E245B

HW #8 soln., 11/28/01

Problem 9.13

Calculate the average power absorbed by the 1-Ω resistor in the network shown in Fig. P 9.13

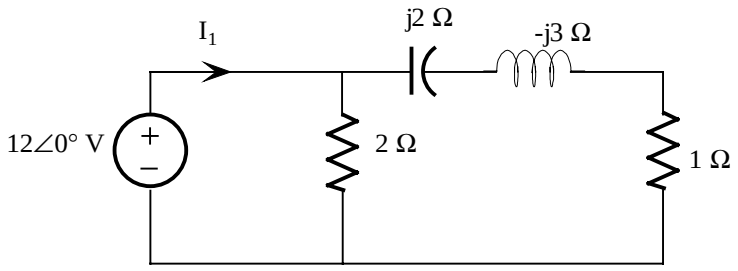
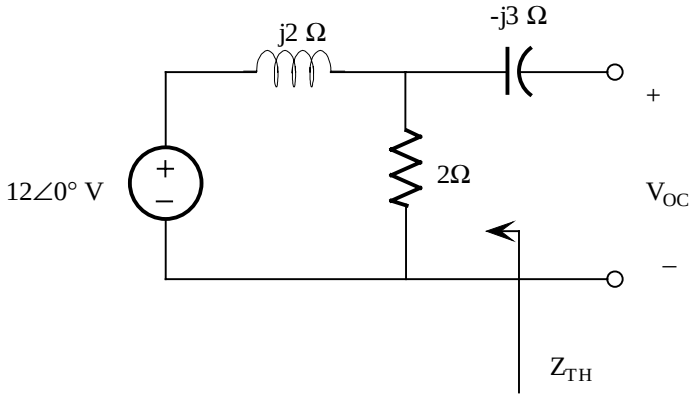


Figure P9.13

Suggested Solution

Therenin's Equation



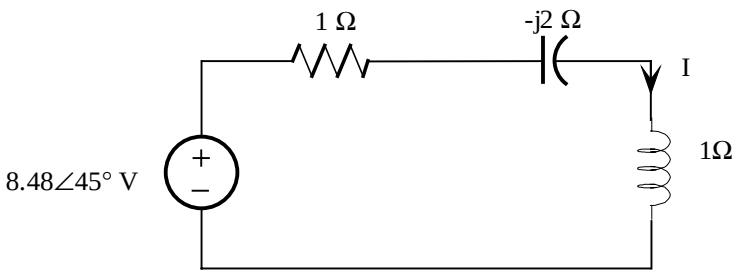
$$V_{OC} = 12\angle 0^\circ\left[\frac{2}{2+j2}\right]$$

$$V_{OC} = \frac{24\angle 0^\circ}{2\sqrt{2}\angle 45^\circ} \qquad V_{OC} = 8.49\angle -45^\circ V$$

$$Z_{TH} = -j3 + (2 \,//\, j2)$$

$$Z_{TH} = -j3 + \frac{j4}{2+j2} = -j3 + \frac{4\angle 90^\circ}{2\sqrt{2}\angle 45^\circ} = -j3 + \sqrt{2}\angle 45^\circ = -j3 + 1 - j1$$

$$Z_{TH} = (1 - j2)\Omega$$



$P_R=I^2R/2$

$$I=\frac{8.49\angle -45^\circ}{2-j2}=\frac{8.49\angle -45^\circ}{2\sqrt{2}\angle -45^\circ}=3\angle 0^\circ A$$

