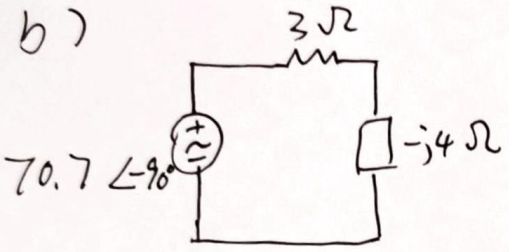
1. a) $Z_T = 3 + j\omega L + \frac{1}{j\omega C} = 3 + j\times10^4\times600\times10^{-6} + \frac{1}{j\times10^4\times10\times10^{-6}}$

$= 3 - j4\ \Omega$

b)



$\vec{I} = \frac{-j70.7}{3-j4} = \frac{70.7\angle-90^\circ}{5\angle-53.13^\circ} = 14.14\angle-36.87^\circ$

$i(t) = 14.14\cos(10^4t - 36.87^\circ)\ A$

c) $\vec{V_L} = \vec{I}\cdot Z_L = 14.14e^{-j36.87^\circ}\times 6e^{j90^\circ} = 84.84\,e^{j53.13^\circ}\ V$

$\vec{V_R} = \vec{I}\cdot R = 42.42\angle-36.87^\circ\ V$

$\vec{V_C} = \vec{I}\cdot Z_C = 14.14e^{-j36.87^\circ}\cdot(10e^{-j90^\circ}) = 141.4e^{-j126.87^\circ}\ V$

$V_R(t) = 42.42\cos(10^4t - 36.87^\circ)\ V$

$V_L(t) = 84.84\cos(10^4t + 53.13^\circ)\ V$

$V_C(t) = 141.4\cos(10^4t - 126.87^\circ)\ V$

d) 2f frequency doubles. $Z_T = 3 + j12 - j5 = 3 + j7\ \Omega$

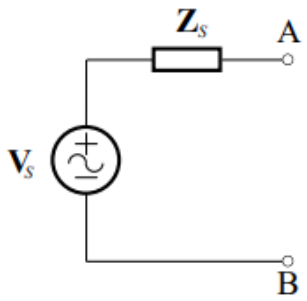
the magnitude of Z_T increases

current peak value decreases.

phase angle is $\tan^{-1}(\frac{7}{3}) = 66.88^\circ$, current lags voltage.

2.

Simplify the circuit be applying Thévenin's Theorem to terminals A and B:



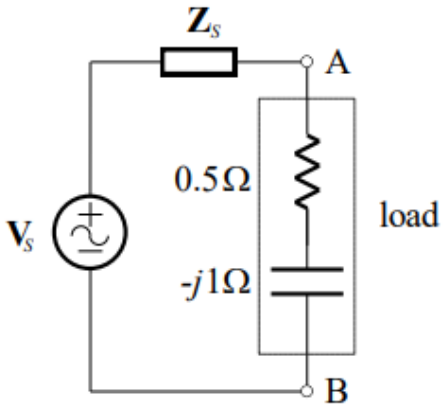
The Thévenin voltage $\mathbf{V}_S$ is the open-circuit voltage. Using the voltage divider rule we get:

$$\mathbf{V}_S = \frac{2+j5}{2.4+j5.8}\times 100\angle 0^\circ = \frac{5.385\angle 68.20^\circ}{6.277\angle 67.52^\circ}\times 100\angle 0^\circ = 85.79\angle 0.678^\circ \text{ V}$$

Setting the independent voltage source to zero, looking into terminals A and B we see two impedances in parallel:

$$\mathbf{Z}_S = (0.4+j0.8)\,\|\,(2+j5) = \frac{-3.2+j3.6}{2.4+j5.8} = \frac{4.817\angle 131.6^\circ}{6.277\angle 67.52^\circ}$$
$$= 0.7673\angle 64.08^\circ\,\Omega = 0.3350 + j0.6904\,\Omega$$

The equivalent circuit is now:



The load current is then given by Ohm's Law:

$$\mathbf{I}_L = \frac{\mathbf{V}_S}{\mathbf{Z}_S+\mathbf{Z}_L} = \frac{85.79\angle 0.678^\circ}{0.3350+j0.6904+0.5-j} = \frac{85.79\angle 0.678^\circ}{0.8905\angle -20.34^\circ} = 96.33\angle 21.02^\circ \text{ A}$$

The voltage between terminals A and B is given by Ohms' Law:

$$\mathbf{V}_L = \mathbf{Z}_L\mathbf{I}_L = (0.5-j)\times 96.33\angle 21.02^\circ = 1.118\angle -63.43^\circ \times 96.33\angle 21.02^\circ$$
$$= 107.7\angle -42.41^\circ \text{ V} = 79.52 - j72.64 \text{ V}$$