

P 9.11

a) $y = 50 \cos(500t + 60^\circ) + 100 \cos(500t - 30^\circ)$

$$Y = Y_1 + Y_2$$

$$= 50 \angle 60^\circ + 100 \angle -30^\circ$$

$$= 50 (\cos 60^\circ + j \sin 60^\circ) + 100 (\cos(-30^\circ) + j \sin(-30^\circ))$$

$$= 25 + j43.3 + 86.6 - j50$$

$$= 111.6 - j6.7$$

$$= 111.8 \angle -3.44^\circ$$

$$y = 111.8 \cos(500t - 3.44^\circ)$$

b) $y = 200 \cos(377t + 50^\circ) - 100 \sin(377t + 150^\circ)$
 $= 200 \cos(377t + 50^\circ) - 100 \cos(377t + 60^\circ)$

$$Y = 200 \angle 50^\circ - 100 \angle 60^\circ$$

$$= 200 (\cos 50^\circ + j \sin 50^\circ) - 100 (\cos 60^\circ + j \sin 60^\circ)$$

$$= 78.56 + j66.61$$

$$= 103 \angle 40.29^\circ$$

$$y = 103 \cos(377t + 40.29^\circ)$$

c) $y = 80 \cos(100t + 30^\circ) - 100 \sin(100t - 135^\circ) + 50 \cos(100t - 90^\circ)$
 $= 80 \cos(100t + 30^\circ) - 100 \cos(100t - 225^\circ) + 50 \cos(100t - 90^\circ)$

$$Y = 80 \angle 30^\circ - 100 \angle -225^\circ + 50 \angle -90^\circ$$

$$= 161.6 \angle -29.97^\circ$$

$$y = 161.6 \cos(100t - 29.97^\circ)$$

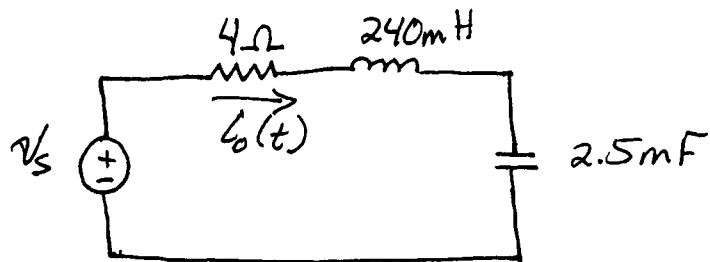
d) $y = 250 \cos \omega t + 250 \cos(\omega t + 120^\circ) + 250 \cos(\omega t - 120^\circ)$

$$Y = 250 \angle 0^\circ + 250 \angle 120^\circ + 250 \angle -120^\circ$$

$$= 0$$

$$y = 0$$

P 9.16



$$\begin{aligned}v_s &= 100 \sin 50t \text{ mV} \\ &= 100 \cos (50t - 90^\circ)\end{aligned}$$

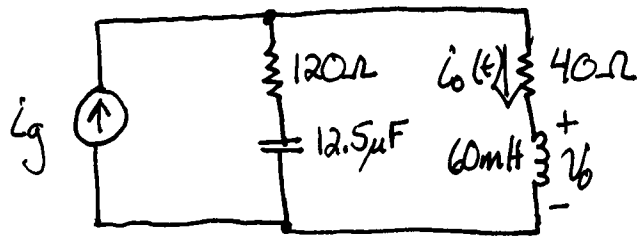
$$V_s = 100 \angle -90^\circ$$

$$\begin{aligned}Z_{eq} &= Z_R + Z_L + Z_C \\ &= R + j\omega L - j\frac{1}{\omega C} \\ &= 4 + j50(240\text{m}) - j\frac{1}{50(2.5\text{m})} \\ &= 4 + j12 - j8 \\ &= 4 + j4 \\ &= 5.66 \angle 45^\circ\end{aligned}$$

