

# HW 11 Solutions

11.3

$$\begin{aligned} \frac{V_0}{V_1}(s) &= \frac{(R_2 + sL)}{(R_2 + sL) + \frac{R_1/s}{R_1 + 1/sC}} = \frac{R_2 + sL}{(R_2 + sL) + \frac{R_1}{sCR_1 + 1}} \\ &= \frac{(R_2 + sL)(sCR_1 + 1)}{R_2 + sCR_1R_2 + s^2LCR_1 + sL + R_1} \\ &= \frac{(R_2 + sL)(sCR_1 + 1)}{s^2LCR_1 + s(L + CR_1R_2) + R_1R_2} \\ &= \frac{(s + R_2/L)(s + 1/CR_1)}{s^2 + \left[ \frac{1}{R_1C} + \frac{R_2}{L} \right]s + \frac{R_1 + R_2}{R_1LC}} \end{aligned}$$

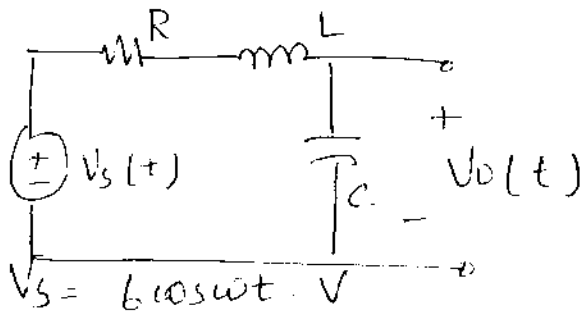
11.34.

$$\omega_0 = 2000 \text{ r/s} = \frac{1}{\sqrt{LC}} \Rightarrow L = 12.5 \text{ mH}$$

$$Q = \frac{\omega_0 L}{R} = \frac{2000 \times 12.5 \times 10^{-3}}{2.4} = 10.42$$

$$BW = \frac{\omega_0}{Q} = \frac{2000}{10.42} = 192 \text{ r/s}$$

11.37



$$\omega_0 = \frac{1}{\sqrt{LC}} = 7071 \text{ rad/s}$$

$$Q = \frac{\omega_0 L}{R} = 14.14$$

$$\omega_{\max} = \omega_0 \sqrt{1 - \frac{2}{2.02}} = 7062 \text{ rad/s}$$

$$|v_o|_{\max} = \frac{Q |v_s|}{\sqrt{1 - 1/4.02}} = 84.89 \text{ V}$$

11.45

$$BW = \frac{1}{RC} = \frac{1}{(1000) \times 10^{-5}} = 100 \text{ rad/s}$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(10^{-1})(10^{-5})}} = 1000 \text{ rad/s}$$

$$\omega_0^2 = \omega_{H1} \omega_{L1} \quad \text{and} \quad \omega_{H1} - \omega_{L1} = BW \quad \therefore \omega_{L1} = \frac{\omega_0^2}{\omega_{H1}}$$

