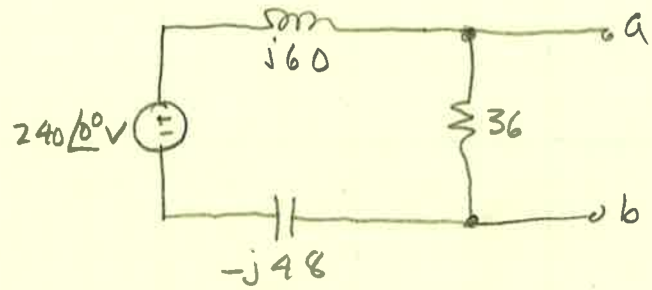
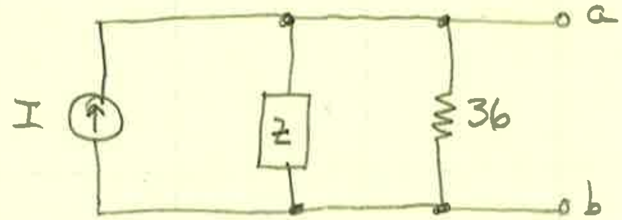
Use source transformation to find thevenin equiv. at ab.



$$Z = j60 - j48 = j12$$

$$I = \frac{V}{Z} = \frac{240\angle 0^\circ}{12\angle 90^\circ} = 20\angle{-90}^\circ$$

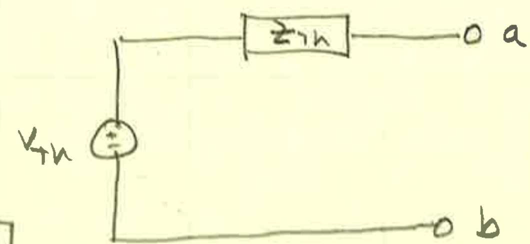


$$Z \parallel 36 = \frac{(12j)(36)}{12j + 36}$$

$$= \frac{432\angle 90^\circ}{37.95\angle 18.43^\circ}$$

$$= 11.384\angle 71.565^\circ$$

$$= Z_{th}$$

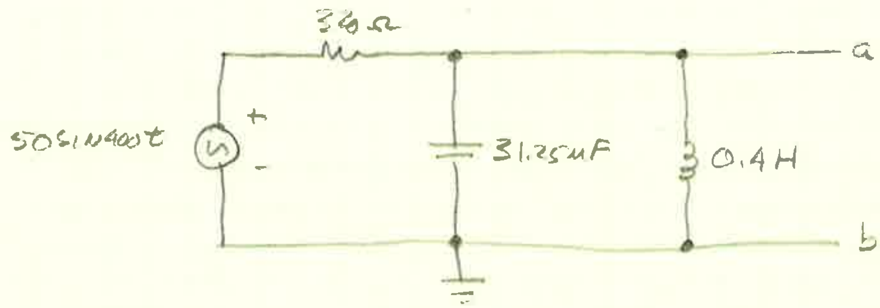


$$V_{th} = I_{th} Z_{th}$$

$$= 20(\angle{-90})(11.384\angle 71.565)$$

$$= 227.7\angle{-18.435}^\circ \text{ V}$$

$$\boxed{\begin{aligned} V_{th} &= 227.7\angle{-18.435}^\circ \text{ V} \\ &= 216 - 72j \text{ V} \\ Z_{th} &= 11.384\angle 71.565^\circ\ \Omega \\ &= 3.6 + 10.8j\ \Omega \end{aligned}}$$

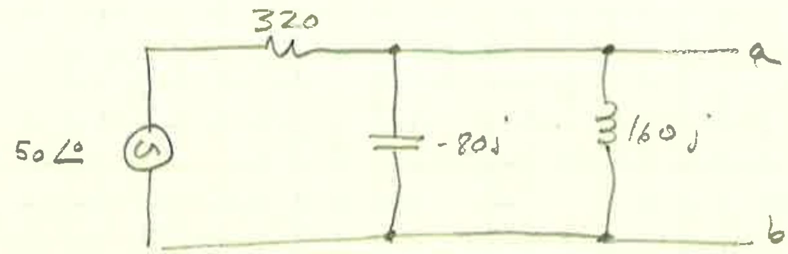


Find the Thevenin equivalent at terminals ab.

• Convert circuit to frequency domain.