$$P_R=\frac{1}{2}I^2R=(\frac{1}{2})(3)^2(1)=\boxed{4.5W}$$

Problem 9.26

Repeat problem 9.24 for the network in Fig P 9.27

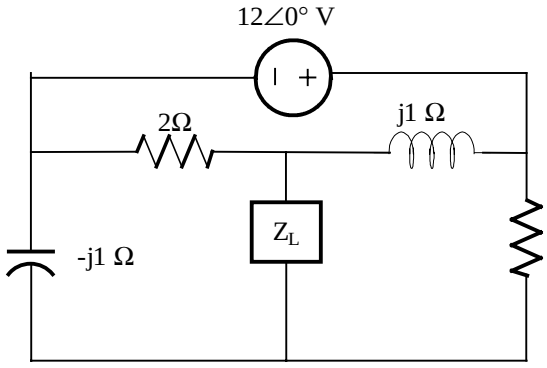
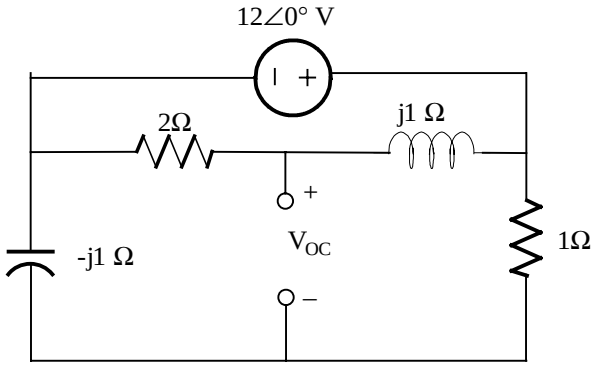
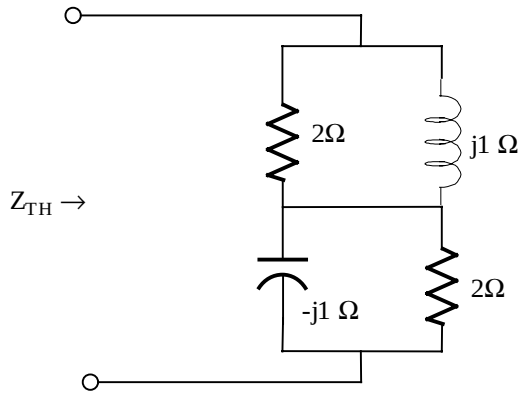


Figure 9.26

Suggested Solution



$$V_{OC}=\frac{12\angle 0^\circ}{2+j}(2)-\frac{12\angle 0^\circ}{1-j}(-j)=3.79\angle 18.43^\circ V$$



$$Z_{TH} = \frac{2j}{2+j} + \frac{-j}{1-j}$$

$$= \frac{3}{3-j} = .9 + j.3\Omega$$

$$\therefore Z_L = .9 - j.3\Omega$$

$$\boxed{P_L = \frac{1}{2}\left(\frac{3.79}{1.8}\right)^2 (.9) = 2W}$$

Problem 9.37

Calculate the rms value of the waveform shown in Fig P 9.37

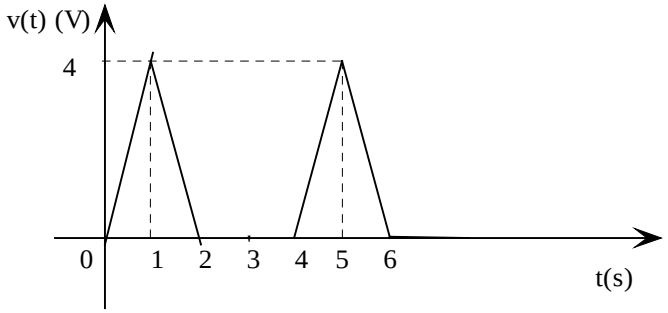


Figure P 9.37

Suggested Solution

$$I_{rms} = \sqrt{\frac{1}{4}\left[\int_0^1 (4t)^2 dt + \int_1^2 (8-4t)^2 dt\right]}$$

$$= \sqrt{\frac{1}{4}\left(\frac{16}{3} + \left(64t - \frac{64t^2}{2} + \frac{16t^3}{3}\right)\Big|_1^2\right)} = \boxed{1.63V}$$

Problem 9.51

Given the network in Fig P 9.51, compute the input source voltage and the input power factor.

