25.51

The value of n for glass is around 1.5 (see Table 23.1), so $n_1 < n_f < n_2$, and there is a phase shift in the glass-ethyl alcohol interface as well as ethyl alcohol-air interface. No net phase shift therefore exists between the beams reflected off the top and bottom of the ethyl alcohol layer, and so Eq. (25.11) applies: $d = m\lambda_0/2n_f$, where $m = 1, 2, 3, \ldots$ For d_{min} take $m = 1$, along with $\lambda_0 = 700\,\text{nm}$, and $n_f = 1.36$, to obtain

$$d_{min} = \frac{m\lambda_0}{2n_f} = \frac{(1)(700\,\text{nm})}{2(1.36)} = 257\,\text{nm}.$$

25.54

In this case $n_1 < n_f > n_2$, as $n_1 = 1.00$ (air), $n_f = 1.42$ (oil), and $n_2 = 1.333$ (water), Eq. (25.12) applies: $d = (m + \frac{1}{2})\lambda_0/2n_f$, where $m = 0, 1, 2, \ldots$. For minimum value of d : $m = 0$, and plug in $\lambda_0 = 400\,\text{nm}$, and $n_f = 1.42$, to obtain

$$d_{min} = \frac{(m + \frac{1}{2})\,\lambda_0}{2n_f} = \frac{400\,\text{nm}}{4(1.42)} = 70.4\,\text{nm}.$$

25.60

Refer to Fig. P60. The wedge-shaped air layer in between the two glass plates provides continuously varying thickness d, from $d = 0$ at the apex to $d = x\tan\alpha \approx x\alpha$ a distance x from the apex. If d assumes the value for the m-th order reflection maximum to occur, then the corresponding value of x is $x_m \approx d_m/\alpha$. Note that there is a π-phase shift due to the difference in the two reflections, one off the top and the other off the bottom of the wedge, so

the condition for the m-th reflection maximum is similar to Eq. (25.12): $d_m = (m + \frac{1}{2})\lambda_f/$ $(m = 0, 1, 2, \ldots)$ Here we noted that $\lambda_f = \lambda_0/n_f$. Therefore

$$x_m \approx \frac{d_m}{\alpha} = \frac{(m + \frac{1}{2})\lambda_f}{2\alpha} \qquad (m = 0, 1, 2, \ldots).$$

26.3

Since by definition $\gamma = 1/\sqrt{1-\beta^2}$,

$$\frac{\gamma^2 - 1}{\gamma^2} = \frac{\left(1/\sqrt{1-\beta^2}\right)^2 - 1}{\left(1/\sqrt{1-\beta^2}\right)^2} = 1 - \frac{1}{1/(1-\beta^2)} = 1 - (1-\beta^2) = \beta^2.$$