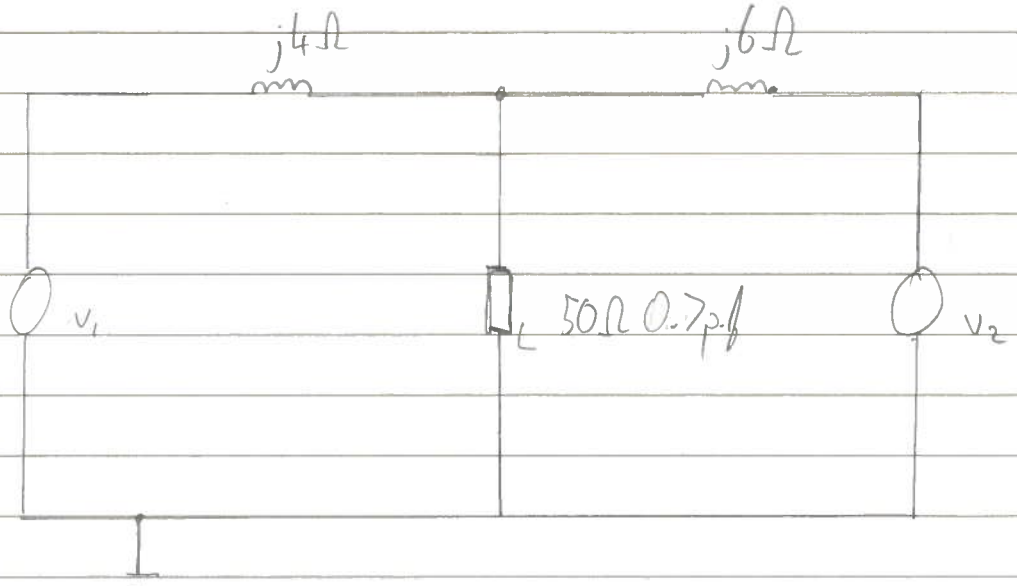
Thevins Voltage
Remove load
Find Z_s
Find V_s
Find current through load.



Impedance of the load

$\cos^{-1} 0.7 = 45.57°$

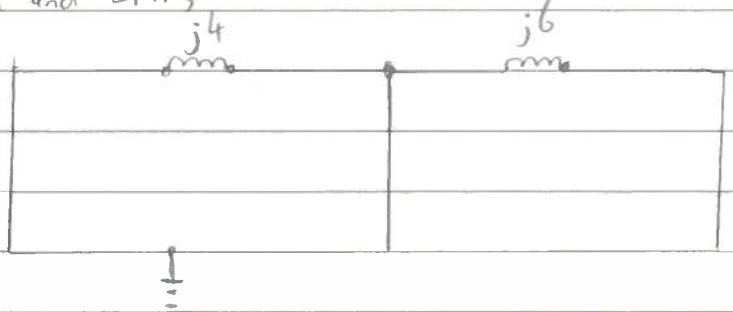
Converted

$50(\cos 45.57) = 35$

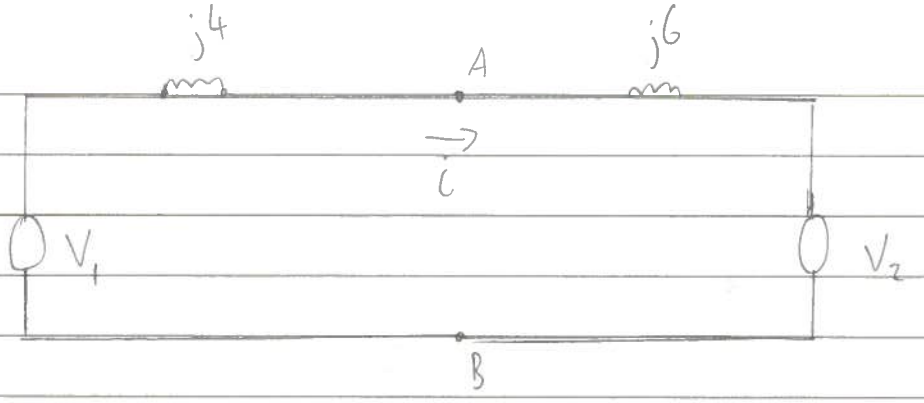
$50(\sin 45.57) = 35.7$

$Z_L = 35 + j35.7$

Remove load and EMF's



$Z_{Th} = \frac{j4 \times j6}{j4 + j6} = \frac{24}{10} = j2.4\ \Omega$



$$I = \frac{V}{Z}$$

Convert Voltage

$V_1 = \sqrt{2} \times 415 \cos(100\pi t)$

$V_2 = \sqrt{2} \times 415 \sin(100\pi t)$

Convert to V_2 to (cos)

$V_2 = \sqrt{2} \times 415 \cos(100\pi t - 90)$

Convert to Polar

$V_1 = 415 \angle 0^\circ$ or 415

$V_2 = 415 \angle -90^\circ$ or $-j415$

$$I = \frac{V}{Z} = \frac{415 - (-j415)}{j4 + j6}$$

$$= \frac{415 + j415}{j10} \times \frac{-j10}{-j10}$$

$$\frac{-j4150 + 4150}{-100} = -41.5 + j41.5 \text{ A}$$

current is flowing the other way

$= 41.5 - j41.5$

5.74 ∠81.1°

To find V_{AB} or Thevinis Voltage

$= j6 \times I + V_2$

$= -j415 + (41.5 - j41.5) \times (0 + j6)$

$= j415 + (0 + j249 + 0 + 249)$

$= 249 + j166$

To find current through load

$I_L = \frac{V_{th}}{Z_{th} + Z_L} = \frac{249 + j166}{j2.4 + (35 + j35.7)}$

$= \frac{249 + j166}{35 + j38.1} \times \frac{35 - j38.1}{35 - j38.1}$

$\frac{8715 - j9486.9 + j5810 - j^2 6324.6}{1225 - j1333.5 + j1333.5 - j^2 1451.61}$