$$\omega_{H1}^2 = BW \omega_{H1} - \omega_0^2 = 0$$

$$\text{and } \omega_{H1} = \frac{BW + \sqrt{BW^2 + 4\omega_0^2}}{2}$$

$$\omega_{H1} = 1051.25 \text{ rad/s}$$

$$\omega_{L1} = 1051.25 - 100 = 951.25 \text{ rad/s}$$

At resonance  $|V_0| = 2 \text{ kV}$  and half-power frequency

$$|V_0| = \frac{2 \text{ kV}}{\sqrt{2}} = 1.41 \text{ kV}$$

11-FE-2

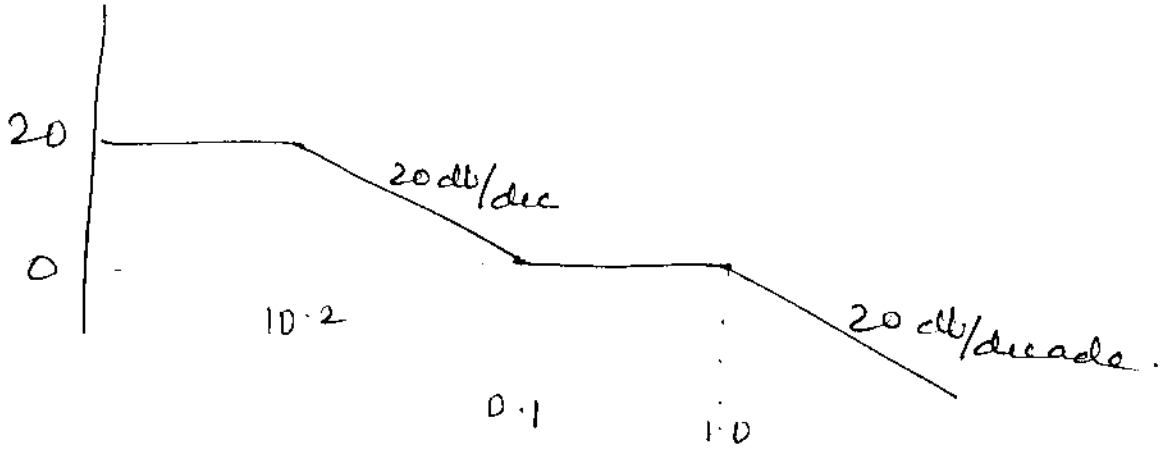
$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(20 \times 10^{-3})(50 \times 10^{-6})}} = 1000 \text{ rad/s}$$

$$Q = \frac{\omega_0 L}{R} \quad \text{and} \quad BW = \frac{\omega_0}{Q}$$

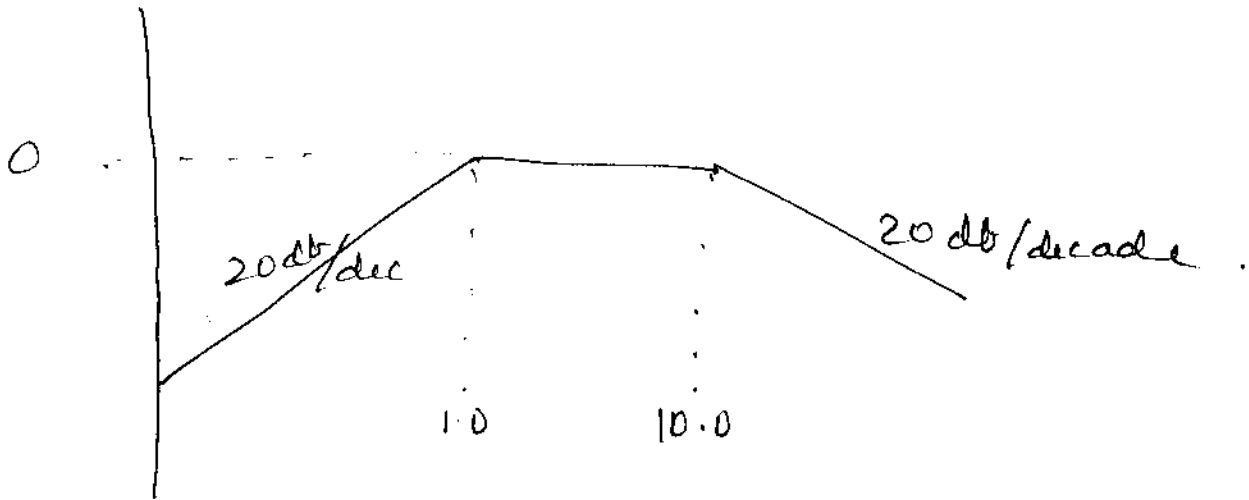
$$\therefore BW = \frac{R}{L} \quad \text{and} \quad 200 = \frac{R}{20 \times 10^{-3}}$$

