Answer for 10.5

(a)

$$Q \gg \left(\frac{4c\epsilon\hbar\pi V_0}{\lambda\mu_{12}^2}\right)^{1/2} \Rightarrow Q_{min} = 5\times 10^7 \tag{1}$$

(b)

$$\left.\begin{array}{l} \Delta\omega = \frac{\pi c}{n\mathcal{F}L_{cav}} \\ Q = \frac{\omega}{\Delta\omega} \gg \left(\frac{4c\epsilon\hbar\pi V_0}{\lambda\mu_{12}^2}\right)^{1/2} \end{array}\right\} \Rightarrow \mathcal{F} \gg \frac{\lambda}{2nL_{cav}}\left(\frac{4c\epsilon\hbar\pi V_0}{\lambda\mu_{12}^2}\right)^{1/2} \Rightarrow \mathcal{F}_{min} = 60000 \tag{2}$$

(c)

$$\left.\begin{array}{l} \tau_{cav} = \frac{nL_{cav}}{c(1-R)} \\ \Delta\omega = \left(\tau_{cav}\right)^{-1} \equiv \kappa \\ Q = \frac{\omega}{\Delta\omega} \gg \left(\frac{4c\epsilon\hbar\pi V_0}{\lambda\mu_{12}^2}\right)^{1/2} \end{array}\right\} \Rightarrow R \gg 1 - \frac{2\pi nL_{cav}}{\lambda}\left(\frac{\lambda\mu_{12}^2}{4c\epsilon\hbar\pi V_0}\right)^{1/2} \Rightarrow R_{min} = 99.995\% \tag{3}$$

Answer for 10.8

$$F_p = \frac{3Q\left(\lambda/n\right)^3}{4\pi^2 V_0} = \frac{3\left(\lambda/n\right)^3\left(\lambda^2 - \frac{1}{4}\Delta\lambda^2\right)}{4\pi^2 V_0\lambda\Delta\lambda} \approx 4.1 \tag{4}$$

Answer for 10.11

(a)

$$\left.\begin{array}{l} \Delta\omega = \frac{1}{\tau_{cav}} \\ \Delta\omega = \frac{\pi c}{n\mathcal{F}L_{cav}} \end{array}\right\} \Rightarrow \tau_{cav} = \frac{n\mathcal{F}L_{cav}}{\pi c} \approx 88.28\text{ns} \Rightarrow \tau_{cav} \sim 100\text{ns} \tag{5}$$

(b)

$$\Delta\Omega^{vac} = 2\sqrt{N}g_0 > \kappa \Rightarrow N > \left(\frac{1}{2g_0\tau}\right)^2 \approx 25 \tag{6}$$