Physics 111 Homework Solutions Collected on Tuesday 2/24

Friday, February 20, 2015

Questions

- none

Multiple-Choice

- none

Problems

21.10 With $f = 20 \ cm = 0.2 \ m$, we can solve the lens equation for d_i to find that in

general $d_i = \frac{1}{5 - \frac{1}{d_o}}$ so that we can fill in the following table with different values

of d_o :

$d_o(m)$	$d_i(m)$
∞	0.20
4	0.21
2	0.22
1	0.25
0.8	0.27
0.6	0.30
0.4	0.40
0.2	∞

21.11 A lens relay system

- a. The magnification is M = 1, so $d_o = d_i$ from magnification equation. Thus using the thin lens equation we find that the focal length is $\frac{1}{f} = \frac{2}{d_0} \rightarrow f = \frac{d_0}{2}$. To calculate d_o we use the fact that $d_o + d_i = L = 1m$ and thus $d_o = \frac{1}{2}m$. Therefore $f = \frac{1}{4}m$.
- b. The relay system is shown below where all distances are in meters.



Here the magnification of the lens on the left is $M_L = -\frac{d_o}{d_i} = -\frac{1/4}{1/4} = -1$ while the

magnification of the lens on the right is $M_R = -\frac{d_o}{d_i} = -\frac{1/4}{1/4} = -1$. Thus the total

magnification is $M_T = M_L M_R = -1 \times -1 = 1$ as is required. The focal length of each lens is $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{\frac{1}{\lambda_4}} + \frac{1}{\frac{1}{\lambda_4}} \rightarrow f = \frac{1}{8}m$.

21.14 Tom Cruise being in addition to a skilled actor is also an accomplished physicist. To prove whether or not the reporter was trespassing he proceeds as follows. Since he knows about optics, Tom uses the thin lens and the magnification equations given by $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ and $M = \frac{d_i}{d_0} = \frac{h_i}{h_o}$ respectively. He needs to calculate d_o . Taking the magnification equation he solve it for d_i as $d_i = Md_o = \left(\frac{h_i}{h_o}\right)d_o$. Using this result and the thin lens equation he has $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{d_o} + \frac{h_o}{h_i d_o} = \frac{1}{d_o} \left(1 + \frac{h_o}{h_i}\right)$ $d_o = \left(\frac{h_i + h_o}{h_i}\right)f = \left(\frac{2.89mm + 620mm}{2.89mm}\right) \times 210mm = 45 \times 10^3 mm = 45m$

Since this is about 135 feet, the reporter could be trespassing, as it depends on where Tom and the baby were standing on his property. More than likely the reporter was trespassing.

Monday, February 23, 2015

Questions - none

Multiple-Choice

- none

Problems - same as Friday 2/20/15