《Fundamentals of Electric Circuits》 homework CH.9

9.19 Using phasors find:

(a) 3 cos(20t + 10°) - 5 cos(20t - 30°)

(b) 40 sin 50t + 30 cos(50t - 45°)

(c) 20 sin 400t + 10 cos(400t + 60°) - 5 sin(400t - 20°) **(20')**

解: a) 原式 $= 3\angle 10° - 5\angle -30°$

$= 3\cos 10° + 3\sin 10° j - (5\cos 30° - 5\sin 30° j)$

$= -1.376 + 3.021j = 3.320\cos(20t - 65.51°)$

b) 原式 $= 40\angle -90° + 30\angle -45°$

$= 40\cos 90° - 40\sin 90° j + 30\cos 45° + 30\sin(-45°)j$

$= 21.21 - 61.21j = 64.78\cos(50t - 70.89°)$

c) 原式 $= 20\angle -90° + 10\angle 60° - 5\angle -110°$

$= 20\cos 90° - 20\sin 90° j + 10\cos 60° + 10\sin 60° j$

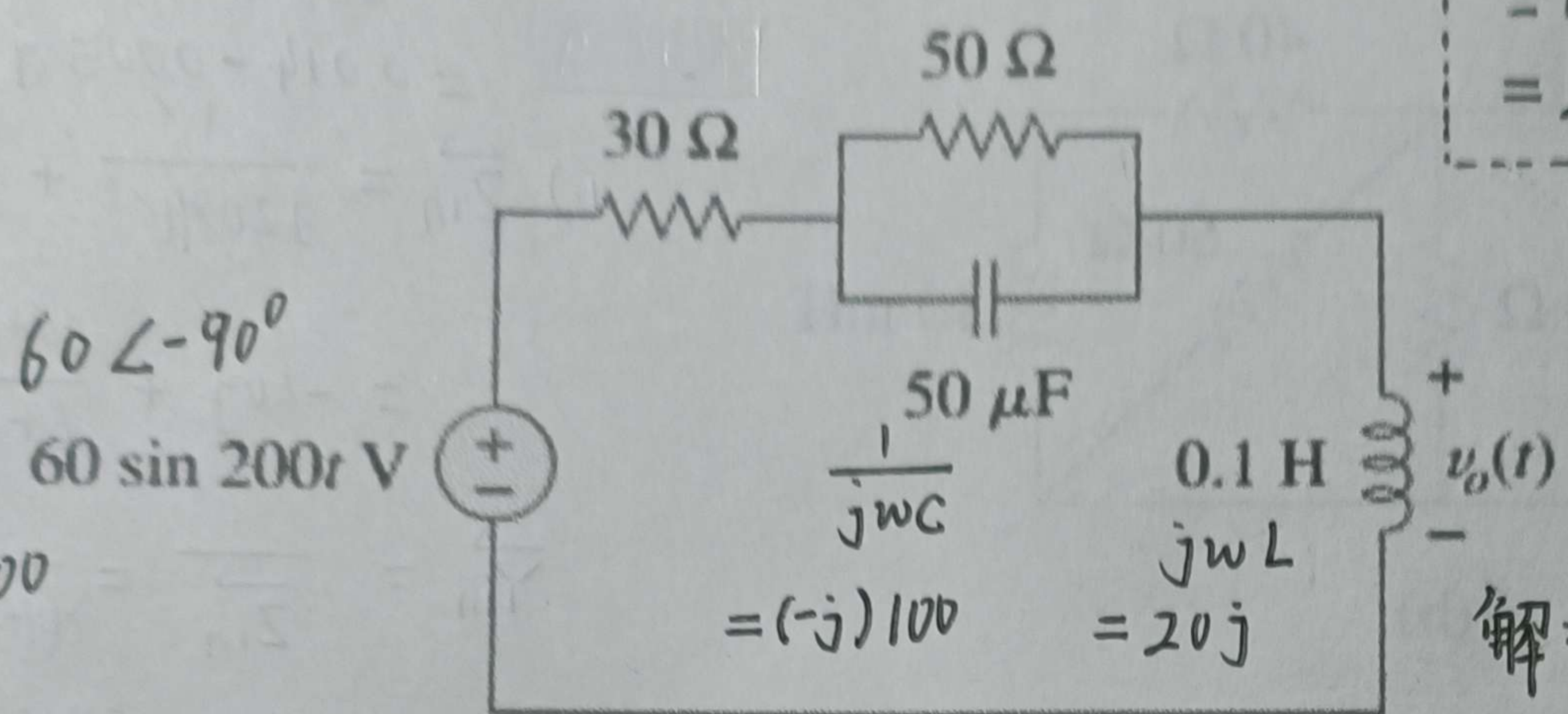
$- 5\cos 110° + 5\sin 110° j$