$Z_C = \frac{1}{j\omega C} = -80j$

$Z_L = j\omega L = 160j$



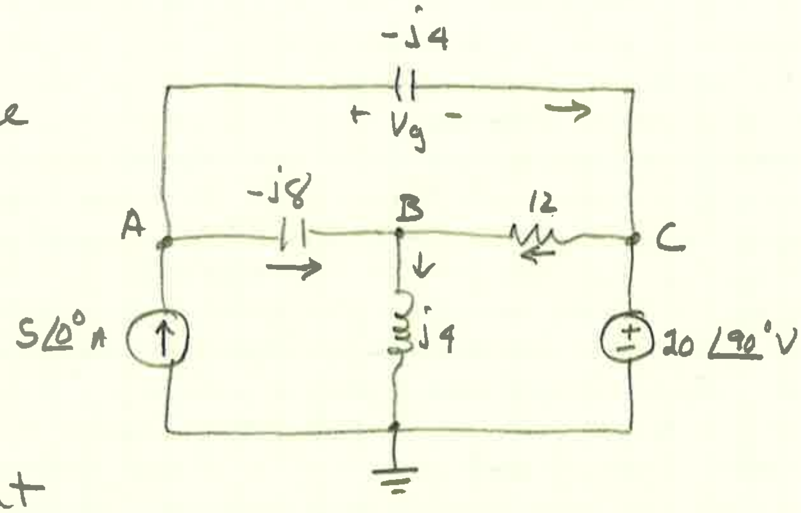
$Z_{Th} = 160j \parallel (-80j \parallel 320)$

$\boxed{\begin{aligned} &= 64 - j128\ \Omega \\ &= 143 \angle -63.43^\circ \end{aligned}}$

use cosine: $50\angle 0^\circ = 50\angle -90^\circ$

$V_{Th} = \frac{(50\angle -90)(-80j \parallel 160j)}{320 + (-80j \parallel 160j)} = \boxed{\begin{aligned} &-20 - j10\ V \\ &= 22.36 \angle -153.46^\circ\ V \end{aligned}}$

Use the node-voltage method to find V_g.



1) Place reference at bottom of circuit

2) $V_c = 20\angle 90^\circ$

Node A: $\Sigma i_{in} = \Sigma i_{out}$

$$5\angle 0 = \frac{V_A - 20\angle 90^\circ}{-j4} + \frac{V_A - V_B}{-j8}$$

Node B: $\Sigma i_{in} = \Sigma i_{out}$

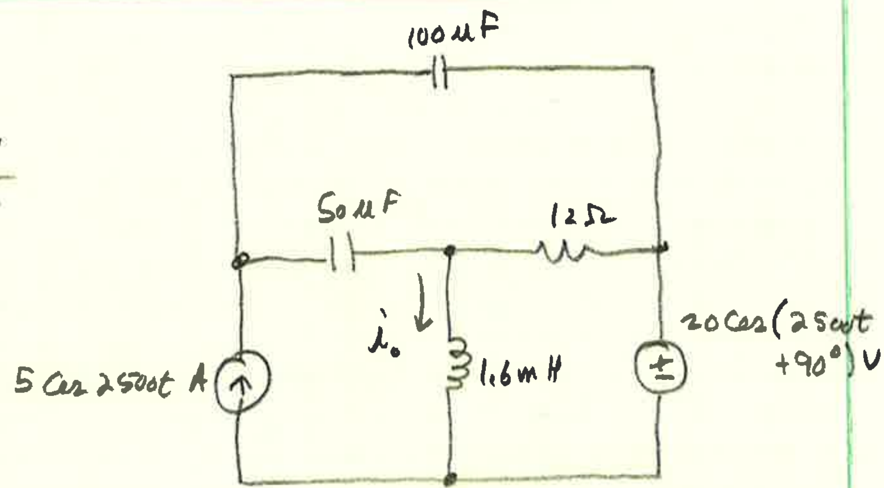
$$\frac{V_A - V_B}{-j8} + \frac{20\angle 90^\circ - V_B}{12} = \frac{V_B}{j4}$$

Solving ; $V_A = -\frac{8}{3} + \frac{4}{3}j$

$V_B = -8 + j4$

$$\boxed{V_g = V_A - V_c = -\frac{8}{3} - j\frac{56}{3}\ \text{V}}$$

Find i_o using the mesh-current method.



