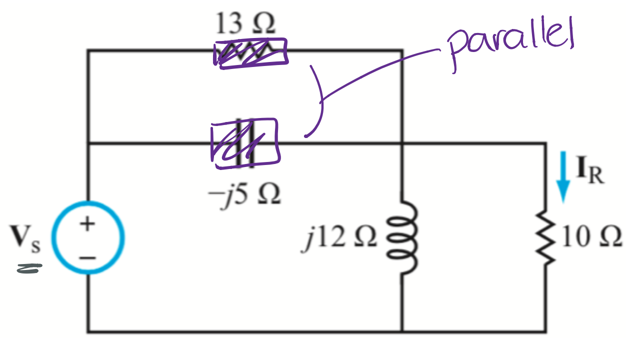
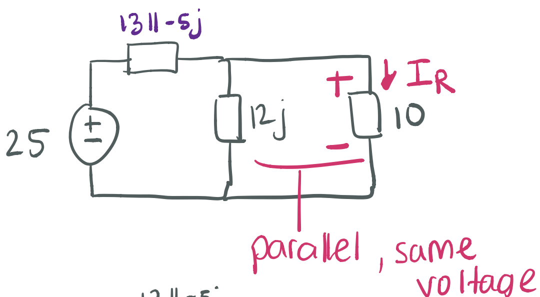
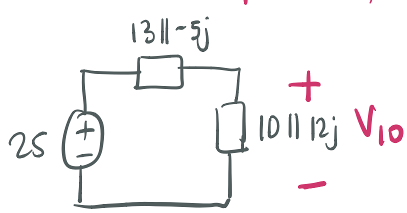
Extra Problem 1

- Find $\boldsymbol{I_R}$, given that $\boldsymbol{V_S} = 25V$.





$$13 \| -5j = \frac{13(-5j)}{13-5j} = 1.67 - 4.35j = 4.67 \angle -68.96$$



$$10 \| 12j = \frac{10(12j)}{10+12j} = 5.9 + 4.91j = 7.68 \angle 39.8$$

voltage division

$$V_{10} = 25 \cdot \frac{7.68\, e^{39.8j}}{7.57 + 0.56j} = 20.57 + 14.71j = 25.29 \angle 35.57^\circ$$

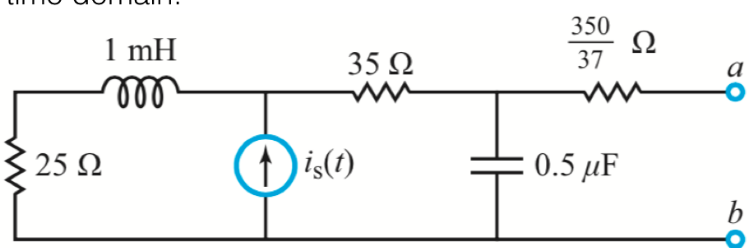
$$I_R = \frac{V_{10}}{10} = \frac{25.29 \angle 35.57}{10} = 2.53 \angle 35.57^\circ$$

$$i_R(t) = 2.53 \cos(wt + 35.57^\circ)$$

Extra Problem 2

Your objective is to obtain a Thevenin, given that i_S(t)=$3\cos(4\times10^4 t)$, then:

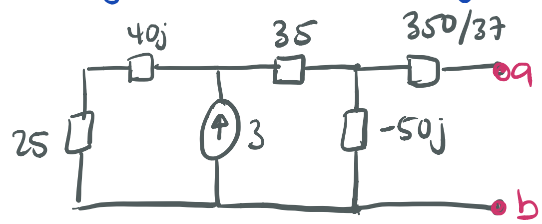
- Transform the circuit to the phasor domain.
- Apply the ~~source transformation~~ technique to obtain the The venin equivalent circuit at terminals (a, b).
- Transform the phasor-domain Thevenin ~~circuit~~ voltage. back to the time domain.



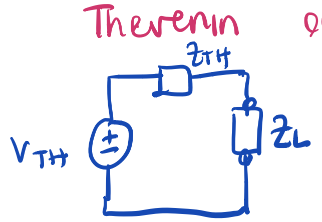
$I(j40K) = 3\angle 0^\circ$ $\qquad \omega = 40K$

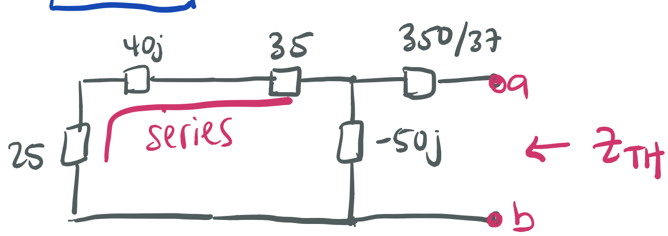
$Z_C = \dfrac{-j}{40K(0.5\times10^{-6})} = -50j$

