Chapter 10, Solution 92.

Let $V_2 =$ voltage at the noninverting terminal of the op amp

$V_o =$ output voltage of the op amp

$$Z_s = R_o$$

$$Z_p = j\omega L \,||\, \frac{1}{j\omega C} \,||\, R = \frac{1}{\frac{1}{R} + j\omega C + \frac{1}{j\omega L}} = \frac{\omega RL}{\omega L + jR(\omega^2 LC - 1)}$$

As in Section 10.9,

$$\frac{V_2}{V_o} = \frac{Z_p}{Z_s + Z_p} = \frac{\frac{\omega RL}{\omega L + jR(\omega^2 LC - 1)}}{R_o + \frac{\omega RL}{\omega L + jR(\omega^2 LC - 1)}}$$

$$\frac{V_2}{V_o} = \frac{\omega RL}{\omega RL + \omega R_o L + jR_o R\,(\omega^2 LC - 1)}$$

For this to be purely real,

$$\omega_o^2 LC = 1 \quad \rightarrow \quad f_o = \frac{1}{2\pi\sqrt{LC}}$$

(a) At $\omega = \omega_o$,

$$\frac{V_2}{V_o} = \frac{\omega_o RL}{\omega_o RL + \omega_o R_o L} = \frac{R}{R + R_o}$$

This must be compensated for by

$$A_v = \frac{V_o}{V_2} = 1 + \frac{R_f}{R_o} = 1 + \frac{1000\,k}{100\,k} = 11$$

Hence,

$$\frac{R}{R + R_o} = \frac{1}{11} \quad \rightarrow \quad R_o = 10\,R = \textbf{100 k}\Omega$$

(b)

$$f_o = \frac{1}{2\pi\sqrt{(10\times10^{-6})(2\times10^{-9})}}$$

$$f_o = \textbf{1.125 MHz}$$