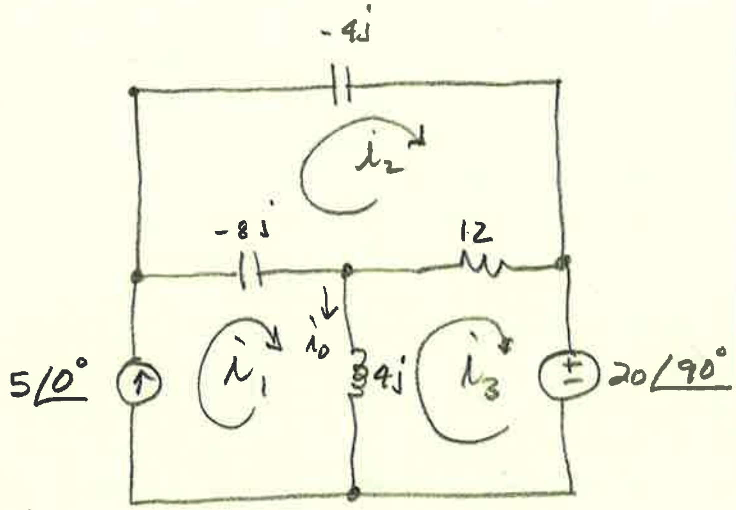
convert to frequency domain

$\omega = 2500$ rad/s

$Z_{100uF} = \frac{1}{j\omega C} = -4j$

$Z_{50uF} = -8j$

$Z_L = j\omega L = 4j$



mesh i_1

$i_1 = 5\angle 0°$

mesh i_2

$-4j(i_2) + 12(i_2 - i_3) - 8j(i_2 - i_1) = 0$

mesh i_3

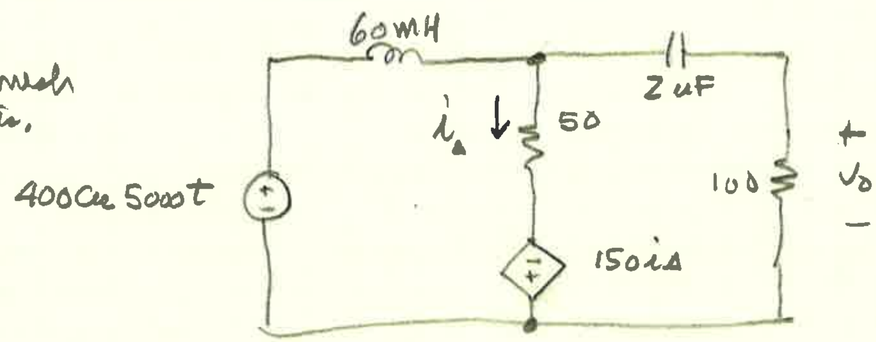
$20\angle 90° + 4j(i_3 - i_1) + 12(i_3 - i_2) = 0$

solving:
$i_1 = 5\angle 0°$ A $= 5 + 0j$ A
$i_2 = -0.667j + 4.667$ A
$i_3 = 4 - j2 = 4.47\angle -26.57°$ A

$i_o = i_1 - i_3$

$$\boxed{\begin{aligned} i_o &= 1 + j2 = 2.24\angle 63.43° \text{ A} \\ &= 2.24 \cos(2500t + 63.43°) \text{ A} \end{aligned}}$$

Find V_0 using mesh analysis.

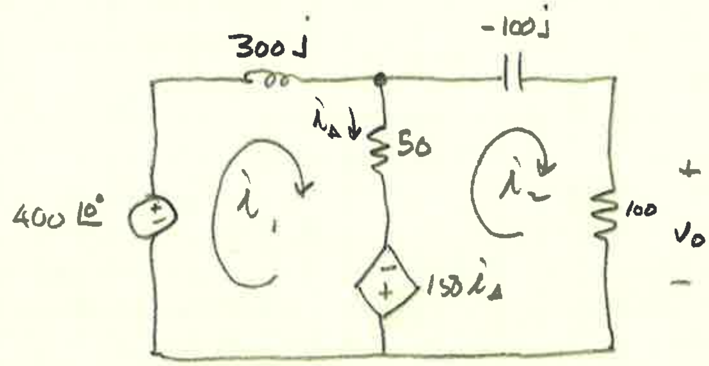


$\omega = 5000$

$Z_L = j\omega L = 300j$

$Z_C = \frac{1}{j\omega C} = -100j$

Redraw:



mesh i_1

(1) $-400\angle 0 + i_1 300j + 50(i_1 - i_2) - 150 i_\Delta = 0$

Mesh i_2

(2) $-100j\, i_2 + 100 i_2 + 150 i_\Delta + 50(i_2 - i_1) = 0$

(3) $i_\Delta = i_1 - i_2$

Solving: $i_1 = -.8 - 1.6$ A
$i_2 = -1.6 + 0.8j$ A
$i_\Delta = 0.8 - 2.4j$ A

$$\boxed{\begin{aligned} V_0 &= 100 i_2 = -160 + 80j = 178.89\angle 153.43° \text{ V} \\ V_0 &= 178.89 \cos(5000t + 153.43°) \text{ V} \end{aligned}}$$