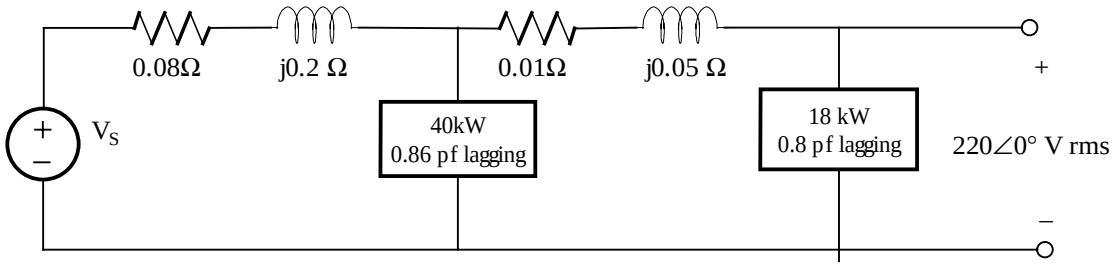


Figure P 9.51

Suggested Solution

$\theta_L = \cos^{-1}.8 = 36.87°$

$I_{L_2} = \dfrac{80000}{(220)(.8)} = 102.27A$

$I_{L_2} = 102.27\angle -36.87°A$

$V_{L_1} = (.01 + j.05)(102.27\angle -36.87°) + 220\angle 0°$

$= 223.91\angle .89°V$

$\theta_1 = \cos^{-1}.86 = 30.68° lagging$

$I_{L_1} = \dfrac{40000}{(223.91)(.86)} = 207.72A$

$I_{L_1} = 207.72\angle(-30.68° + .89°) = 207.72\angle -29.79°A$

$I_L = I_{L_1} + I_{L_2} = 207.72\angle -29.79° + 102.27\angle -36.87°A$

$= 309.47\angle -32.12°A$

$V_S = (309.47\angle -32.12°)(.08 + j.2) + 223.91\angle .89°$

$= 281.02\angle 8.75°V$

$\theta_S = \theta_{VS} - \theta_{iS} = 8.75° - (-32.12°) = 40.87°$

$P_{Fsource} = \cos(40.87°) = \boxed{.756 lagging}$

$$\theta_L = \cos^{-1}.8 = 36.87°$$

$$I_{L_2} = \frac{80000}{(220)(.8)} = 102.27A$$

$$I_{L_2} = 102.27\angle -36.87°A$$

$$V_{L_1} = (.01 + j.05)(102.27\angle -36.87°) + 220\angle 0°$$

$$= 223.91\angle .89°V$$

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$$I_L = I_{L_1} + I_{L_2} = 207.72\angle -29.79° + 102.27\angle -36.87°A$$

$$= 309.47\angle -32.12°A$$

$$V_S = (309.47\angle -32.12°)(.08 + j.2) + 223.91\angle .89°$$

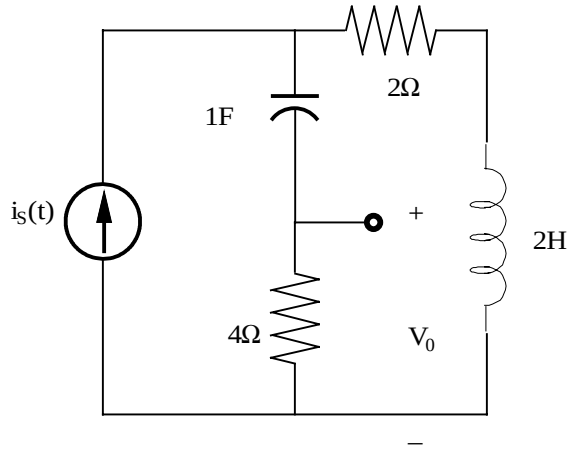
$$= 281.02\angle 8.75°V$$

$$\theta_S = \theta_{VS} - \theta_{iS} = 8.75° - (-32.12°) = 40.87°$$

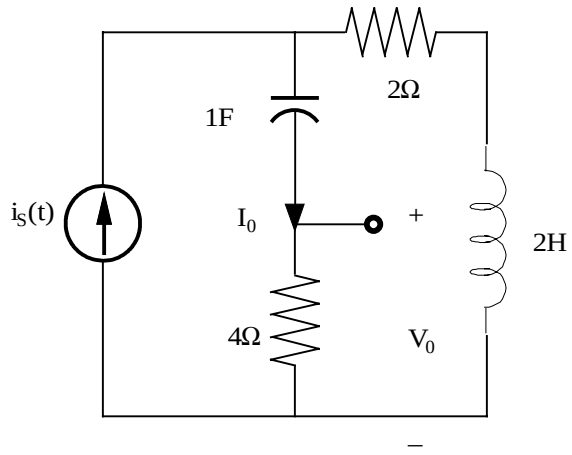
$$P_{Fsource} = \cos(40.87°) = \boxed{.756 lagging}$$

Problem 11.4

Find the transfer impedance Vo(s)/Is(s) for the network shown in fig 11.4.



Suggested Solution



$$I_O = I_S\left[\frac{2S+2}{2S+2+4+\frac{1}{S}}\right]$$

$$\frac{I_O}{I_S} = \frac{2S^2+2S}{2S^2+6S+1}, V_O = 4I_O, SO \quad \frac{V_O}{I_S} = \frac{8S(S+1)}{2S^2+6S+1}$$

$$\frac{8S(S+1)}{2S^2+6S+1}$$

Problem 11.6

Draw the bode plot for the network function.

Suggested Solution

$$H(jw) = \frac{jw5+1}{jw20+1}$$