Name_____ Units? Units?

Phys 2020, Section 2
Quiz #4 — Spring 2002

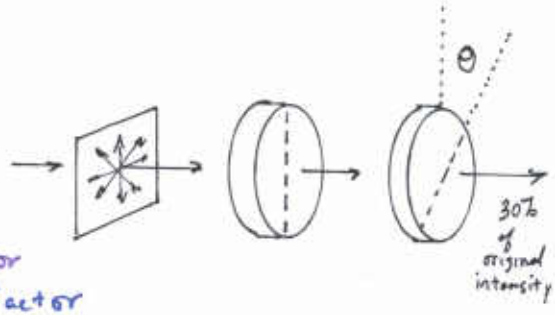
1. What is the frequency of electromagnetic radiation which has a wavelength of 12.5 cm ?

$\lambda = 0.125\ m$. Then from $\lambda f = c$,

$$f = \frac{c}{\lambda} = \frac{(2.998 \times 10^8\ m/s)}{(0.125\ m)} = \boxed{2.40 \times 10^9\ s^{-1} = 2.40\ GHz}$$

2. Unpolarized light is incident of a polarizer and then falls on an analyzer whose transmission axis makes an angle of θ with the polarizer.

If a fraction 0.30 (that is, 30%) of the original light transmitted through both the polarizer and analyzer, what is θ?



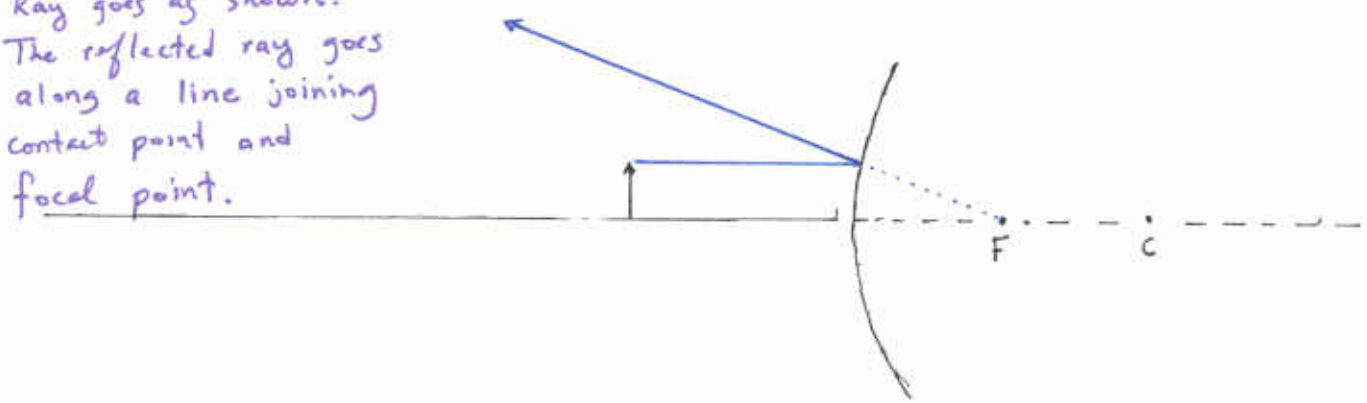
After the first polarizer, the intensity reduced by factor of $\frac{1}{2}$ and after second polarizer by a further factor of $\cos^2\theta$. The overall factor is given as 0.30, so:

$$\tfrac{1}{2}\cos^2\theta = 0.30 \Rightarrow \cos^2\theta = 0.60 \rightarrow \cos\theta = 0.77 \rightarrow \boxed{\theta = 39.2^\circ}$$

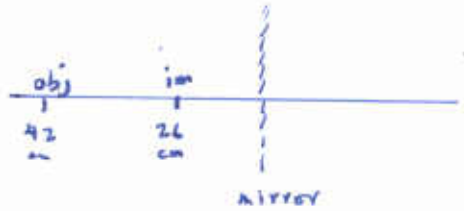
3. Shown below is a schematic of an object (the arrow) in front of a convex mirror. The Center of Curvature C and focal point F are shown.

Trace the ray which starts from the tip of the arrow and goes parallel to the principal axis. (I.e. show how it "bounces off the mirror".)

Ray goes as shown:
The reflected ray goes along a line joining contact point and focal point.



4. An object 4.0 cm high is placed 42.0 cm in front of a spherical mirror. The image is located 26.0 cm in front of the mirror.



a) What is the focal length of the mirror?

Using $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$,

$\frac{1}{f} = \frac{1}{42\,cm} + \frac{1}{26\,cm} = 6.2 \times 10^{-2}\,cm^{-1}$

$f =$ **16.1 cm**

b) Is the mirror concave or convex?

f is positive so mirror is **concave**

c) State whether the image is Real of Virtual; Upright or Inverted.

$m = -\frac{d_i}{d_o} = -\frac{26.0}{42.0} = -0.619$

Image is in front of mirror, so image is **Real**

Magnification is negative, so image is **Inverted**

d) What is the height of the image?

From $m = \frac{h_i}{h_o}$, get

$h_i = h_o m = (4.0\,cm)(-0.619) =$ **-2.48 cm**

That is, image has height 2.48 cm and is upside-down.

You must show all your work and include the right units with your answers!

$\lambda f = c \qquad c = 2.998 \times 10^8 \frac{m}{s} \qquad \overline{S}_{pol} = \frac{1}{2}\overline{S}_{unpol} \qquad \overline{S} = \overline{S}_0 \cos^2\theta$

$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f} \qquad m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$