CH#33
H.W. Solution.

#4

$$\Delta f = \frac{c}{\Delta\lambda} = \frac{3\times10^{8}}{1\times10^{-11}} = 3\times10^{19}\ Hz.$$

#9

$P = 10^{2}\ TW = 10^{2}\times10^{+12}$ watt $= 10^{14}$ watt

$\Delta t = 1ns = 1\times10^{-9}$ sec.

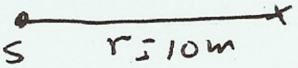
$\lambda = 0.26\ \mu m = 2.6\times10^{-7} m.$

$$P = \frac{E}{\Delta t} \Rightarrow E = P.\Delta t = 10^{14}\times10^{-9} =$$

$= 10^{5}$ Joule.

$= 0.1$ MJ.

#15



$E_m = 2.\ \frac{V}{m}$

a. $c = \frac{E_m}{B_m}$, $B_m = \frac{E_m}{c} = \frac{2}{3\times10^{8}} = 0.67\times10^{-8} T$

$B_m = 6.7\ nT$

b. $I = \frac{1}{c\mu_0} E_{rms}^2 = \frac{1}{c\mu_0}\cdot\frac{E_m^2}{2} = \frac{1}{3\times10^{8}\times4\pi\times10^{-7}}\cdot\frac{4}{2}$

$= 5.3\times10^{-3}\ \frac{W}{m^2} = 5.3\ \frac{mW}{m^2}$

c. $I = \frac{P_s}{4\pi r^2}$, $P_s = I\times4\pi r^2$

$= 5.3\times10^{-3}\times4\times3.14\times100$

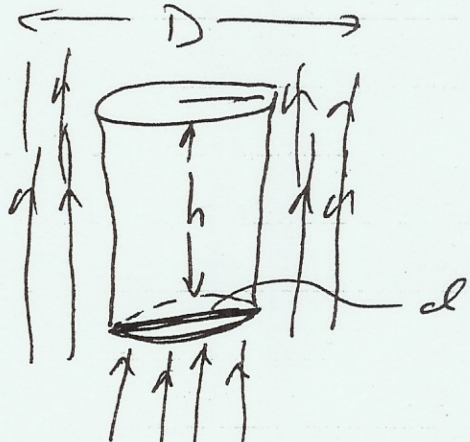
~~= 6.667 W~~ $= 6.7$ W

#20

$$P_r = \frac{I}{c} \quad \text{(Total absorbtion)}$$

$$= \frac{10}{3 \times 10^8} = 3.3 \times 10^{-7} \ \frac{N}{m^2}.$$

#26



The radiation pressure P_r is

$$P_r = \frac{2I}{c} \quad \text{Total reflection.}$$

~~$I = \frac{P}{4\pi r^2}$~~ $\frac{\text{Power}}{4\pi r^2}$

~~$I = \frac{\text{Power}}{\text{Area}} = \frac{\text{Power}}{\pi D^2}$~~

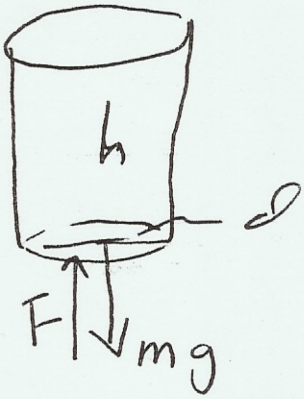
$$I = \frac{\text{Power}}{\text{Area}} = \frac{4.6}{\pi\left(\frac{D}{2}\right)^2} = \frac{4.6}{\pi(1.3 \times 10^{-3})^2}$$

$$= 8.67 \times 10^5 \ \frac{W}{m^2}.$$

#26.

$\therefore P_r = \frac{2I}{c} = \frac{2 \times 8.67 \times 10^5}{3 \times 10^8} = 5.78 \times 10^{-3} \frac{N}{m^2}$

The force on the lower face of the cylinder due to the laser is



$F = P_r A = 5.78 \times \pi (\frac{d}{2})^2 \times 10^{-3}$

At balance $F = mg$

m = mass of cylinder

= density × volume

$= \text{density} \times \pi (\frac{d}{2})^2 \times h \times 9.8$

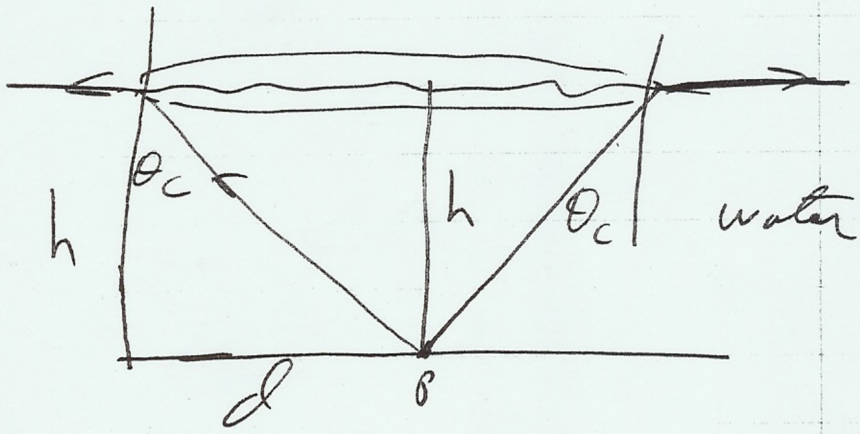
$\therefore 5.78 \times 10^{-3} = \frac{1.2 \times 10^{-3}}{10^{-6}} \frac{kg}{m^3} . h \times 9.8$

$5.78 \times 10^{-3} = 1.2 \times 10^3 \, h \times 9.8$

$\therefore h = \frac{5.78 \times 10^{-3}}{1.2 \times 10^3 \times 9.8}$

$= 0.49 \, \mu m$.

#55



~~sin θc =~~

$\tan\theta_c = \frac{d}{h}$

$\sin\theta_c = \frac{1}{n_1(\text{water})}$

$= \frac{1}{1.33}$

$\theta_c = \sin^{-1}\left(\frac{1}{1.33}\right)$

$\theta_c = 48.75^\circ$.

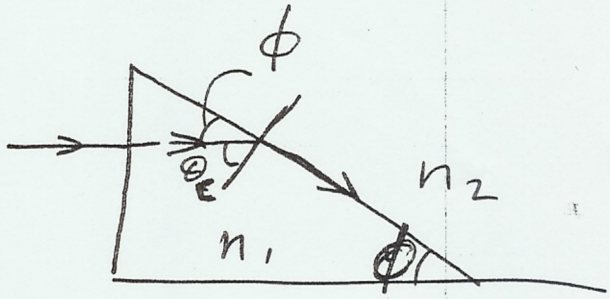
$d = h\tan\theta_c$

$= 80\tan 48.7$

$= 91.2$ cm.

$D = 1.82$ m.

#61



$\theta_c = 90 - \phi$

If the prism is in air

then $n_2 = 1$.

$\therefore \sin\theta_c = \frac{1}{n_{glass}} = \frac{1}{n_1}$

$= \frac{1}{1.52}$

or $\theta_c = 41.1$

$\therefore \phi = 90 - 41.1$

$= 48.86°C$

If prism in in water

then $n_2 = 1.33$

$\sin\theta_c = \frac{1.33}{1.52}$

$\theta_c = 61°$

$\phi = 29°$