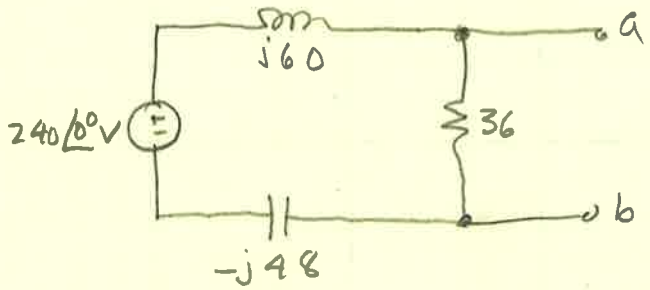
Use Source transformation to find thevenin equiv. at ab.



$Z = j60 - j48 = j12$

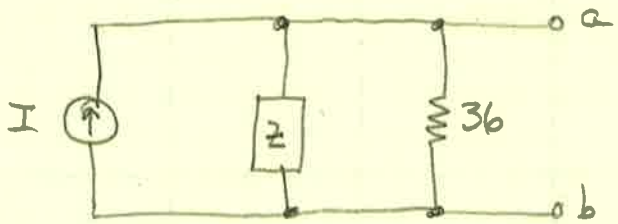
$I = \frac{V}{Z} = \frac{240\angle 0^\circ}{12\angle 90^\circ} = 20\angle -90^\circ$

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

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

$= 11.384\angle 71.565^\circ$

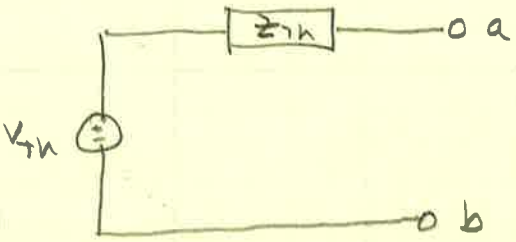
$= Z_{th}$



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

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

$= 227.7\angle -18.435^\circ$ V



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

$= 216 - 72j$ V

$Z_{th} = 11.384\angle 71.565^\circ\ \Omega$

$= 3.6 + 10.8j\ \Omega$

$i = 125\cos(800t + 36.87°)\ mA$

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

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

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

$0 = 125\cos(800t + 36.87°)$

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

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

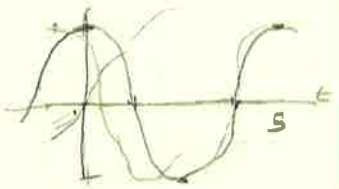
g) smallest positive value of t at which $\frac{di}{dt} = 0$

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

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

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

$v(t) = 25\cos(400\pi t + 60°)$ V



a) what is the maximum amplitude of V?

$V_{max} = 25$ V

b) Find freq. in Hz

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

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

d) find phase angle in radians

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

e) find θ in degrees

$\theta = 60°$

f) find period

$P = \frac{1}{f} = \frac{1}{200} =$ 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 $60° = \frac{1}{6}$ period so crosses 0 after $\left(\frac{1}{4} - \frac{1}{6}\right)5\text{ms} = \frac{1}{12}(5\text{ms}) =$ 416.7 μs

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 $= 60°$ so $V = 25\cos 400\pi t$ 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?

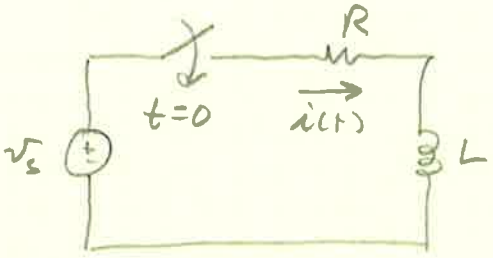
must be shifted $\frac{3}{9}T - \frac{1}{6}T = \frac{7}{12}T =$ 2.917 ms

$V_s = 75\cos(4000t - 60°)$

$R = 400\,\Omega$

$L = 75\,mH$

$i_L(0) = 0\,A$



a) Find $i(t)$ for $t > 0$.

From equation 9.9:

$$i = \frac{-V_m}{\sqrt{R^2+\omega^2L^2}}\cos(\phi-\theta)\,e^{-R/Lt} + \frac{V_m}{\sqrt{R^2+\omega^2L^2}}\cos(\omega t+\phi-\theta)$$

$$\phi = -60°, \quad \theta = \tan^{-1}\frac{\omega L}{R} = \tan^{-1}\frac{(4000)(.075)}{400} = 36.87°$$

$$i(t) = \frac{-75}{\sqrt{400^2+4000^2(.075)^2}}\cos(-60°-36.87°)\,e^{-5333t} + \frac{75}{\sqrt{(\quad)}}\cos(4000t-60-36.87°)$$

$$\boxed{i(t) = \underbrace{(+17.94\,e^{-5333t}}_{\text{transient}} + \underbrace{150\cos(4000t-96.87°)}_{\text{steady state}})\,mA}$$

b) what are the transient and steady state components?

c) Find i @ $t = 750\,\mu s$

$$\boxed{i(750\,\mu s) = 39.45\,mA}$$

d) what are the max amplitude, freq, & phase angle of the steady state current?

$$\boxed{\begin{aligned} \text{Amp max} &= 150\,mA \\ f_{max} &= 4000\ \text{Rad/Sec} \\ \text{phase} \angle &= -96.87° \end{aligned}}$$

e) By how many degrees are the voltage & SS current out of phase?