$i = 125\cos(800t + 36.87°)\ mA$

a) Find F

$800 = \omega = 2\pi f \Rightarrow F = \frac{800}{2\pi} = \boxed{127.32\ Hz}$

b) Find T in milli seconds

$T = \frac{1}{f} = \frac{1}{127.32} = \boxed{7.854\ mS}$

c) Find I_m

$I_m = \boxed{125\ mA}$

d) Find $i(0)$

$i(0) = 125\cos(36.87°) = \boxed{100\ mA}$

e) Find ϕ in degrees + radians

$\boxed{\phi = 36.87°} = \frac{36.87(2\pi)}{360°} = \boxed{0.644\ \text{Radians} = \phi}$

f) smallest positive value of t for which $i = 0$.

$0 = 125\cos(800t + 36.87°)$

$800 \frac{Rad}{Sec} t = 53.13° = 53.13\left(\frac{2\pi\ Rad}{360°}\right) = 0.9273\ Rad$

$t = \frac{0.9273}{800} = \boxed{1.159\ ms}$

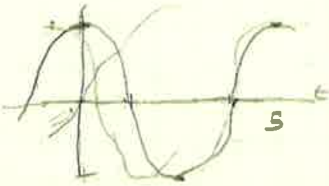
g) smallest positive value of t at which $\frac{di}{dt} = 0$

$\frac{di}{dt} = 125\left(-800\sin(800t + 36.87°)\right)$

$\frac{di}{dt} = 0$ when $800t + 36.87° = 180°$

$t = \frac{(180° - 36.87°)\left(\frac{2\pi}{360}\right)}{800} = \boxed{3.12\ ms}$

$v(t) = 25\cos(400\pi t + 60^\circ)$ V



a) what is the maximum amplitude of V?

$\boxed{V_{max} = 25V}$

b) Find Freq. in Hz

$\omega = 2\pi f = 400\pi \Rightarrow f = \frac{400\pi}{2\pi} = \boxed{200\ Hz}$

c) Find freq in Rad/sec $\Rightarrow \omega = 400\pi = \boxed{1257\ Rad/sec}$

d) find phase angle in radian

$\theta = 60^\circ = 60\left(\frac{\pi}{180}\right) = \frac{\pi}{3} = \boxed{1.047\ Rad}$

e) find θ in degrees

$\boxed{\theta = 60^\circ}$

f) find period

$P = \frac{1}{f} = \frac{1}{200} = \boxed{5\ ms}$

g) what is the first time after $t=0$ that $v=0$V?

For Cos $V=0$ after $\frac{1}{4}$ period
But $60^\circ = \frac{1}{6}$ period so crosses 0 after $\left(\frac{1}{4}-\frac{1}{6}\right)5ms = \frac{1}{12}(5ms) = \boxed{416.7\mu s}$

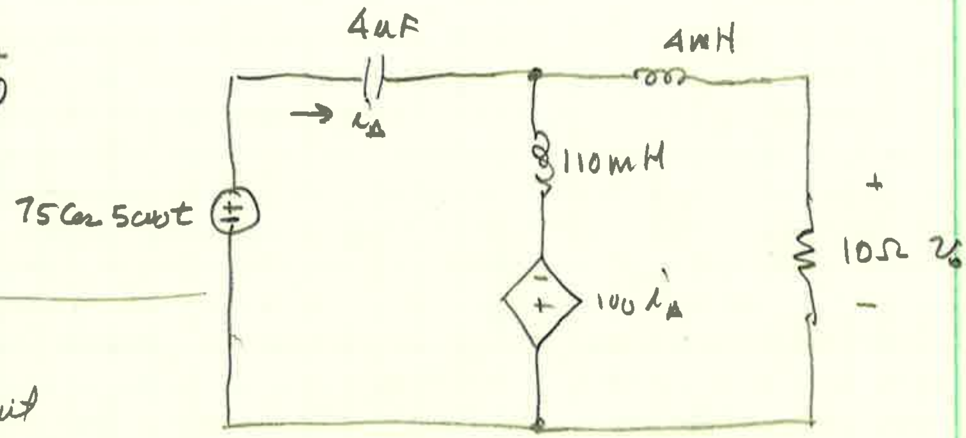
h) V is shifted 5/6 ms to the right. what is the new $v(t)$?

