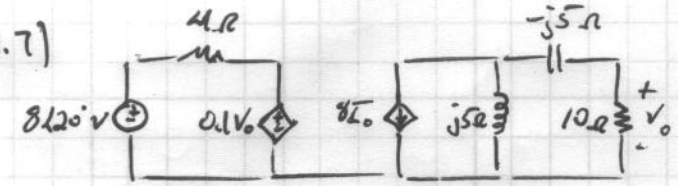
ECE 300 | HW Set #14

(11.7)



Find the average power absorbed by the 10Ω resistor.

KVL: $8\angle 20^\circ = 4I_o + 0.1V_o$

KCL: $8I_o + \frac{V_1}{j5} + \frac{V_1}{10-j5} = 0$

$V_o = \frac{10}{10-j5} V_1 \Rightarrow V_1 = \frac{10-j5}{10} V_o$

$8I_o + \frac{10-j5}{j50} V_o + \frac{V_o}{10} = 0$

$I_o = j0.025 V_o$

Substituting:

$8\angle 20^\circ = 0.1V_o(1+j)$

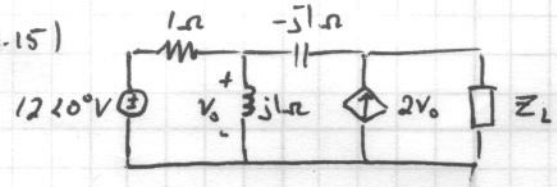
$V_o = \frac{80\angle 20^\circ}{1+j}$

$I_1 = \frac{V_o}{10} = \frac{8}{\sqrt{2}} \angle -25^\circ$

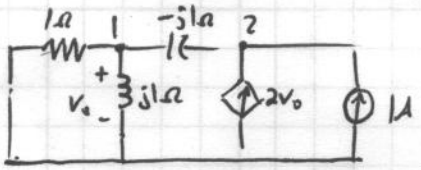
$P = \frac{1}{2} I^2 R$

$= \frac{1}{2}\left(\frac{64}{2}\right)(10) = \underline{\underline{160\ W}}$

(11.15)



- Find the value of Z_L that will absorb the maximum power and the value of the max power.



From node 1:

$$\frac{V_o}{1} + \frac{V_o}{j} = \frac{V_2 - V_o}{-j}$$

$$V_o = jV_2$$

From node 2:

$$1 + 2V_o = \frac{V_2 - V_o}{-j}$$

$$1 = jV_2 - (2+j)V_o$$

Substituting:

$$1 = jV_2 - (2+j)(j)V_2 = (1-j)(V_2)$$

$$V_2 = \frac{1}{1-j}$$

$$Z_{th} = \frac{V_2}{1} = \frac{1+j}{2} = 0.5 + j0.5$$

$$Z_2 = Z_{th}^* = \underline{\underline{0.5 - j0.5\ \Omega}}$$

For Power: Open Z_L in figure and determine V_{th}

$$2V_o + \frac{12 - V_o}{1} = \frac{V_o}{j}$$

$$V_o = \frac{-12}{1+j}$$

$$-V_o - (-j \cdot 2V_o) + V_{th} = 0$$

$$V_{th} = (1 - j2)V_o = \frac{(-12)(1-j2)}{1+j}$$

$$P_{max} = \frac{|V_{th}|^2}{8R_L} = \frac{\left(\frac{12\sqrt{5}}{\sqrt{2}}\right)^2}{8(0.5)} = \underline{\underline{90\ W}}$$

(11.30) Determine the rms value of the waveform.

$$v(t) = \begin{cases} t & 0 < t < 2 \\ -1 & 2 < t < 4 \end{cases}$$

$$V_{rms}^2 = \frac{1}{4}\left[\int_0^2 t^2\,dt + \int_2^4 (-1)^2\,dt\right]$$

$$= \frac{1}{4}\left[\frac{8}{3} + 2\right]$$

$$= 1.1667$$

$$V_{rms} = \underline{1.08V}$$

(11.34)

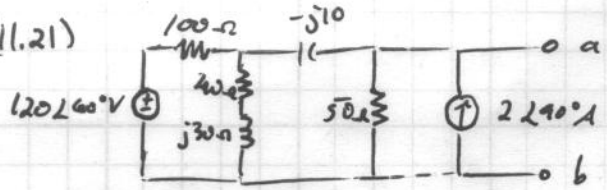
Find the effective value of $s(t)$ in Fig. 11.65

$$s_{rms}^2 = \frac{1}{T}\int_0^T s^2(t)\,dt = \frac{1}{3}\left[\int_0^2 (3t)^2\,dt + \int_2^3 6^2\,dt\right]$$

$$= \frac{1}{3}\left[\frac{9t^3}{3}\Big|_0^2 + 36\right] = 20$$

$$s_{rms} = \underline{4.472}$$

(11.21)



- What load should be connected to terminals a-b of the circuits in Fig. 11.52 so that max power is transferred to the load

Assumptions:
Purely resistive load impedance.

Find Z_{th} at terminals a-b: open current source

$Z_{th} = 50 \,||\, [-j10 + 100 \,||\, (40 + j30)]$

where $100 \,||\, (40 + j30) = \frac{(100)(40 + j30)}{140 + j30}$

$= 31.707 + j\,14.634$

$Z_{th} = 50 \,||\, 31.707 + j\,14.634$

$= 19.5 + j\,1.73$

$R_L = |Z_{th}| = \underline{\underline{19.58\ \Omega}}$