$$I = \frac{V_s}{Z_{eq}} = \frac{100 \angle -90^\circ}{5.66 \angle 45^\circ} = 17.67 \angle -135^\circ$$

$$i_0(t) = 17.67 \cos (50t - 135^\circ) \text{ mA}$$

P 9.18



$$i_g = 0.5 \cos 200t \text{ A}$$

$$I_g = 0.5 \angle 0^\circ$$

- current divider

$$I_o = \frac{Z_{120} + Z_c}{Z_{TOT}} \cdot I_g$$

$$= \frac{120 - j40}{120 - j40 + 40 + j120} \cdot I_g$$

$$= \frac{120 - j40}{160 + j80} \cdot 0.5 \angle 0^\circ$$

$$= \frac{126.4911064 \angle -18.43494882^\circ}{178.8854382 \angle 26.56505118^\circ} \cdot 0.5 \angle 0^\circ$$

$$= 0.707106781 \angle -45^\circ \cdot 0.5 \angle 0^\circ$$

$$= 0.353553391 \angle -45^\circ$$

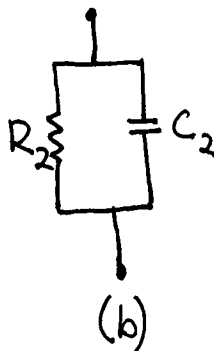
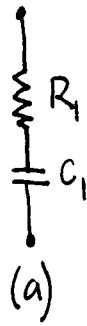
$$V_o = I_o Z_L$$

$$= 0.353553391 \angle -45^\circ \cdot 120 \angle 90^\circ$$

$$= 42.42640687 \angle 45^\circ$$

$$v_o = 42.43 \cos(200t + 45^\circ) \text{ V}$$

P9.22



$$R_2 = \frac{1 + \omega^2 R_1^2 C_1^2}{\omega^2 R_1 C_1^2}$$

$$C_2 = \frac{C_1}{1 + \omega^2 R_1^2 C_1^2}$$

a) $Z_a = R_1 + \frac{1}{j\omega C_1}$

$$= \frac{1 + j\omega R_1 C_1}{j\omega C_1} \cdot \frac{1 - j\omega R_1 C_1}{1 - j\omega R_1 C_1}$$

$$= \frac{1 + \omega^2 R_1^2 C_1^2}{j\omega C_1 + \omega^2 R_1 C_1^2}$$

$$\Rightarrow Z_a = Z_b$$

$$Z_b = \left(\frac{1}{R_2} + \frac{1}{j\omega C_2} \right)^{-1}$$

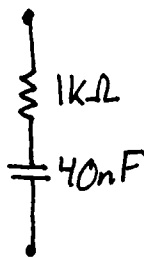
$$= \left(\frac{1}{R_2} + j\omega C_2 \right)^{-1}$$

$$= \left(\frac{\omega^2 R_1 C_1^2}{1 + \omega^2 R_1^2 C_1^2} + \frac{j\omega C_1}{1 + \omega^2 R_1^2 C_1^2} \right)^{-1}$$

$$= \left(\frac{\omega^2 R_1 C_1^2 + j\omega C_1}{1 + \omega^2 R_1^2 C_1^2} \right)^{-1}$$

$$= \frac{1 + \omega^2 R_1^2 C_1^2}{\omega^2 R_1 C_1^2 + j\omega C_1}$$

b)



$$\omega = 50 \text{krad/s}$$

$$R_2 = \frac{1 + (50 \times 10^3)^2 (1 \times 10^3)^2 (40 \times 10^{-9})^2}{(50 \times 10^3)^2 (1 \times 10^3) (40 \times 10^{-9})^2}$$

$$= 1250 \Omega = 12.5 \text{k}\Omega$$

$$C_2 = \frac{40 \times 10^{-9}}{1 + (50 \times 10^3)^2 (1 \times 10^3)^2 (40 \times 10^{-9})^2}$$

$$= 8 \times 10^{-9} \text{F} = 8 \text{nF}$$