36. (a) On both sides of the soap is a medium with lower index (air) and we are examining the reflected light, so the condition for strong reflection is Eq. 35-36. With lengths in nm,

$$\lambda = \frac{2n_2L}{m+\frac{1}{2}} = \begin{cases} 3360 & \text{for } m = 0 \\ 1120 & \text{for } m = 1 \\ 672 & \text{for } m = 2 \\ 480 & \text{for } m = 3 \\ 373 & \text{for } m = 4 \\ 305 & \text{for } m = 5 \end{cases}$$

from which we see the latter *four* values are in the given range.

(b) We now turn to Eq. 35-37 and obtain

$$\lambda = \frac{2n_2L}{m} = \begin{cases} 1680 & \text{for } m = 1 \\ 840 & \text{for } m = 2 \\ 560 & \text{for } m = 3 \\ 420 & \text{for } m = 4 \\ 336 & \text{for } m = 5 \end{cases}$$

from which we see the latter *three* values are in the given range.

39. For constructive interference, we use Eq. 35-36:

$$2n_2 L = (m + 1/2)\lambda \, .$$

For the smallest value of L, let $m = 0$:

$$L_0 = \frac{\lambda/2}{2n_2} = \frac{624\,\text{nm}}{4(1.33)} = 117\,\text{nm} = 0.117\,\mu\text{m}.$$

(b) For the second smallest value, we set $m = 1$ and obtain

$$L_1 = \frac{\left(1+1/2\right)\lambda}{2n_2} = \frac{3\lambda}{2n_2} = 3L_0 = 3\left(0.1173\mu\text{m}\right) = 0.352\mu\text{m}.$$

75. **THINK** The formation of Newton's rings is due to the interference between the rays reflected from the flat glass plate and the curved lens surface.

EXPRESS Consider the interference pattern formed by waves reflected from the upper and lower surfaces of the air wedge. The wave reflected from the lower surface undergoes a π rad phase change while the wave reflected from the upper surface does not.

At a place where the thickness of the wedge is d, the condition for a maximum in intensity is $2d=\left(m+\frac{1}{2}\right)\lambda$, where λ is the wavelength in air and m is an integer. Therefore,

$$d = (2m + 1)\lambda/4.$$

ANALYZE As the geometry of Fig. 35-46 shows, $d=R-\sqrt{R^2-r^2}$, where R is the radius of curvature of the lens and r is the radius of a Newton's ring. Thus, $\left(2m+1\right)\lambda/4=R-\sqrt{R^2-r^2}$. First, we rearrange the terms so the equation becomes

$$\sqrt{R^2-r^2}=R-\frac{\left(2m+1\right)\lambda}{4}.$$

Next, we square both sides, rearrange to solve for r^2, then take the square root. We get

$$r=\sqrt{\frac{\left(2m+1\right)R\lambda}{2}-\frac{\left(2m+1\right)^2\lambda^2}{16}}.$$

If R is much larger than a wavelength, the first term dominates the second and

$$r=\sqrt{\frac{\left(2m+1\right)R\lambda}{2}}.$$

LEARN Similarly, the radii of the dark fringes are given by

$$r=\sqrt{mR\lambda}.$$