→ The current lags the voltage by 36.87°.

$f = 80{,}000$ Hz

$V = 25 \sin(2\pi f \cdot t)$ mV

$I = 628.32 \sin(2\pi f \cdot t + 90°)$ mA

a) find frequency in Rad/sec

$\omega = 2\pi f = 502{,}655 \text{ rad/sec}$

b) Find phase of current.

$V = .025 \angle 0$

$I = 628.32 \times 10^{-6} \angle 90°$

$\theta_I = 90°$

c) find Z_{cap}

$$Z_{cap} = \frac{V}{I} = \frac{1}{j\omega C} = \frac{.025\angle 0}{628.32\times10^{-6}\angle 90°}$$

$Z_{cap} = 39.79 \angle -90° \ \Omega = -39.79\Omega$

$Z_{cap} = -39.79\Omega$

d) find C

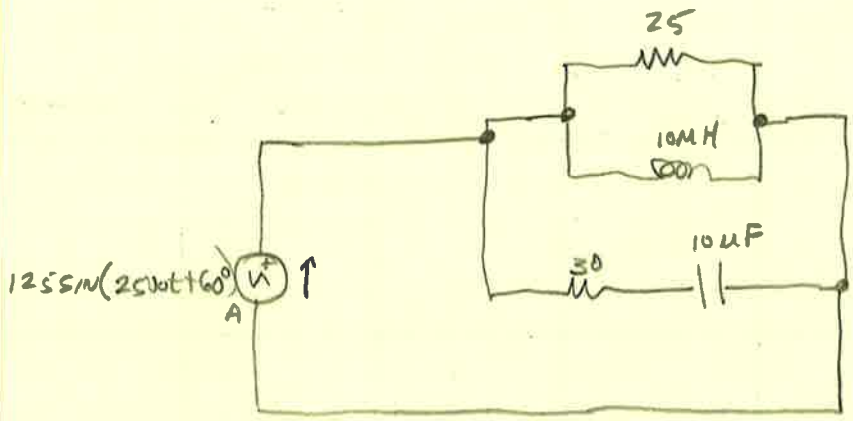
$$Z_C = \frac{1}{j\omega C} = 39.79 \angle -90°$$

$$C = \frac{1}{39.79\angle -90° (j)(\omega)} = 0.05 \ \mu F$$

$C = 0.05 \ \mu F$

e) Find Z_{cap}

$Z_{cap} = 39.79 \angle -90° = -j39.79$



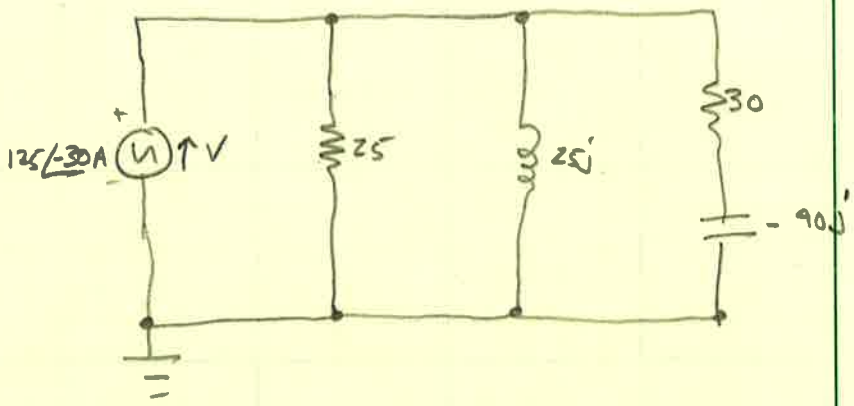
a) Draw Frequency-domain equivalent circuit

