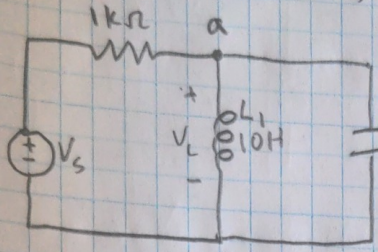
Chris Hunt

HW4

ENGR 202

4.1) Find $V_L(t)$ across L_1

$V_s(t) = 10\sin(377t + 40°) = 10\cos(377t - 50°) = 10\angle -50 \quad \omega = 377 \frac{rad}{s}$



$L_1 = j\omega L = j3770\ \Omega$

$C_1 = \frac{1}{j\omega C} = -j2652.52\ \Omega$

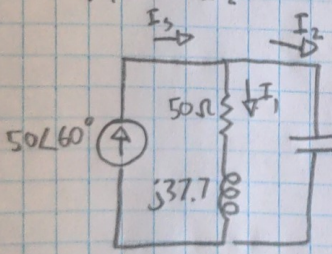
$Z_1 = 1k\Omega \qquad Z_2 = L_1 \| C_1 = \frac{(j3770)(-j2652.52)}{j1117.48}\ \Omega$

$Z_2 = -j8948.71\ \Omega$

$V_L = V_a = V_s\left(\frac{Z_2}{Z_1 + Z_2}\right) \qquad V_L = 10\angle -50(.9877 - j.1104)$

$V_L = 6.428 - j7.676 = \boxed{10.01\cos(377t - 50.06°)\ V}$

4.7) Find I_2



$I_2 = I_s\left(\frac{Z_1}{Z_1 + Z_2}\right) = (25 + j43.3A)\left(\frac{50 + j37.7\Omega}{50 - j28.6\Omega}\right)$

$I_2 = -32.55 + j43.53$

$\boxed{I_2 = 54.353\angle -126.79A}$

$Z_1 = 50 + j37.7\ \Omega \qquad Z_2 = -j66.3$

$I_s = 25 - j43.3$

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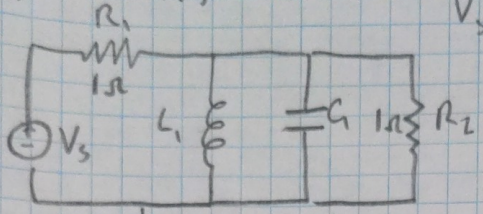
4.3) Find $i(t)$



$V_s = 12\cos(10t) = 12\angle 0 = 12 \quad \omega = 10\frac{rad}{s}$

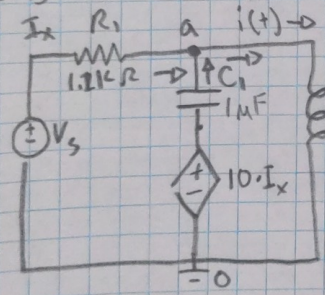
$L_1 = j10 \quad C_1 = -j.1$

$$Z_{eq} = \frac{1}{1-j.1+j10} = \frac{1}{1+j9.9} = 1.01 - j.1\,\Omega = 1.0149\angle -5.65$$

$$I_s = \frac{V_s}{Z_{eq}} = \frac{12\angle 0}{1.0149\angle -5.65} = 11.82\angle 5.65$$

$$\boxed{i(t) = 11.82\cos(10t + 5.65^\circ)\,A}$$

4.4) Find $i(t)$



$V_s = 120\cos(1000t) = 120\angle 0 \quad \omega = 1000\frac{rad}{s}$

$L_1 = j1000 \quad C_1 = -j1000$

$$@a: \frac{V_s - V_a}{1.2k\Omega} + \frac{10\left(\frac{V_s - V_a}{1.2k\Omega}\right) - V_a}{-j1000} = \frac{V_a}{j1000}$$

$$\frac{120 - V_a}{1200\Omega} + \frac{120 - V_a}{\frac{120}{-j1000}} - \frac{V_a}{-j1000} = \frac{V_a}{j1000}$$

$$.1 - \frac{V_a}{1200\Omega} + \frac{1}{-j1000} - \left(\frac{V_a}{120}\right)\left(\frac{1}{-j1000}\right) - \frac{V_a}{-j1000} = \frac{V_a}{j1000}$$

$$.1 - \frac{V_a}{1200} + j0.001 - \left(\frac{V_a}{120}\right)(j0.001) - V_a j0.001 = -V_a j0.001$$

$$.1 + j0.001 = \frac{V_a}{1200\Omega} + \left(\frac{V_a j0.001}{120}\right) \rightarrow .1 + j0.001 = \left(\frac{1}{1200\Omega} + \frac{1}{-j120000}\right)V_a$$

$$V_a = \frac{.1 + j0.001}{\frac{1}{1200} + j\frac{1}{-j120000}} = 120\angle 0\,V \qquad I_L = \frac{120\angle 0}{1000\angle 90} = .12\angle -90\,A$$

$$\boxed{i(t) = .12\cos(1000t - 90^\circ)\,A}$$