$Z_L = j(40K)(1m) = 40j$

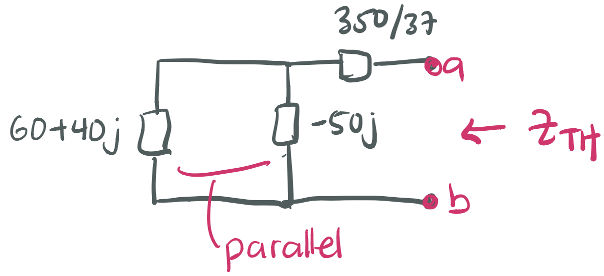


Thevenin equivalent





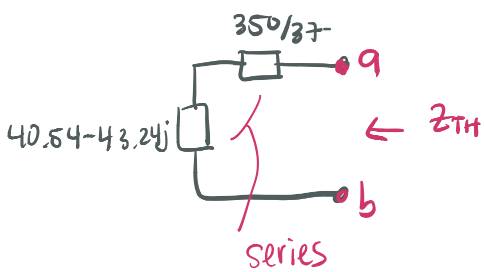
$$25 + 35 + 40j = 60 + 40j$$



$$(60+40j) \parallel -50j = \frac{(60+40j)(-50j)}{60-10j}$$

$$= 40.54 - 43.24j$$

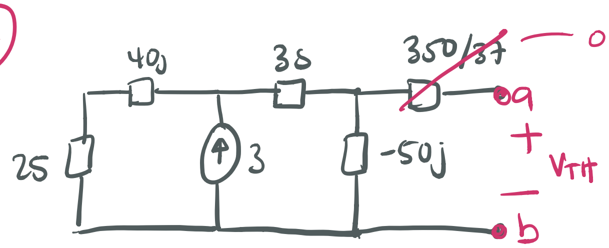
$$= 59.27 \angle -46.85°$$



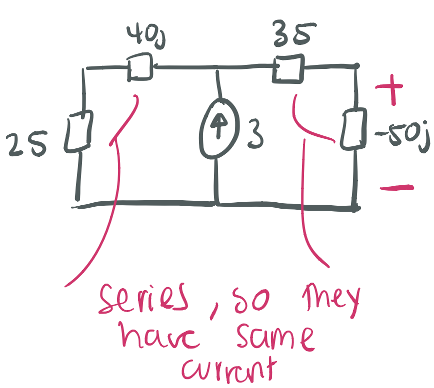
$$Z_{TH} = 50 - 43.24j$$

$$= 66.1 \angle -40.85°$$

V_{TH}

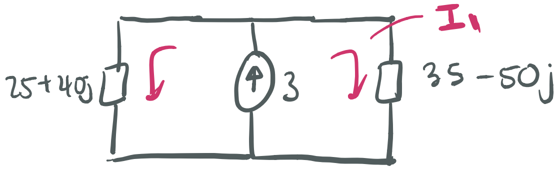


— open circuit $i = 0$



$$V_{TH} = V_c$$

current division



$$V_{TH} = (-50j)\, I_1$$

$$I_1 = \frac{Z_{eq}}{(35-50j)} \cdot 3 \qquad Z_{eq} = \frac{(35-50j)(25+40j)}{60-10j}$$

$$= \frac{25+40j}{60-10j} \cdot 3$$

$$= 0.89 + 2.15j$$

$$= 2.33 \angle 67.46^\circ$$

$$V_{TH} = (-50j)(2.33 \angle 67.46^\circ)$$

$$= 107.43 - 44.59j$$

$$= 116.32 \angle -22.54$$

$$v_{th}(t) = 116.32 \cos(40K t - 22.54^\circ) \checkmark$$

Extra Problem 3

- Determine the complex power, apparent power, average power absorbed, reactive power, and power factor for a load circuit whose voltage and current at its input terminals are given by:
  1. ○ $v(t) = 100\cos(377t - 30°)\ V,\ i(t) = 2.5\cos(377t - 60°)\ A.$
  2. ○ $v(t) = 25\cos(2\pi\times 10^3 t + 40°)\ V,$
     $i(t) = 0.2\cos(2\pi \times 10^3 t\ - 10°) A.$
  3. ○ $\boldsymbol{V} = 110\ \angle 60°\ V,\ \boldsymbol{I} = 3\angle 45°\ A.$
  4. ○ $\boldsymbol{V} = 440\angle 0° V, \boldsymbol{I} = 0.5\angle 75° A.$

$$S = \frac{V \cdot I^*}{2}$$

1. $\boldsymbol{V} = 100 \angle -30°$ $\quad I = 2.5 \angle -60°$

$$S = \frac{(100 \angle -30)(2.5 \angle 60)}{2}$$
$$= 125 \angle 30°$$
$$= 125 \cos(30) + j125 \sin(30)$$
$$= 108.25 + j62.5$$