$\omega = 2500$

$Z_L = j\omega L = 25j\ \Omega$

$Z_C = \frac{1}{j\omega C} = -40j\ \Omega$

source: $125\sin\ldots = 125\angle -30°$



b) FIND V

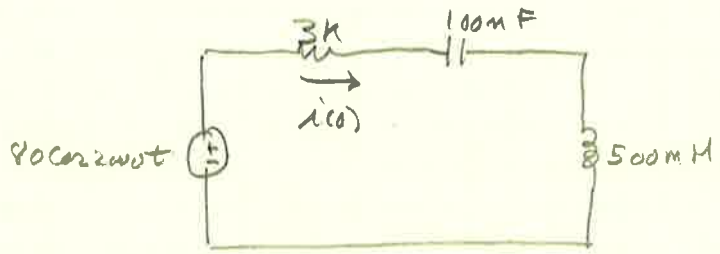
$Z_{eq} = 25 \| 25j \| (30-40j) = 17.46\angle 24.78°\ \Omega$

$\boxed{V = IZ = 2182.6\angle -5.22°\ V}$

c) Find ss expression for v(t)

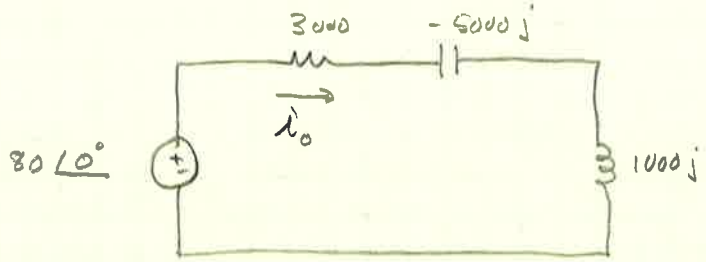
$\boxed{v(t) = 2182.6\cos(2500t - 5.22°)\ V}$

FIND $i_o(t)$.



Convert to frequency domain using:

$$Z_L = j\omega L = j(2000)(.5) = 1000j\ \Omega$$
$$Z_C = \frac{1}{j\omega C} = -j\left(\frac{1}{2000(100\times10^{-9})}\right) = -5000j\ \Omega$$



Loop equation: $80\angle 0 = I_o(3000 - 5000j + 1000j)$

$= I_o(3000 - 4000j)$

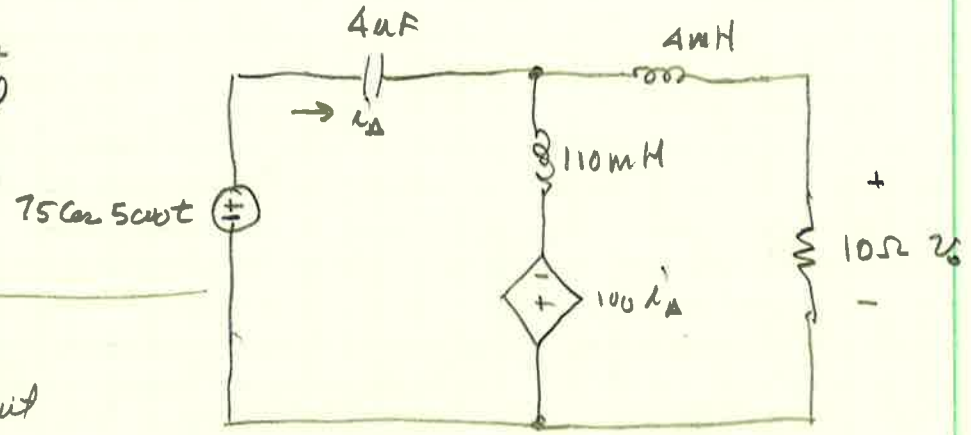
$= I_o(5000\angle -53.13°$

$$i_o(t) = \frac{80\angle 0}{5000\angle -53.13°}$$

$= 16\angle 53.13°$ mA

$= 16\cos(2000t + 53.13°)$ mA

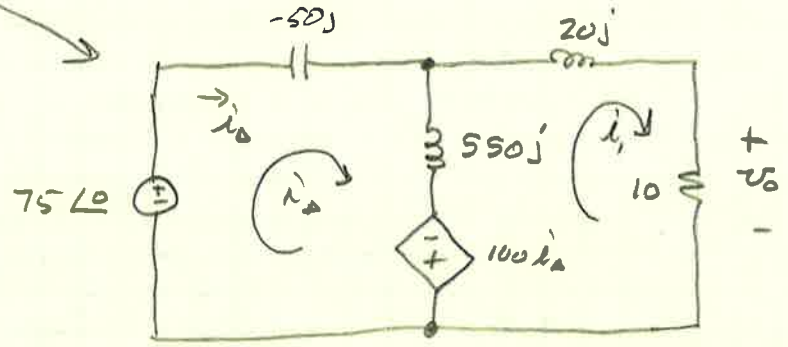
use mesh-current method to find v_o.