$= 6.710 + (-6.641)j = 9.441\cos(400t - 44.70°)$

9.42 Calculate $v_o(t)$ in the circuit of Fig.9.49. (10')

$\vec{V} = 60\angle -90°$

$w = 200$



$\frac{1}{j\omega C} = (-j)100$ $\quad j\omega L = 20j$

Figure 9.49

$\frac{1}{wC} = \frac{10^6}{200 \times 50 \times 10^{-6}} = 100$

解: $\vec{V_o} = \frac{\vec{V}}{Z} \cdot j\omega L$

$= \frac{60\angle -90°}{30 + 50 \| 100(-j) + 20j} \cdot 20j$

$= \frac{1200}{30 + 20j + 40 - 20j} = \frac{1200}{70}$

$= 17.14$

$V_o(t) = 17.14\cos 200t$

9.44 Calculate $i(t)$ in the circuit of Fig.9.51. (10')

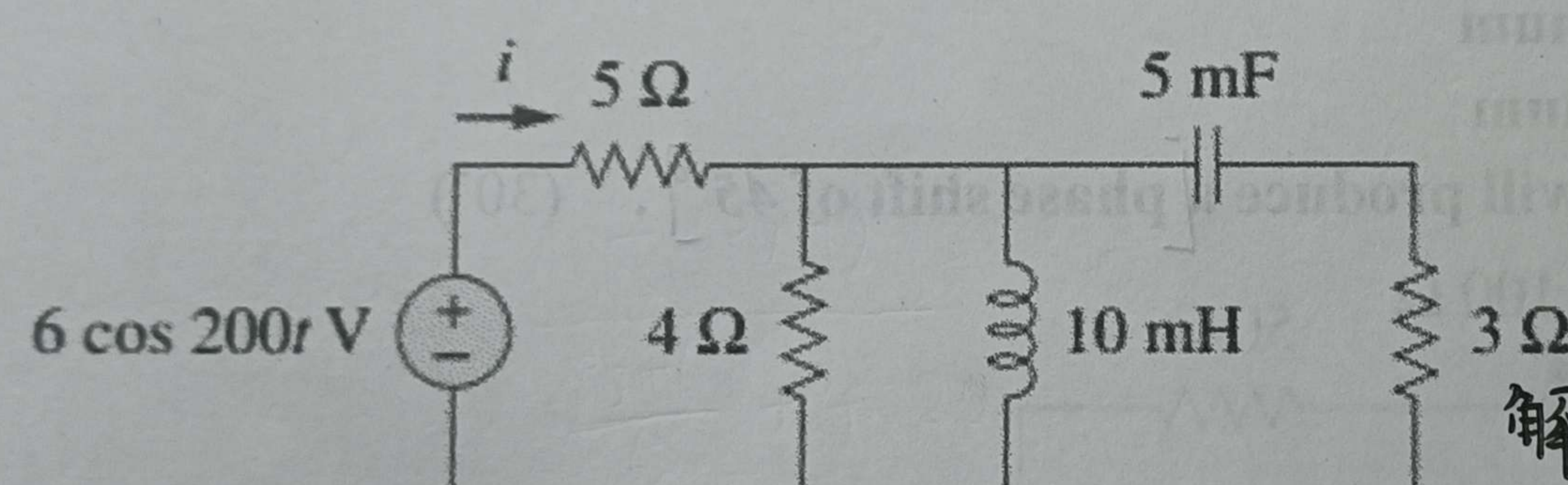


Figure 9.51

$\omega L = 10 \times 10^{-3} \times 200j = 2j$, $\quad \frac{1}{j\omega C} = \frac{1}{200 \times 5 \times 10^{-3} j} = -j$

