.

$E = P/A$ (Luminous flux/ area)

Light from a point source propagates spherically so that $A = 4\pi r^2$

$E = P/A = 4\pi I/4\pi r^2$ or $E = I/r^2$ or E is proportional to Luminous Intensity and inversely proportional to the distance from the source squared

V) The colors and combinations of light

A) White light can be separated into a spectrum of colors by passing it through a prism. Hence, white light (W) is composed of colors.

1) each color in the spectrum (roygbiv) is associated with a specific wavelength of light

B) Red (R), blue (B), and green (G) - primary colors of light $R + B + G = W$

1) equal intensity of each primary color will produce white light

C) Combinations of the primary colors of light will produce the secondary of yellow, magenta, and cyan

1) $B + G = \text{CYAN (C)}$

2) $B + R = \text{MAGENTA (M) - PINK}$

3) $R + G = \text{YELLOW (Y)}$

D) White light can also be produced by mixing a primary color with its complementary secondary color (which contains equal mixtures of the other two primaries)

1) $C + R = W$

2) $M + G = W$

3) $Y + B = W$

VI) Colors and combinations of pigments

A) a dye is a molecule and a pigment is a colored material that absorbs certain wavelengths of light and transmits or reflects others

1) the color of an object depends on which wavelengths of light the object absorbs and reflects

B) the primary pigment colors, (M, C, Y) are the secondary light colors

1) magenta pigments absorb green and reflect blue and red which combines to form magenta light.

2) Yellow pigments absorb blue and transmit red and green while cyan pigments absorb red and reflect green and blue

C) combining the primary pigments produces the secondary pigment colors of red, green, and blue which absorb two primary colors.

1) red absorbs green and blue

2) green absorbs red and blue

3) blue absorbs green and red

D) creating the secondary pigments

1) Cyan (absorbs red) + Y (absorbs blue) = green

2) Yellow (absorbs blue) + magenta (absorbs green) = red

3) Cyan (absorbs red) + magenta (absorbs green) = blue

E) Equal combinations of the primary pigments produce black

1) $C(\text{absorbs } r) + Y(\text{absorbs } b) + M(\text{absorbs } g) = \text{no reflection of light} = \text{black}$

F) primary pigment plus its complementary secondary pigment also produces black

1) Cyan + red = black

2) yellow + blue = black

3) Magenta + green = black

VII) Polarized light is light whose wave vibrates in one plane

A) a single filter will block out all wave orientations except those that are aligned with polarized filter (one plane)

B) When two filters are aligned at 90 degrees, they block all of the light and the filter looks black