

**Note:**  $M\angle\theta = Me^{j\theta}$ ; angles in degrees; impedances in  $\Omega$  throughout.

1a.  $500\angle 60; 400; j(8000)(0.0875) = j700; 1/[j(8000)(312.5 \times 10^{-9})] = -j400$  in series.

1b.  $I = (500\angle 60)/(400 + j700 - j400) = 1\angle 23.13$ . **1c.**  $i(t) = \cos(8000t + 23.13)A$ .

2a.  $Y = j\omega(0.004) + \frac{1}{10 + j\omega(2)} = \frac{10}{100 + 4\omega^2} + j[\omega(0.004) - \frac{\omega(2)}{100 + 4\omega^2}]$ .

Want  $0 = \text{Im}[Y] = \omega(0.004) - \frac{\omega(2)}{100 + 4\omega^2} \rightarrow \omega = 10 \rightarrow 1.59Hz$  ( $\omega$  cancels).

2b.  $Y = \frac{10}{100 + 4(10)^2} = 0.02 \rightarrow I = \frac{10}{(1/0.02) + 150} = 0.05 \rightarrow i_o(t) = 0.05 \cos(10t)A$ .

3. **Sources:**  $V = 50\angle -45; I = 0.1\angle -8.13 \rightarrow Z = \frac{V}{I} = 500\angle -36.87 = 400 - j300$ .

**Impedance:**  $Z = 400 + j[\omega(0.04) - 1/(\omega(4 \times 10^{-7}))] = 400 - j300$  if  $\omega = 5000$ .

Quadratic eqn:  $\omega(0.04) - 10^7/(4\omega) = -300 \rightarrow \omega^2 + 7500\omega - (62,500,000) = 0$ .

4.  $Y$  of parallel branches:  $Y = \frac{1}{6-j2} + \frac{1}{4+j12} + \frac{1}{5} + \frac{1}{j10} = \frac{3-j}{8}$ . (50 millisiemens  $\angle 36.87$ ).

$Z_{ab} = -j12.8 + \frac{8}{3-j} + 13.6 = 16 - j12 = 20\angle -36.87 \rightarrow Y_{ab} = 0.05\angle 36.87 = 0.04 + j0.03$ .

5. Need  $Y_2 = \frac{1}{R_2} - \frac{j}{\omega L_2} = Y_1 = \frac{1}{R_1 + j\omega L_1} = \frac{R_1 - j\omega L_1}{R_1^2 + \omega^2 L_1^2} \rightarrow \frac{1}{R_2} = \frac{R_1}{R_1^2 + \omega^2 L_1^2}; \frac{1}{\omega L_2} = \frac{\omega L_1}{R_1^2 + \omega^2 L_1^2}$

$\rightarrow R_2 = (R_1^2 + \omega^2 L_1^2)/R_1$  and  $L_2 = (R_1^2 + \omega^2 L_1^2)/(\omega^2 L_1)$  as desired.

6.  $Z_1 = 600 - j/[(5000)(0.25 \times 10^{-6})] = 600 - j800$ .  $Z_2 = 300 + j(5000)(0.4) = 300 + j2000$ .

$V_o = (75\angle 0) \frac{600 - j800}{(600 - j800) + (300 + j2000)} = (75) \frac{1000\angle -53.13}{1500\angle 53.13} = 50\angle -106.26$  (voltage divider).

$v_o(t) = 50 \cos(5000t - 106.26)$ .

7. Parallel branches:  $Z = (100 + j(1000)(0.1)) || (-j100) = \frac{10000(1-j)}{100 + j100 - j100} = 100(1 - j)$ .

$V_{OC} = (247.49\angle 45) \frac{100(1-j)}{j100 + 100(1-j)} = (247.49\angle 45)(\sqrt{2}\angle -45) = 350\angle 0$ .

$R_{TH} = (j100) || 100(1 - j) = \frac{(j100)100(1-j)}{j100 + 100(1-j)} = 100(1 + j)$ .

8. Sources:  $V_{g1} = 10\angle 53.13 = 6 + j8$ .  $V_{g2} = 8\angle -90 = -j8$ .  $Z_c = \frac{-j}{(5000)(0.00005)} = -j4$ .

$\frac{V_o - (6 + j8)}{j(5000)(0.0004)} + \frac{V_o}{6} + \frac{V_o - 8j}{-j4} = 0 \rightarrow V_o = 12 \rightarrow v_o(t) = 12 \cos(5000t)$ .