① $I_L = I_o e^{gL} \Rightarrow 1.1 = 1\, e^{g(0.1)} \Rightarrow \underline{g = 0.95\, m^{-1}}$

② $g_{th} \geqslant \alpha_{eff} + \frac{1}{2L} \ln\left(\frac{1}{R_1 R_2}\right)$

$\Rightarrow g_{th} = 0 + \frac{1}{2\times 0.5} \ln\left(\frac{1}{0.9\times 0.9}\right) = \underline{0.210\, m^{-1}}$

③ $\Delta\nu = 10^8\, Hz \Rightarrow g(\omega) = \frac{1}{\Delta\omega} = \frac{1}{2\pi\Delta\nu} = 1.59\times 10^{-9}\, s \approx \underline{1.6\, ns}$

④ $g_{th} = \alpha_{eff} + \frac{1}{2L} \ln\left(\frac{1}{R_1 R_2}\right)$

$\Rightarrow g_{th} = \left[0.1 + \frac{1}{2\times 0.1} \ln\left(\frac{1}{0.96\times 0.96}\right)\right] = \underline{0.508\, m^{-1}}$

$\therefore$ cavity lifetime $t_c = \frac{n_0}{c\, g_{th}} = \frac{1.78}{3\times 10^8 \times 0.508}$

$\Rightarrow t_c = 1.168\times 10^{-8}\, s \approx \underline{11.7\, ns}$

⑤ $g_{th} = \alpha_{eff} + \frac{1}{2L} \ln\left(\frac{1}{R_1 R_2}\right)$

$\Rightarrow 0.02 = 0 + \frac{1}{2\times 1} \ln\left(\frac{1}{1\times R_2}\right) \Rightarrow 0.04 = \ln\left(\frac{1}{R_2}\right)$

$\Rightarrow R_2 = 0.961 \approx \underline{96\,\%}$

⑥ $g_{th} = \alpha_{eff} + \frac{1}{2L} \ln\left(\frac{1}{R_1 R_2}\right) = 0 + \frac{1}{2\times 0.2} \ln\left(\frac{1}{0.98\times 0.98}\right)$

$= \underline{0.101\, m^{-1}}$

$\therefore t_c = \frac{n_0}{c\, g_{th}} = \frac{1}{3\times 10^8 \times 0.101} = 3.3\times 10^{-8}\, s \approx \underline{33\, ns}$

⑦ $g_{th} = \alpha_{eff} + \frac{1}{2L} \ln\left(\frac{1}{R_1 R_2}\right) = 30 + \frac{1}{(2\times 600\times 10^{-4})} \ln\left(\frac{1}{0.3\times 0.3}\right)$

$\Rightarrow g_{th} = 30 + \frac{1}{0.12} \ln\left(\frac{1}{0.09}\right) = \underline{50\, cm^{-1}}$

⑧ To be theortically discussed.