解: $\vec{I} = \frac{\vec{V}}{Z} = \frac{6\angle 0°}{5 + 4 \| [2j \| (3 - j)]}$

$= \frac{6}{5 + \frac{16j + 12}{4j + 13}} = \frac{78 + 24j}{77 + 36j}$

$= \frac{81.61\angle 17.10°}{85\angle 25.06°} = 0.9601\angle -7.96°$

$i(t) = 0.9601\cos(200t - 7.96°)$ A

9.52 If $V_o = 8\angle 30°$ V in the circuit of Fig.9.59, find I_s. (10')

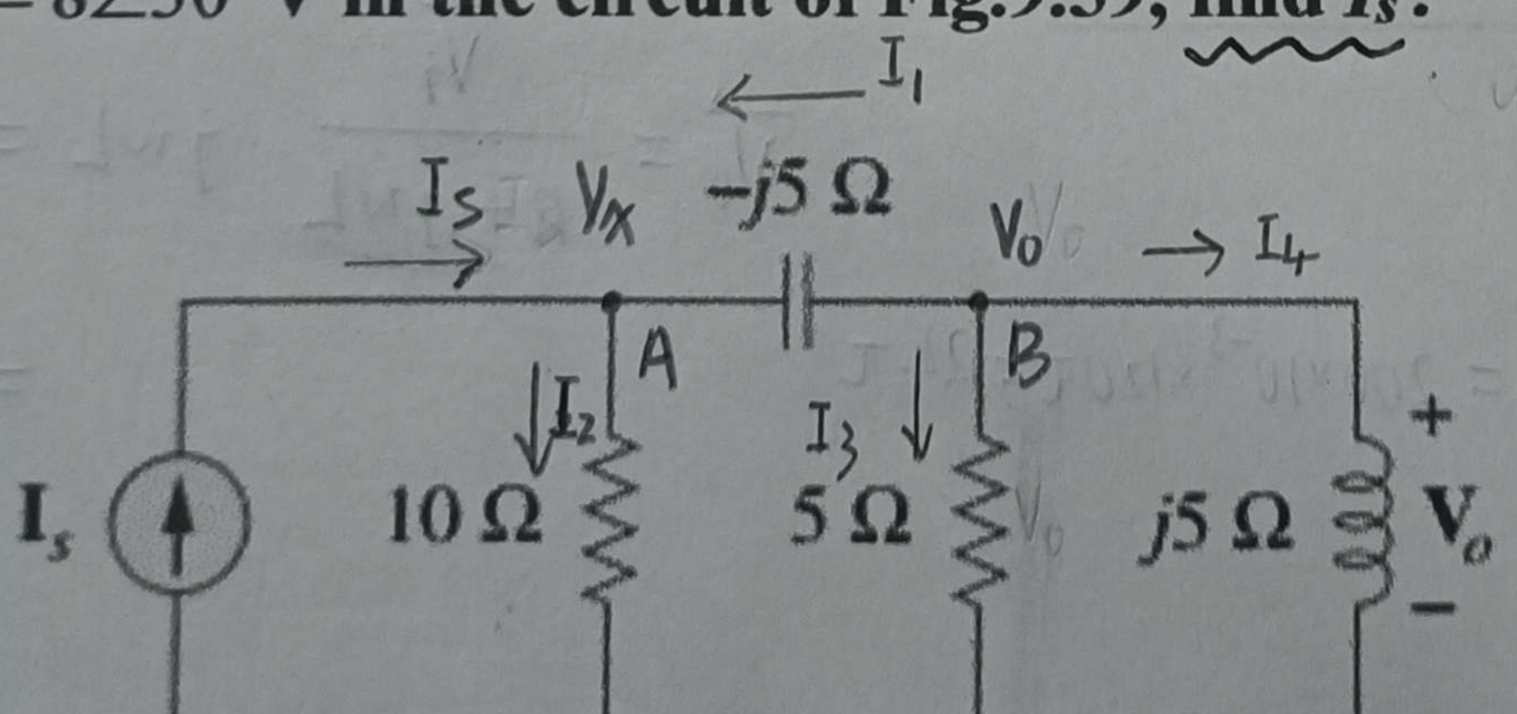


Figure 9.59

解: $\vec{I_1} = \frac{\vec{V_o} - \vec{V_x}}{-5j}$, $\vec{I_2} = \frac{\vec{V_x}}{10}$

$\Rightarrow \vec{I_s} + \frac{\vec{V_o} - \vec{V_x}}{-5j} - \frac{\vec{V_x}}{10} = 0$ node A

$\frac{\vec{V_o} - \vec{V_x}}{-5j} + \frac{\vec{V_o}}{5j} + \frac{\vec{V_o}}{5} = 0$ node B

$\Rightarrow \vec{V_x} = -j\vec{V_o}$

$\vec{I_s} = \frac{1}{5}\vec{V_o} - \frac{3}{10}j\vec{V_o}$

$= 2.586 - 1.278j$

$= 2.885\angle -26.30°$

9.67 At $\omega = 10^3$ rad/s, find the input admittance of each of the circuits in Fig. 9.74.

(20')

这个方法适用吗?

