P37.1 $\Delta y_{\text{bright}} = \dfrac{\lambda L}{d} = \dfrac{(632.8\times 10^{-9})(5.00)}{2.00\times 10^{-4}}\ \text{m} = \boxed{1.58\ \text{cm}}$

P37.16 (a) $\dfrac{I}{I_{\max}} = \cos^2\left(\dfrac{\phi}{2}\right)$ (Equation 37.11)

Therefore, $\phi = 2\cos^{-1}\sqrt{\dfrac{I}{I_{\max}}} = 2\cos^{-1}\sqrt{0.640} = \boxed{1.29\ \text{rad}}$.

(b) $\delta = \dfrac{\lambda\phi}{2\pi} = \dfrac{(486\ \text{nm})(1.29\ \text{rad})}{2\pi} = \boxed{99.8\ \text{nm}}$

P37.26 Constructive interference occurs where $m = 0,\ 1,\ 2,\ 3,\ \ldots,$ for

$$\left(\frac{2\pi x_1}{\lambda} - 2\pi ft + \frac{\pi}{6}\right) - \left(\frac{2\pi x_2}{\lambda} - 2\pi ft + \frac{\pi}{8}\right) = 2\pi m \qquad \frac{2\pi(x_1 - x_2)}{\lambda} + \left(\frac{\pi}{6} - \frac{\pi}{8}\right) = 2\pi m$$

$$\frac{(x_1 - x_2)}{\lambda} + \frac{1}{12} - \frac{1}{16} = m \qquad \boxed{x_1 - x_2 = \left(m - \frac{1}{48}\right)\lambda \qquad m = 0,\ 1,\ 2,\ 3,\ \ldots}.$$

P37.40 For total darkness, we want destructive interference for reflected light for both 400 nm and 600 nm. With phase reversal at just one reflecting surface, the condition for destructive interference is

$$2n_{\text{air}}t = m\lambda \qquad m = 0,\ 1,\ 2,\ \ldots.$$

The least common multiple of these two wavelengths is 1 200 nm, so we get no reflected light at $2(1.00)t = 3(400\ \text{nm}) = 2(600\ \text{nm}) = 1\,200\ \text{nm}$, so $t = 600\ \text{nm}$ at this second dark fringe.

By similar triangles, $\dfrac{600\ \text{nm}}{x} = \dfrac{0.050\,0\ \text{mm}}{10.0\ \text{cm}}$,

or the distance from the contact point is

$$x = (600\times 10^{-9}\ \text{m})\left(\frac{0.100\ \text{m}}{5.00\times 10^{-5}\ \text{m}}\right) = \boxed{1.20\ \text{mm}}.$$

P37.52 For destructive interference, the path length must differ by $m\lambda$. We may treat this problem as a double slit experiment if we remember the light undergoes a $\dfrac{\pi}{2}$-phase shift at the mirror. The second slit is the mirror image of the source, 1.00 cm below the mirror plane. Modifying Equation 37.5,

$$y_{\text{dark}} = \frac{m\lambda L}{d} = \frac{1(5.00\times 10^{-7}\ \text{m})(100\ \text{m})}{(2.00\times 10^{-2}\ \text{m})} = \boxed{2.50\ \text{mm}}.$$

P37.54 For dark fringes,

$2nt = m\lambda$

and at the edge of the wedge, $t = \dfrac{84(500\ \text{nm})}{2}$.

When submerged in water,

$2nt = m\lambda$

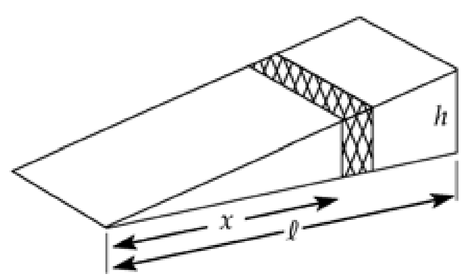

FIG. P37.54

$$m = \frac{2(1.33)(42)(500\ \text{nm})}{500\ \text{nm}}$$

so $m + 1 = \boxed{113\ \text{dark fringes}}$.

P38.6 (a) $\sin\theta = \frac{y}{L} = \frac{m\lambda}{a}$

Therefore, for first minimum, $m = 1$ and

$$L = \frac{ay}{m\lambda} = \frac{(7.50\times10^{-4}\ \text{m})(8.50\times10^{-4}\ \text{m})}{(1)(587.5\times10^{-9}\ \text{m})} = \boxed{1.09\ \text{m}}.$$

(b) $w = 2y_1$ yields $y_1 = 0.850$ mm

$$w = 2(0.850\times10^{-3}\ \text{m}) = \boxed{1.70\ \text{mm}}$$

P38.24 The principal maxima are defined by

$d\sin\theta = m\lambda$ $\quad m = 0,\ 1,\ 2,\ \ldots.$

For $m = 1$, $\quad \lambda = d\sin\theta$

where θ is the angle between the central ($m = 0$) and the first order ($m = 1$) maxima. The value of θ can be determined from the information given about the distance between maxima and the grating-to-screen distance. From the figure,

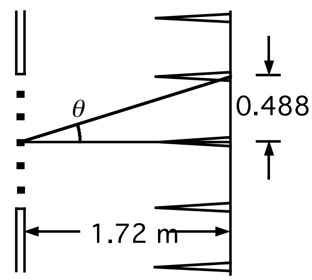

FIG. P38.24

$$\tan\theta = \frac{0.488\ \text{m}}{1.72\ \text{m}} = 0.284$$

so $\theta = 15.8°$

and $\sin\theta = 0.273$.

The distance between grating "slits" equals the reciprocal of the number of grating lines per centimeter

$$d = \frac{1}{5\ 310\ \text{cm}^{-1}} = 1.88\times10^{-4}\ \text{cm} = 1.88\times10^{3}\ \text{nm}.$$

The wavelength is $\quad \lambda = d\sin\theta = (1.88\times10^{3}\ \text{nm})(0.273) = \boxed{514\ \text{nm}}.$

P38.36 $2d\sin\theta = m\lambda \Rightarrow d = \frac{m\lambda}{2\sin\theta} = \frac{(1)(0.129\ \text{nm})}{2\sin(8.15°)} = \boxed{0.455\ \text{nm}}$

P38.47 Complete polarization occurs at Brewster's angle $\quad \tan\theta_p = 1.33 \quad \theta_p = 53.1°$.

Thus, the Moon is $\boxed{36.9°}$ above the horizon.