$$\therefore R = 4 \Omega$$

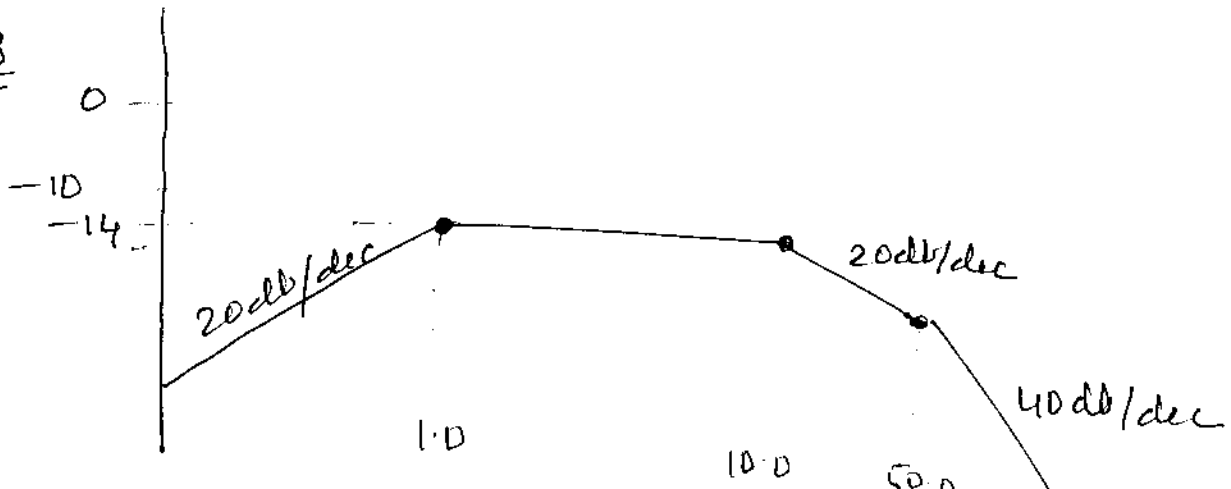
11.8



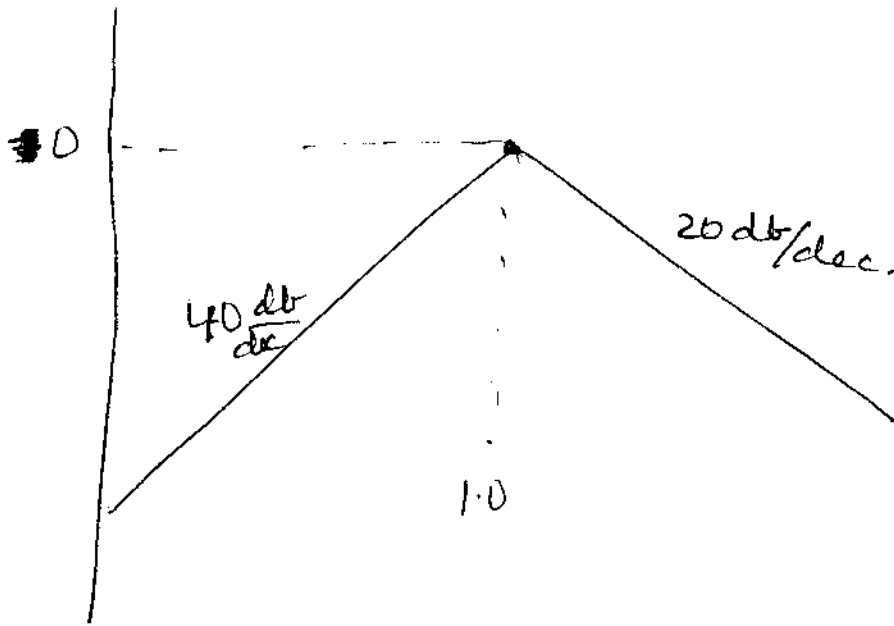
11.9



11.13



11.21



11.29

$$H(j\omega) = \frac{40 (j\omega/50 + 1) (j\omega/1000 + 1)}{(j\omega) (j\omega/400 + 1)^2}$$