✓

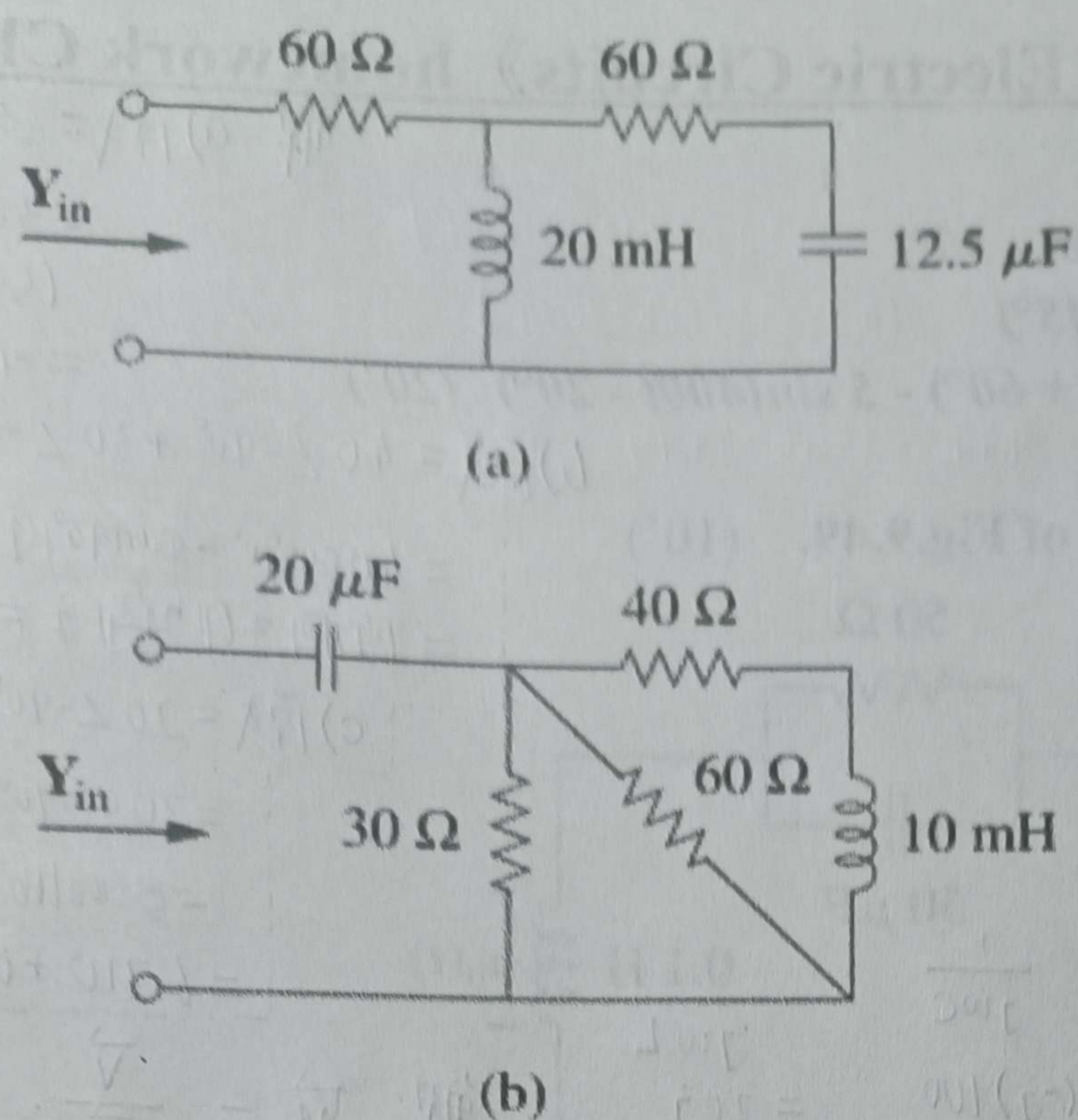


Figure 9.74

$w=10^3$ rad/s

解: a) $\vec{Y}_{in} = \frac{1}{\vec{Z}_{in}}$

$\vec{Z}_{in} = 60 + j20 \| (60+\frac{1}{j\times12.5\times10^{-3}})$

$= \frac{80+60j}{3-3j} + 60$

$\vec{Y}_{in} = \frac{3-3j}{80+60j+60(3-3j)} = \frac{3-3j}{260-120j}$

$= \frac{4.243\angle-45^\circ}{286.4\angle-24.78^\circ} = 0.01481\angle-20.22^\circ$ S

