

(1)

HW7. Solutions

$$(1) (a) \quad \omega_c = \frac{R}{L} = \frac{1500}{250 \times 10^{-3}} = 6000 \text{ (rad/s)}$$

$$f_c = \frac{\omega_c}{2\pi} = 954.9 \text{ (Hz)}$$

$$(b) \quad H(s) = \frac{R/L}{s + R/L} = \frac{6000}{s + 6000}$$

$$H(j\omega) = \frac{6000}{6000 + j\omega}$$

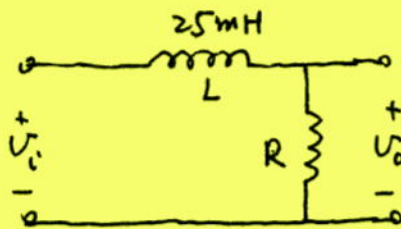
$$H(j\omega_c) = \frac{6000}{6000 + j6000} = 0.707 \angle -45^\circ$$

$$H(j3\omega_c) = \frac{6000}{6000 + j18,000} = 0.316 \angle -71.6^\circ$$

$$(c) \quad V_o(\omega_c) = 0.707 \times 50 \text{ V} \angle (6000t - 45^\circ) \text{ (V)}$$

$$V_o(3\omega_c) = 0.316 \times 50 \text{ V} \angle (18,000t - 71.6^\circ) \text{ (V)}$$

(2)



$$(a) \quad \omega_c = \frac{R}{L}$$

$$\Rightarrow R = L\omega_c = 2\pi L f_c$$

$$\Rightarrow R = 2\pi \times 25 \times 10^{-3} \times 2.5 \times 10^3$$

$$= 392.7 \text{ } (\Omega)$$

$$(b) \quad R_{\text{eff}} = 392.7 // 750 = 257.7 \text{ } (\Omega)$$

$$\omega_{c, \text{loaded}} = \frac{R_{\text{eff}}}{L} = 10,309.8 \text{ (rad/s)}$$

$$\Rightarrow f_{c, \text{loaded}} = 1640.9 \text{ (Hz)}$$

(2)

$$(3) (a) \quad \omega_c = \frac{1}{RC} = \frac{1}{4 \times 10^{-9} \times 20 \times 10^3} = 12,500 \text{ (rad/s)}$$

$$f_c = \frac{\omega_c}{2\pi} = 1989.4 \text{ (Hz)}$$

$$(b) \quad H(j\omega) = \frac{\frac{1}{RC}}{j\omega + \frac{1}{RC}} = \frac{12,500}{j\omega + 12,500} \quad \text{EVA 70V/XX}$$

$$H(j\omega_c) = \frac{12,500}{12,500 + j12,500} = 0.707 \angle -45^\circ$$

$$H(8j\omega_c) = \frac{12,500}{12,500 + j100,000} = 0.124 \angle -82.9^\circ$$

$$(c) \quad V_o(\omega_c) = 0.707 \times 480 \cos(12,500t - 45^\circ) \text{ (mV)}$$

$$V_o(8\omega_c) = 0.124 \times 480 \cos(100,000t - 82.9^\circ) \text{ (mV)}$$