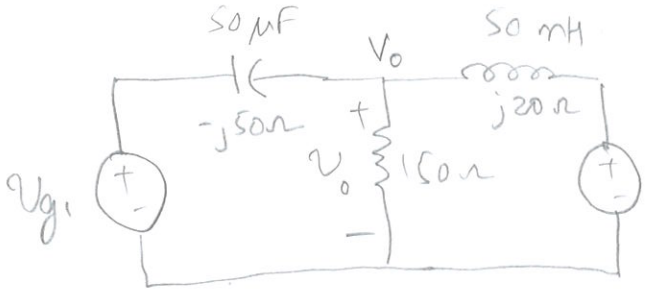
Pr 9.54
25 points



$\omega = 400$ rad/sec.

$j\omega L = j400 \times 50\times10^{-3}$
$= j20\ \Omega$.

$\frac{-j}{\omega C} = \frac{-j}{400 * 50\times10^{-6}}$
$= -j50\ \Omega$

Also, $v_{g_1} = 25\cos(400t + 53.15°)$
$v_{g_2} = 18.03\cos(400t + 33.69°)$

or $\bar{V}_{g_1} = 25\angle 53.15° = 15 + j20$ V
$\bar{V}_{g_2} = 18.03\angle 33.69° = 15 - j10$ V

writing KCL at the node V_o,

$$\frac{\bar{V}_o - (15+j20)}{-j50} + \frac{\bar{V}_o}{150} + \frac{\bar{V}_o - (15+j10)}{j20} = 0.$$

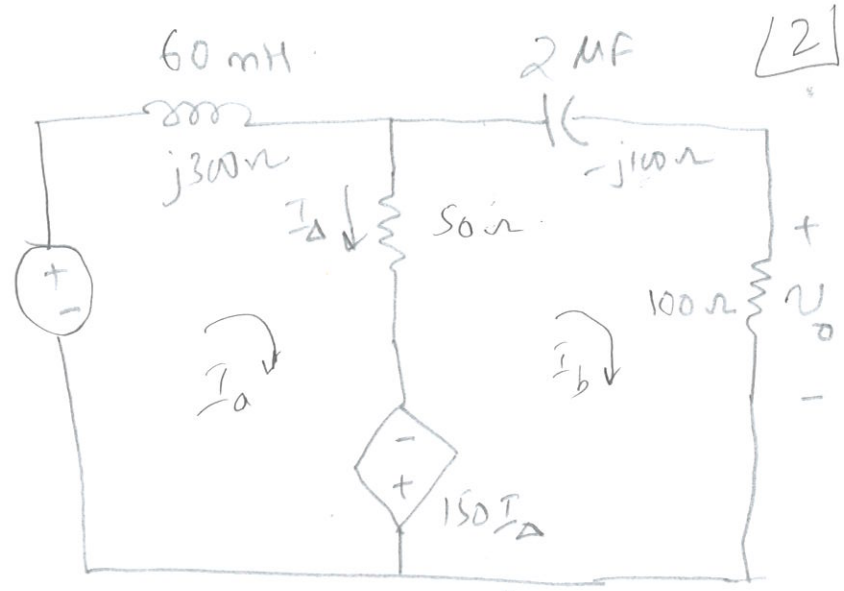
$\frac{1}{j} = -j$
$\frac{1}{-j} = j$

$$j\left[\bar{V}_o - (15+j20)\right] + \frac{\bar{V}_o}{150} + -j\left[\bar{V}_o - (15+j10)\right] = 0$$
$$50 \qquad\qquad 150 \qquad\qquad 20$$

or $\frac{6j\bar{V}_o - 6j(15+j20) + 2\bar{V}_o + (-15j\bar{V}_o + 225j + 150j^2)}{300} = 0.$

So $\bar{V}_o = 15\angle 0°$, or $v_o(t) = 15\cos 400t$ Volts.

Pr 9.64



$v_g = 400 \cos 5000t$ V

$j\omega L = j(5000)(60\times10^{-3})$
$= j300\ \Omega$

$\frac{-j}{\omega C} = \frac{-j}{5000(2\times10^{-6})}$
$= -j100\ \Omega$

$\bar{V}_g = 400\angle 0$
$\bar{I}_\Delta = \bar{I}_a - \bar{I}_b$

So the 2 mesh KVL equations are:

(1) $-400\angle 0 + j300\bar{I}_a + 50(\bar{I}_a - \bar{I}_b) - 150(\bar{I}_a - \bar{I}_b) = 0$

or $\bar{I}_a(-100 + j300) + 100\bar{I}_b = 400 \rightarrow (1)$

(2) $150(\bar{I}_a - \bar{I}_b) - 50(\bar{I}_a - \bar{I}_b) + (j100\bar{I}_b) + 100\bar{I}_b = 0$

$100\bar{I}_a - j100\bar{I}_b = 0 \rightarrow (2)$

Multiply (1) by j:

(1) becomes: $\bar{I}_a(-j100 + 300j^2) + j100\bar{I}_b = 400j \rightarrow (1)$

also; $j^2 = -1$

Add (1) & (2) to get

$-200\bar{I}_a - j100\bar{I}_a = j400$

Hence; $\bar{I}_a = \frac{j400}{(-200 - j100)} = -0.8 - j1.6$ Amps.

