24.3 (a) The distance between the central maximum and the first order bright fringe is

$$\Delta y = y_{bright}\Big|_{m=1} - y_{bright}\Big|_{m=0} = \frac{\lambda L}{d}\text{, or}$$

$$\Delta y = \frac{\lambda L}{d} = \frac{\left(546.1\times10^{-9}\text{ m}\right)\left(1.20\text{ m}\right)}{0.250\times10^{-3}\text{ m}} = 2.62\times10^{-3}\text{ m} = \boxed{2.62\text{ mm}}$$

(b) The distance between the first and second dark bands is

$$\Delta y = y_{dark}\Big|_{m=1} - y_{dark}\Big|_{m=0} = \frac{\lambda L}{d} = \boxed{2.62\text{ mm}} \text{ as in (a) above.}$$

24.16 With $n_{glass} > n_{air}$ and $n_{liquid} < n_{glass}$, light reflecting from the air-glass boundary experiences a 180° phase shift, but light reflecting from the glass-liquid boundary experiences no shift. Thus, the condition for destructive interference in the two reflected waves is

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

For minimum (non-zero) thickness, $m = 1$ giving $t = \dfrac{\lambda}{2n_{glass}} = \dfrac{580 \text{ nm}}{2(1.50)} = \boxed{193 \text{ nm}}$

24.26 With a phase reversal due to reflection at each surface of the magnesium fluoride layer, there is zero net phase difference caused by reflections. The condition for destructive interference is then

$$2t=\left(m+\frac{1}{2}\right)\lambda_n=\left(m+\frac{1}{2}\right)\frac{\lambda}{n_{film}}, \text{ where } m=0,1,2,\ldots$$

For minimum thickness, $m=0$, and the thickness is

$$t=(2m+1)\frac{\lambda}{4n_{film}}=(1)\frac{\left(550\times10^{-9}\text{ m}\right)}{4(1.38)}=9.96\times10^{-8}\text{ m}=\boxed{99.6\text{ nm}}$$

24.61 With $n_{air} < n_{oil} < n_{water}$, there is a 180° phase shift in light reflecting from each surface of the oil film. In such a case, the conditions for constructive and destructive interference are reversed from those valid when a phase shift occurs at only one surface. Thus, in this case, the condition for constructive interference is

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

If $n_{oil} = 1.25$ and $\lambda = 525\text{ nm}$, thicknesses of the oil film producing constructive interference are

$$t = m\left[\frac{\lambda}{2n_{oil}}\right] = m\left[\frac{525\text{ nm}}{2(1.25)}\right] = m(210\text{ nm}) \quad \text{or} \quad \boxed{\text{any positive integral multiple of 210 nm}}$$