$= \frac{15039.6 - j3676.9}{2676.61} = 5.62 - j1.37$

Convert to Polar

$r = \sqrt{x^2 + y^2} = \sqrt{5.62^2 - 1.37^2} = 5.45$

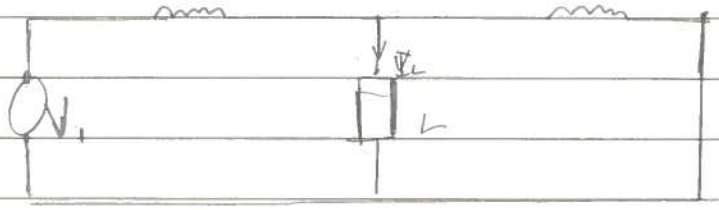
$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{-1.37}{5.62}\right) = -13.7$

$I_L = 5.62 - j1.37$ or $5.62 \angle -13.7°$

or $\sqrt{2} \times 5.62 \cos(100\pi - 13.7)$

Superposition Theory

For I_L from V_1



Impedance of $j6 + Z_L = Z_2$

$$Z_2 = \frac{(j6) \times (35 + j35.7)}{j6 + (35 + j35.7)} = \frac{j210 + j214.2}{35 + j41.7}$$

$$= \frac{j210 - 214.2}{35 + j41.7} \times \frac{35 - j41.7}{35 - j41.7}$$

$$= \frac{j7350 - 7497 + 8757 + j8932.14}{1225 + 1738.89} = \frac{1260 + j16282.14}{2963.39}$$

$$= 0.43 + j5.49$$

Voltage Divide $= \left(\frac{Z_2}{Z_1 + Z_2}\right) \times V_1$ = Voltage on the load

$$\frac{0.43 + j5.49}{j4 + (0.43 + 5.49)} \times 415$$

$$= \frac{0.43 + j5.49}{0.43 + j9.49} \times \frac{0.43 - j9.49}{0.43 - j9.49}$$

$$= \frac{0.18 - j4.08 + j2.36 + 52.1}{0.18 + 90.06}$$

$$= \frac{52.46 - j1.72}{90.24} = 0.58 - j0.019$$

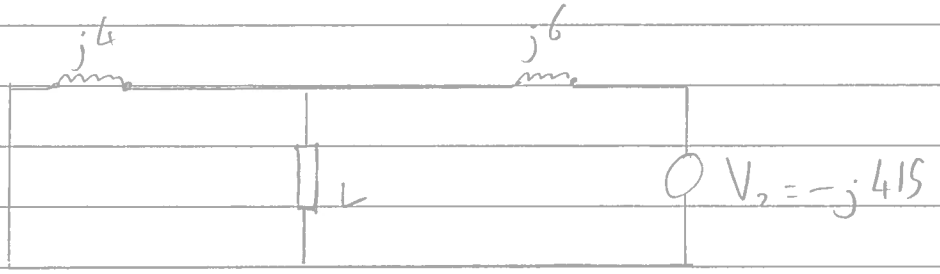
$$415 \times 0.58 - j0.019 = 240.7 - j7.89 \ V$$

$$I_L = \frac{240.7 - j7.89}{35 + j35.7} = \frac{240.7 - j7.89}{35 + j35.7} \times \frac{35 - j35.7}{35 - j35.7}$$

$$I_L = \frac{8424.5 - j8592.99 - j276.15 + j^2 281.7}{1225 + 1274.49}$$

$$= \frac{8142.8 - j8869.14}{2499.49} = 3.26 - j3.55 \ A$$

For I_L from V_2



Impedance of $j4 + Z_L = (Z_2)$

$$Z_2 = \frac{j4 \times (35 + j35.7)}{j4 + (35 + j35.7)} = \frac{-142.8 + j140}{35 + j39.7}$$

$$= \frac{-142.8 + j140}{35 + j39.7} \times \frac{35 - j39.7}{35 - j39.7}$$

$$= \frac{-4998 + j5669.16 + j4900 + 5558}{1225 + 1576.09}$$

$$= \frac{560 + j10569.16}{2801.09} = 0.20 + j3.77\ \Omega$$

Voltage Divide $= \frac{Z_2}{Z_1+Z_2} \times V_2 \Rightarrow$ Voltage on load

$$\frac{0.20 + j3.77}{j6+(0.20+j3.77)} \times -j415$$

$$\frac{0.20 + j377}{0.20+j9.77} \times \frac{0.20 - j9.77}{0.20 - j9.77}$$

$$= \frac{0.04 - j1.95 + j0.754 + 36.83}{0.04 + 95.45} = \frac{36.87 - j1.20}{95.49}$$

$$= 0.39 - j0.012 \times (-j415)$$

$$= -4.98 - j161.9$$

$$I_L = \frac{-4.98 - j161.9}{35 + j35.7}$$

$$= \frac{-4.98 - j161.9}{35+j35.7} \times \frac{35 - j35.7}{35 - j35.7}$$

$$\frac{-174.3 - j5666.5 + j177.8 - 5779.83}{2499.49} = \frac{-5954.13 - j584}{2499.49}$$

$$= -2.38 - j2.34$$

$$I_4 + I_{42} = I_L$$

$3.26 - j3.55 + -2.38 - j2.34 =$ Obviously wrong