PHYS3038 Fall 2015

Homework #2

Due date: 22 September 2015

3.13 Prove that the irradiance of a harmonic EM-wave is given by

$$I = \frac{1}{2c\mu_0} E_0^2$$

And then determine the average rate at which energy is transported per unit area by a plane wave having an amplitude of 15.0 V/m.

3.23 How many photons per second are emitted from a 100-W yellow lightbulb if we assume negligible thermal losses and a quasi-monochromatic wavelength of 550 nm? In actuality only about 2.5% of the total dissipated power emerges as visible radiation in an ordinary 100-W lamp.

3.32 A surface is placed perpendicular to a beam of light of constant irradiance *(I)*. Suppose that the fraction of the irradiance absorbed by the surface is α. Show that the pressure on the surface is given by

$$P = (2 - \alpha)I/c$$

5.1 The shape of the interface pictured in Fig. P.5.1 is known as a Cartesian oval after Rene Descartes who studied it in the early 1800s. It's the perfect configuration to carry any ray from *S* to the interface to *P*. Prove that the defining equation is

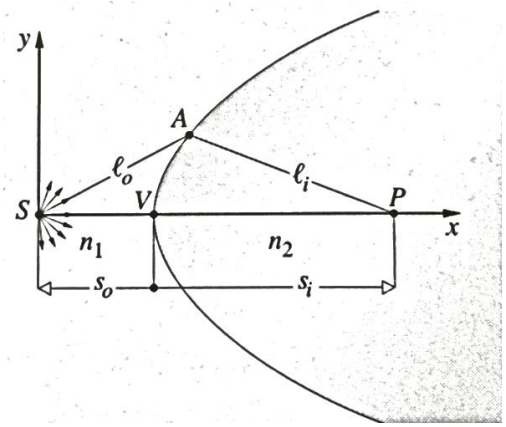
$$l_o n_1 + l_i n_2 = constant$$

Show that this is equivalent to

$$n_1(x^2 + y^2)^{1/2} + n_2[y^2 + (s_o + s_i - x^2)]^{1/2} = constant$$

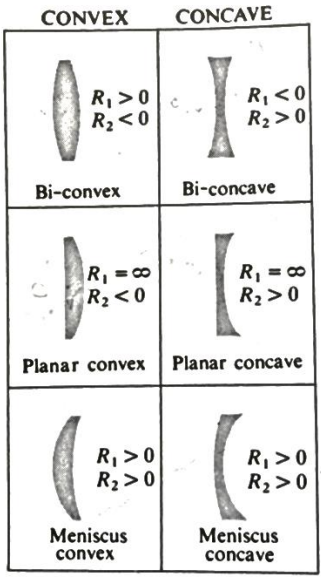
where x and y are the coordinates of point A.

Figure P.5.1



5.12 A meniscus concave glass ($n_i = 1.5$) this lens (see Fig.5.12) has radii of curvature of +20.0 cm and +10.0 cm. If an object is placed 20.0 cm in front of the lens, show that the image distance will be -13.3 cm. Describe that image and draw a ray diagram.

Figure 5.12



5.31 Observe the three vectors $\vec{\mathbf{A}}, \vec{\mathbf{B}}$, and $\vec{\mathbf{C}}$ in Fig. P.5.31, each of which has a length of 0.10*f* where *f* is the focal length of the thin positive lens. The plane formed by $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ is at a distance of 1.10*f* from the lens. Describe the image of each vector.

Figure P.5.31

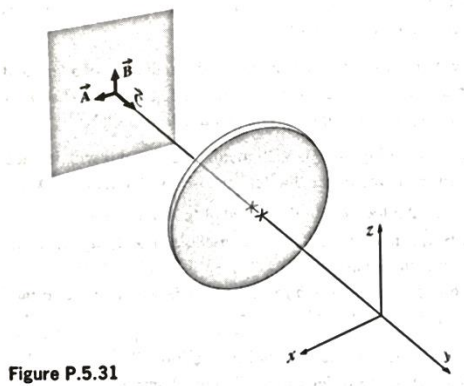


Figure P.5.31

5.47 Figure P.5.47 shows a lens system, an object, and the appropriate pupils. Diagrammatically locate the image.

Figure P.5.47