Name_____ Units! Units?

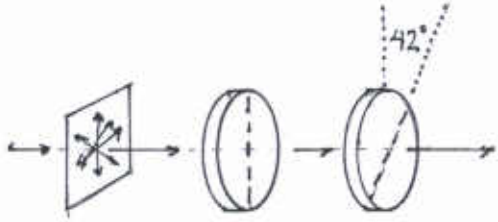
Phys 2020, Section 1
Quiz #4 — Spring 2002

1. What is the wavelength of radio waves which have a frequency of 103.7 MHz ?

Frequency is $f = 103.7 \times 10^6\ s^{-1}$, so from $\lambda f = c$ we get:

$$\lambda = \frac{c}{f} = \frac{2.998 \times 10^8\ \frac{m}{s}}{103.7 \times 10^6\ s^{-1}} = \boxed{2.89\ m}$$

2. Unpolarized light is incident of a polarizer and then falls on an analyzer whose transmission axis makes an angle of $\theta = 42.0°$ with the polarizer.



What is the fraction of the original light transmitted through both the polarizer and analyzer?

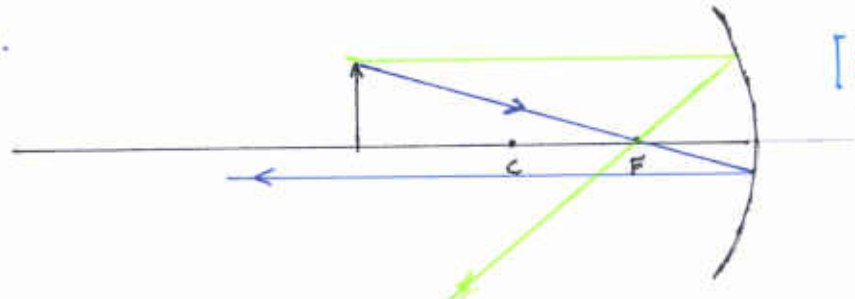
After passing thru first polarizer, we have $\frac{1}{2}$ the original intensity. After passing thru second polarizer intensity is reduced further by a factor of $\cos^2 42.0°$. Overall, beam is reduced by factor of:

$$\frac{1}{2} \cdot \cos^2 42° = \boxed{0.276 = 27.6\%}$$

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

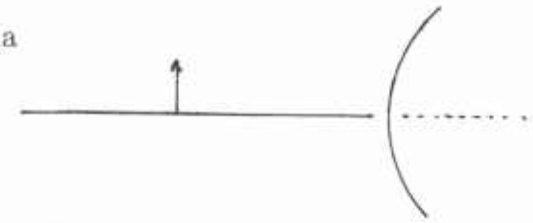
Trace the ray which starts from the tip of the arrow and goes through the focal point. (I.e. show how it "bounces off the mirror".)

The ray drawn here goes thru the focal point and then bounces back along a line parallel to the axis.



[Note: The wording was ambiguous and so the light green ray is also a possible answer.]

4. An object 4.0 cm high is placed 42.0 cm in front of a convex mirror of focal length −23 cm.



a) What is the position of the image?

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

$$\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{(-23\,cm)} - \frac{1}{(42.0\,cm)} = -6.73\times10^{-2}\,cm^{-1}$$

$d_i = \boxed{-14.9\,cm}$ (Image is $\boxed{14.9\,cm}$ behind mirror.)

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

An image behind the mirror is $\boxed{\text{Virtual.}}$

The magnification is

$$m = -\frac{d_i}{d_o} = -\frac{(-14.9)}{(42.0)} = 0.35$$; positive, so image is $\boxed{\text{Upright}}$

c) What is the height of the image?

Since $m = 0.35 = \frac{h_i}{h_o}$, then

$$h_i = (0.35)\,h_o = (0.35)(4.0\,cm) = \boxed{1.42\,cm}$$

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

$$\lambda f = c \qquad \overline{S}_{pol} = \tfrac{1}{2}\overline{S}_{unpol} \qquad \overline{S} = \overline{S}_0 \cos^2\theta$$

$c = 2.998\times10^8\ m/s$

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