Name: Key

Physics 2020 – Fall 2001

Quiz #3

$c = 3.00 \times 10^8$ m/s

You must show your working and/or explain your answers to receive full credit.

1. Ghost images are formed when the electromagnetic wave from the broadcasting antenna reflects from a building, or other large object, and arrives at the TV set shortly after the wave coming directly from the broadcasting antenna. If the reflected wave arrives 5.0×10^{-7}s after the direct wave, what is the difference in distances traveled by the two waves? (3 points)

$c = \frac{\text{distance}}{\text{time}} \Rightarrow \text{distance} = c \times \text{time}$

$= 3.00 \times 10^8 \text{ m/s} \times 5.0 \times 10^{-7} \text{ s}$

$= \underline{\underline{150 \text{ m}}}$

2. Green light has a wavelength of approximately 550 nm. What is its frequency? (2 points)

$c = f\lambda \Rightarrow f = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m/s}}{550 \times 10^{-9} \text{ m}}$

$= \underline{\underline{5.45 \times 10^{14} \text{ Hz}}}$

3. **Unpolarized** light of intensity 1.10 W/m^2 is incident on one side of a sheet of polaroid.

a) What is the intensity of the light that emerges from the other side? (2 points)

If incident light is unpolarized half the intensity passes through the polaroid

$= \underline{\underline{0.55 \text{ W/m}^2}}$

b) This light then hits another polaroid whose axis of polarization is at an angle of 75° to the first. What is the intensity of the light that makes it through both polaroids? (3 points)

$S = S_0 \cos^2\theta$

$= 0.55 \text{W/m}^2 \cos^2 75^\circ$

$= \underline{\underline{0.037 \text{ W/m}^2}}$

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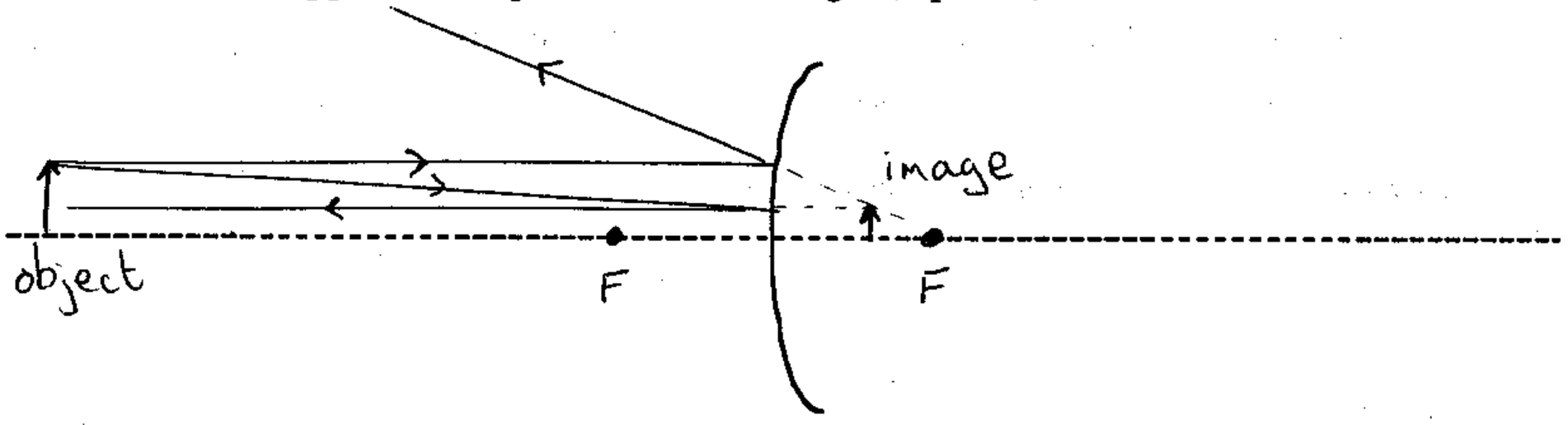
4. A convex mirror with a radius of curvature of 4.0 m, is used to monitor an aisle in a store.

a) What is the foal length of this mirror? (2 points)

$|f| = \frac{R}{2} = 2.0\,m$ but it is a convex mirror

$\Rightarrow f = \underline{\underline{-2.0\,m}}$

b) A person is located 15 m in front of the mirror. On the diagram below, draw light rays to locate the approximate position of the image. (4 points)



c) Calculate the position and magnification of the image. Is it real or virtual, inverted or upright? (4 points)

$f = -2.0\,m \qquad d_o = 15.0\,m \qquad d_i = ?$

$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f} \Rightarrow \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{-2.0} - \frac{1}{15.0} = -0.50 - 0.067$

$= 0.567\,m^{-1}$

$\Rightarrow d_i = \frac{1}{0.567\,m^{-1}} = \underline{\underline{-1.76\,m}}$

Image is virtual, upright and diminished

$m = -\frac{d_i}{d_o} = -\frac{1.76\,m}{15.0\,m} = \underline{\underline{0.118}}$

Useful equations:

$$c = f\lambda \qquad u = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} \qquad E = cB \qquad f_o = f_s\left(1 \pm \frac{v_{rel}}{c}\right) \qquad S = S_0 \cos^2\theta$$

$$\theta_r = \theta_i \qquad |f| = \frac{R}{2} \qquad \frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f} \qquad m = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$$