So, $\bar{I}_b = -1.6 + j0.8$ Amps

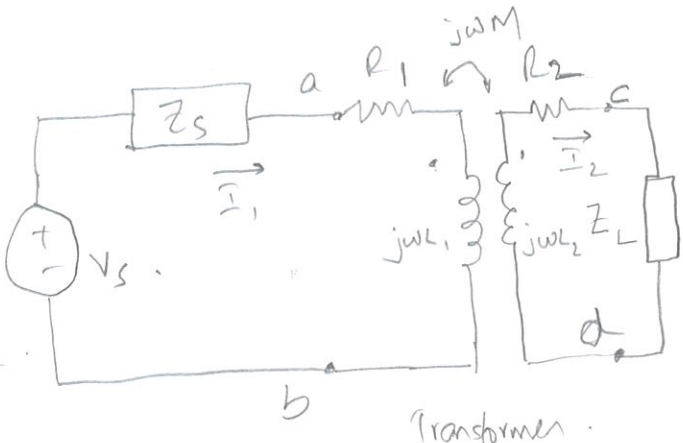
and $\bar{V}_o = 100 * \bar{I}_b$

$= -160 + j80$

$= 178.89 \angle 153.43^\circ$

and $v_o(t) = 178.89 \cos(5000t + 153.43^\circ)$ Volts

AP 9.14.



$Z_L \rightarrow 360\,\Omega$ in Series with 0.25H.

$Z_s \rightarrow 184 + j0\ \Omega$.

$V_s \rightarrow 245.20^\circ$, $\omega = 800$ rl/sec

$R_1 = 100\,\Omega$, $L_1 = 0.5$H

$R_2 = 40\,\Omega$, $L_2 = 0.125$ H

$k = 0.4$

Find a) Z_R b) $\bar{I}_1$ and c) $\bar{I}_2$

Given $M = 0.4\sqrt{0.5 * 0.125} = 0.1$H, So $\omega M = 80\,\Omega$.

$Z_{22} = R_2 + j\omega L_2 + Z_L = 40 + j800(0.125) + 360 + j800(0.25)$

$= (400 + j300)\ \Omega$.

$= 500 \angle 36.86^\circ$.

Also $Z_{22}^* = 400 - j300\ \Omega$.

Hence, $Z_R = \left(\frac{80}{500}\right)^2 (400 - j300)$ (4)

$= (10.24 - j7.68)\ \Omega$

b) $\bar{I}_1 = \frac{V_s}{Z_{11} + Z_R} = \frac{245.20^\circ}{(184 + j0) + (100 + j400) + (10.24 - j7.68)}$

$= \frac{245.20}{294.24 + j392.32}$

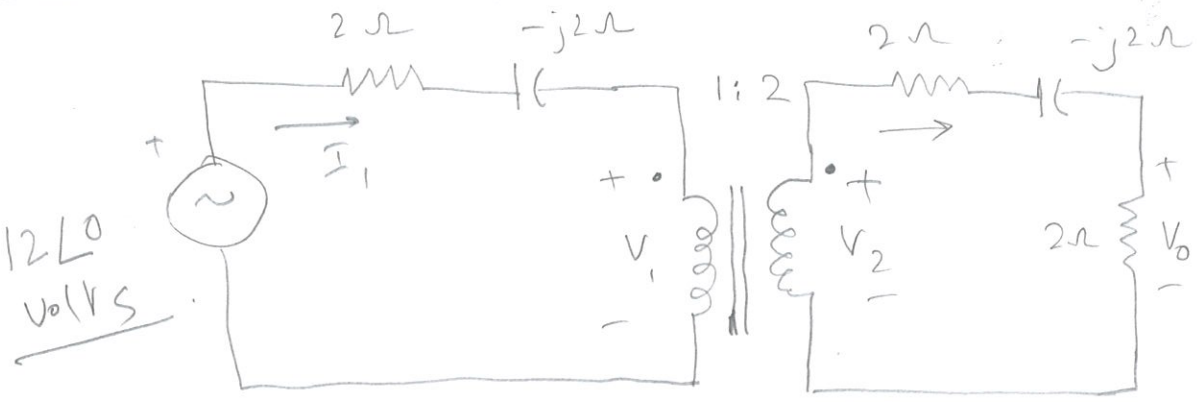
$= 0.5\angle -53.13^\circ$

c) $I_2 = \frac{j\omega M}{Z_{22}} * \bar{I}_1$

$= \left(\frac{j80}{400 + j300}\right)(0.5\angle -53.13^\circ)$

$\bar{I}_2 = 0.08\angle 0$ Amps.

Problem x Ideal transformer



Find I_1 & V_o. $n = \frac{N_2}{N_1} = 2$

Reflecting impedance from Secondary to Primary:

$$Z_R = \frac{2-j2+2}{n^2} = \frac{4-j2}{4} = (1-j0.5)\,\Omega$$

$$\text{So, } \bar{I}_1 = \frac{V}{Z_{11}+Z_R} = \frac{12\angle 0}{2-j2+(1-j0.5)} = \frac{12}{3-j2.5}$$

$$= 3.07\angle 39.8^\circ \text{ Amps}$$

Hence $\bar{I}_2 = +\frac{\bar{I}_1}{n} = 1.535\angle 39.8^\circ$ Amps (+ve sign!)

and $V_o = IR = 1.535\angle 39.8 * 2$

$= 3.07\angle 39.8^\circ$ Volts

8.75 «42.04 new