1) transform circuit

$Z_L = j\omega L$

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



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

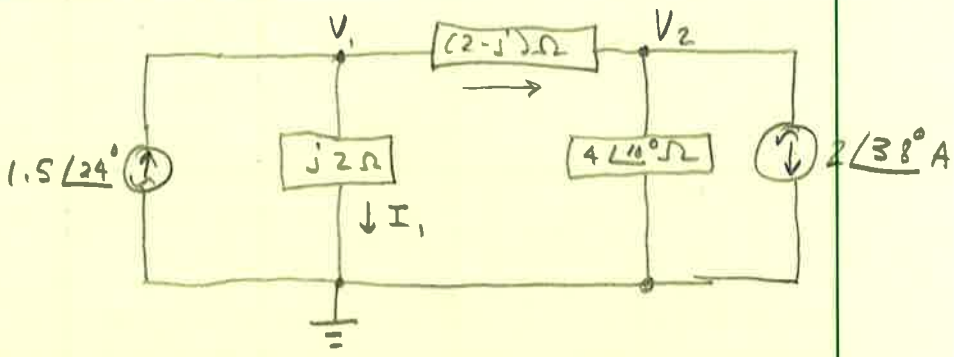
i_1 : $i_\Delta(100 - 550j) + i_1(10 + 570j) = 0$

Solving: $i_\Delta = 3.25j$ A

$i_1 = 2.5j$ A

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

Find the Thevenin equivalent seen by the 2-j Ω impedance then FIND I_1

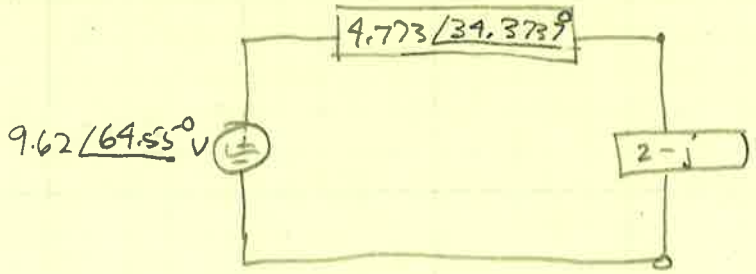


$$Z_{th} = j2 + 4\angle 10^\circ$$
$$= 3.9392 + j\,2.6946$$
$$= \boxed{4.773\angle 34.3737^\circ\ \Omega}$$

$$V_1 = j2(1.5\angle 24^\circ) = (2\angle 90^\circ)(1.5\angle 24^\circ) = 3\angle 114^\circ\ V$$

$$V_2 = (4\angle 10^\circ)(-2\angle 38^\circ) = -8\angle 48^\circ = 8\angle -132^\circ\ V$$

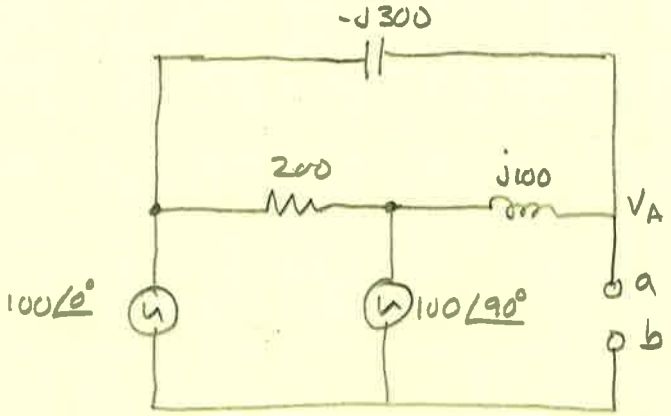
$$V_{th} = V_1 - V_2 = 3\angle 114^\circ - 8\angle -132^\circ$$
$$= -1.2202 + j\,2.7406 - (-5.353 - j\,5.9452)$$
$$= 4.133 + j\,8.6858 = \boxed{9.62\angle 64.55^\circ\ V}$$



$$I_{2-j} = \frac{V}{Z} = \frac{9.62\angle 64.55^\circ}{4.773\angle 34.3737} = 2.0153\angle 30.18^\circ\ A$$

$$I_1 = 1.5\angle 24^\circ - 2.0153\angle 30.18^\circ\ A$$
$$= 1.3703 + 0.6101j - (1.7421 + 1.0131j)$$
$$= -0.3718 - 0.403j\ A$$
$$\boxed{= 0.548\angle -132.7^\circ\ A}$$

Find the Thevenin equivalent @ terminals ab.



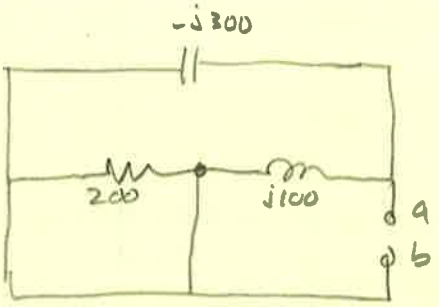
Z_{th}

$Z_{th} = j100 \,||\, -j300$

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

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

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



V_{th}

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

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