$= 0.014 - 0.005j$ S

b) $\vec{Z}_{in} = \frac{1}{j20\times10^{-3}} + 30\|60\|(40+10j)$

$= -50j + \frac{80+20j}{6+j}$

$\vec{Y}_{in} = \frac{1}{\vec{Z}_{in}} = \frac{6+j}{80+20j-300j+50} = \frac{6+j}{130-280j}$

$= \frac{6.083\angle9.462^\circ}{308.71\angle-65.10^\circ} = 0.01970\angle74.56^\circ$ S $= 5.245+18.99j$ mS

9.80 Consider the phase-shifting circuit in Fig. 9.83. Let V_i= 120 V operating at 60 Hz.
Find:
(a) V_o when R is maximum
(b) V_o when R is minimum
(c) the value of R that will produce a phase shift of 45°. (30')

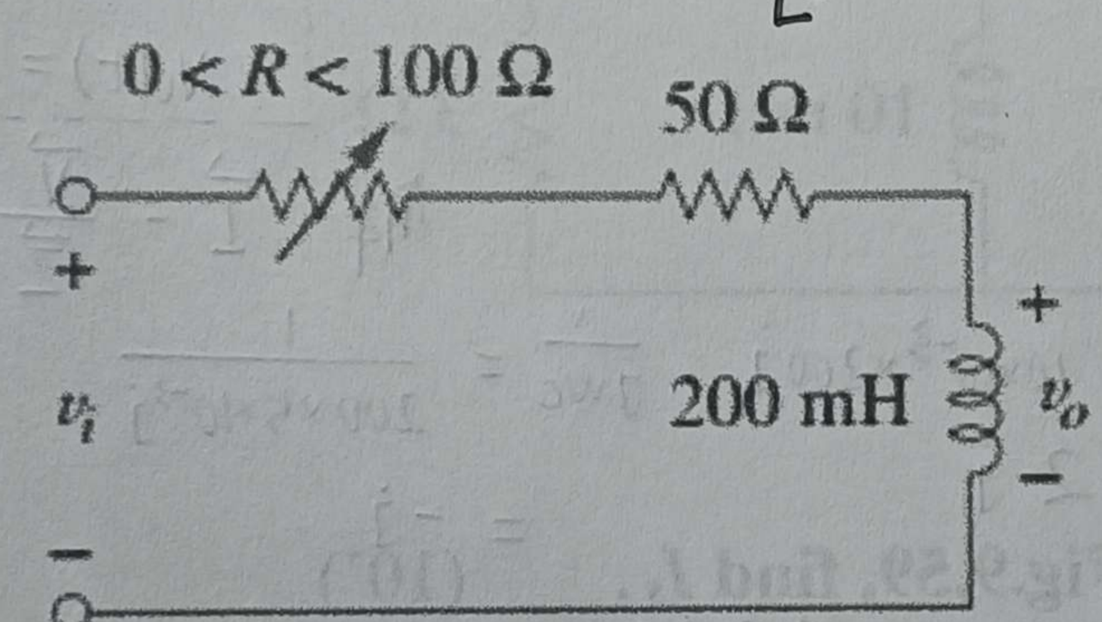


Figure 9.83

$\vec{V}_o = \frac{\vec{V}_i}{R+j\omega L}\cdot j\omega L = \frac{j\omega L(R-j\omega L)\vec{V}_i}{R^2+\omega^2L^2} = \frac{(\omega^2L^2+R\omega Lj)}{R^2+\omega^2L^2}\vec{V}_i$

解: a) $f = 60Hz = \frac{1}{T} = \frac{w}{2\pi}$

$w = 120\pi$ rad/s, $wL = 200\times10^{-3}\times120\pi = 24\pi$

$v_i(t) = 120\cos(120\pi t+\phi)$

$\vec{V}_i = 120$

$\vec{V}_o = \frac{24^2\pi^2+150\times24\pi j}{150^2+24^2\cdot\pi^2}\cdot120 = \frac{682187+1357168j}{28185} = 24.20+48.15j = 53.89\angle63.32^\circ$ V

b) $\vec{V}_o = \frac{24^2\pi^2+50\times24\pi j}{50^2+24^2\cdot\pi^2}\cdot120 = \frac{682187+452389j}{8185} = 83.35+55.27j = 100.01\angle33.55^\circ$ V

c) $\theta = \tan^{-1}(\frac{R\cancel{wL}}{w^2L^{\cancel{2}}}) = 45^\circ$

$\frac{R}{wL} = 1$

$R = wL = 24\pi$ Ω

$R_0 = 24\pi - 50 = 25.40$ Ω