$P = 108.25$ W $\quad Q = 62.5$ VA

$|S| = 125$ $\quad PF = \cos(30) = 0.86$

2. $\boldsymbol{V} = 25 \angle 40°$ $\quad I = 0.2 \angle -10$

$$S = \frac{(25 \angle 40)(0.2 \angle 10)}{2}$$
$$= 2.5 \angle 50$$
$$= 2.5 \cos(50) + j\,2.5 \sin(50)$$
$$= 1.61 + j1.91$$

$P = 1.61$ $\qquad Q = 1.91$

$|S| = 2.5$ $\qquad PF = \cos(50) = 0.64$

3. $V = 110\angle 60$ $\qquad I = 3\angle 45$

$$S = \frac{(110\angle 60)(3\angle -45)}{2}$$

$$= 165\angle 15$$

$$= 165\cos(15) + j\,165\sin(15)$$

$$= 159.38 + 42.7j$$

$P = 159.38$ $\qquad Q = 42.7$

$|S| = 165$ $\qquad PF = \cos(15) = 0.96$

4. $V = 440\angle 0^{\circ}$ $\qquad I = 0.5\angle 75^{\circ}$

$$S = \frac{(440)(0.5\angle -75)}{2}$$

$$= 110\angle 75$$

$$= 110\cos(-75) + j\,110\sin(-75^{\circ})$$

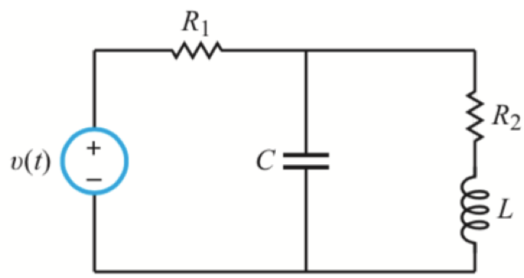
$$= 28.47 - 106.25j$$

$P = 28.47$ $\qquad Q = -106.25$

$|S| = 110$ $\qquad PF = \cos(-75) = 0.26.$

Extra Problem 4

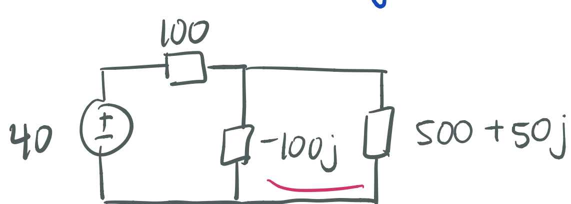
- In the circuit below, $v(t) = 40\cos(\overset{10^5}{\cancel{105}}t)\,V$, $R_1 = 100\,\Omega$, $R_1 = 500\,\Omega$, $C = 0.1\,\mu F$, and $L = 0.5\,mH$. Determine the complex power for each passive element, and verify that conservation of energy is satisfied.



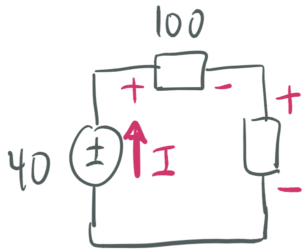
$\mathbf{V} = 40\angle 0^\circ$ $\qquad \omega = 10^5$

$$Z_C = \frac{-j}{10^5(0.1\times 10^{-6})} = -100j$$

$$Z_L = j(10^5)(0.5\times 10^{-3}) = 50j$$



parallel, same voltage



$$Z_{\parallel} = \frac{(-100j)(500+50j)}{500-50j}$$

$$= 19.8 - 98.02j$$

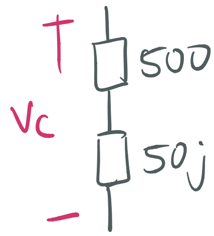
$$= 100\angle -78.58^\circ$$

voltage division

$$V_{100} = \frac{40\cdot 100}{119.8 - 98.02j} = 25.84\angle 39.29^\circ$$

$$V_{\parallel} = V_c = \frac{40 \cdot 100\angle{-78.58^\circ}}{119.8 - 98.02j} = 25.84\angle{-39.29^\circ}$$

$$I = \frac{40}{119.8 - 98.02j} = 0.26\angle{39.29^\circ}$$



$$I_{500} = I_L = \frac{V_c}{500 + 50j}$$

$$= 0.05\angle{-45^\circ}$$

$$S_c = \frac{(25.84)^2}{2(100j)} = -3.34j$$

$$S_L = \frac{(0.05)^2(50j)}{2} = 0.06j$$

$$S_{100} = \frac{(25.84)^2}{2 \cdot 100} = 3.34$$

$$S_{500} = \frac{(0.05)^2(500)}{2} = 0.625$$

$$3.97 - 3.28j$$

$$S = \frac{V \cdot I^*}{2} \quad - \frac{V_m^2}{2 \cdot Z^*} \qquad I = \frac{V}{Z} \qquad I^* = \frac{V^*}{Z^*}$$

$$- \frac{I_m^2 \cdot Z}{2} \qquad V = I \cdot Z$$

$$S_{V_s} = \frac{40\,(0.26\angle{-39.29^\circ})}{2} = 5.2\angle{-39.29}$$

$$= 4.02 - 3.29j$$