$\frac{5}{6}$ ms is $\frac{1}{6}$ of a period $= 60^\circ$ so $\boxed{V = 25\cos 400\pi t\ \ V}$

i) what is the minimum number of mS that the function must be shifted to the left for $v(t) = 25\sin 400\pi t$ V?

must be shifted $\frac{3}{4}T - \frac{1}{6}T = \frac{7}{12}T = \boxed{2.917\ ms}$

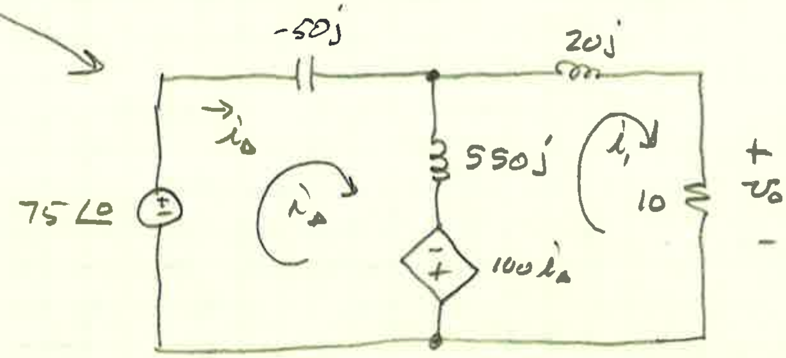
use mesh-current method to find v_o.



1) transform circuit

$Z_L = j\omega L$

$Z_C = \dfrac{1}{j\omega C}$



2) write mesh equations:

i_Δ : $-75\angle 0 - 50j(i_\Delta) + 550j(i_\Delta - i_1) - 100 i_\Delta = 0$

i_1 : $20j(i_1) + 10(i_1) + 100 i_\Delta + 550j(i_1 - i_\Delta) = 0$

i_Δ : $i_\Delta(400j) + i_1(-550j) = 75\angle 0$

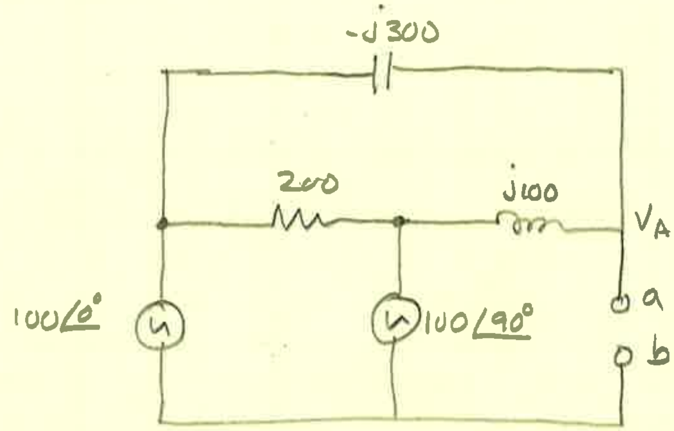
i_1 : $i_\Delta(100 - 550j) + i_1(10 + 570j) = 0$

Solving : $i_\Delta = 3.25j$ A

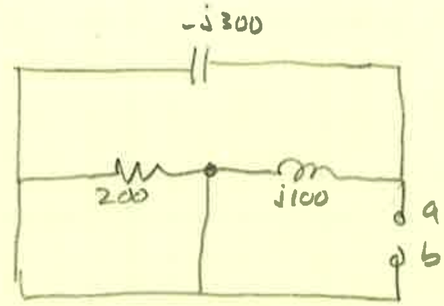
$i_1 = 2.5j$ A

$$\boxed{V_o = 10(i_1) = 25j = 25\angle 90^\circ = 25\cos(5000t + 90^\circ)\ V.}$$

Find the Thevenin equivalent @ terminals ab.



Z_{th}



$$Z_{th} = j100 \parallel -j300$$

$$= \frac{(j100)(-j300)}{j100 - j300}$$

$$= 30{,}000 / -200j$$

$$\boxed{Z_{th} = 150j\ \Omega}$$

V_{th}

NODE A: $\dfrac{100\angle 0 - V_A}{-j300} = \dfrac{V_A - 100\angle 90°}{j100}$

$$\boxed{V_A = 158.11\ \angle 108.43°\ \text{V}}$$