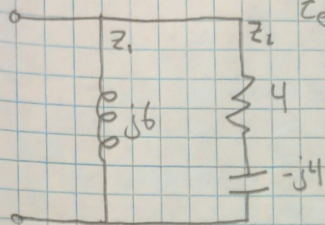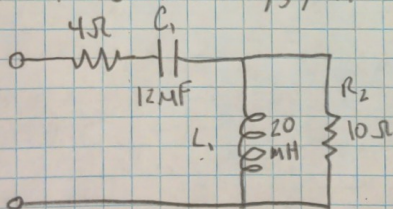## 3.1) Find Z_{eq}

$$Z_{eq} = Z_1 || Z_2 = \frac{(j6)(4-j4)}{4+j2}$$

$$Z_1 || Z_2 = \frac{j24 - j^2 24}{4+j2} \rightarrow \frac{24 + j24}{4+j2}$$

$$Z_1 || Z_2 = \frac{12(1+j)}{2+j}\left(\frac{2-j}{2-j}\right)$$

$$Z_1 || Z_2 = 12\left(\frac{2-j+j2-j^2}{4-j^2}\right) \rightarrow 12\left(\frac{3+j}{5}\right)$$

$$Z_1 || Z_2 = \frac{36}{5} + j\frac{12}{5} \rightarrow \boxed{Z_{eq} = 7.59 \angle 18.4}$$

3.2) At $\omega = 1000$ rad/s, Find Z_{eq}

$$C_1 = -j83.33 \qquad L_1 = j20$$

$$L_1 || R_2 = \frac{(10\Omega)(j20)}{10+j20} = \frac{j200}{10+j20}$$

$$L_1 || R_2 = \frac{200\angle 90}{10\sqrt{5}\angle 63.43} = \frac{20}{\sqrt{5}}\angle 26.57 \,\Omega$$

$$L_1 || R_2 = 8 + j4 \,\Omega$$

$$Z_{eq} = 4 - j83.33 + (L_1 || R_2)$$

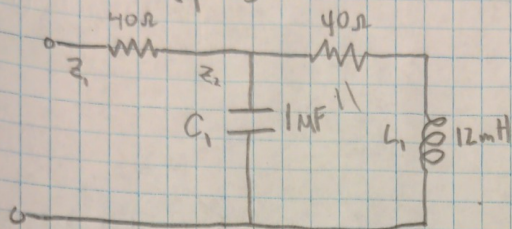$$Z_{eq} = 4 - j83.33 + 8 + j4 \,\Omega$$

$$\boxed{Z_{eq} = 12 - j79.33 \,\Omega}$$

3.3) Find Y_{eq} given $\omega = 600$ rad/s

$C_1 = \dfrac{1}{j\omega C} = -j1666.67 \ \Omega$

$L_1 = j\omega L = j7.2 \ \Omega$

$Z_{eq} = Z_1 + Z_2$

$Z_{eq} = 40\Omega + 40.33 + j6.26 \ \Omega$

$\qquad\quad R \qquad\quad X$

$Z_{eq} = 80.33 + j6.26 \ \Omega$

$Y_{eq} = G + jB$

$G = \dfrac{80.33}{80.33^2 + 6.16^2} = .124 \times 10^{-4}$

$B = -\dfrac{6.16}{80.33^2 + 6.16^2} = -9.49 \times 10^{-4}$

$Z_2 = \dfrac{(-j1666.67)(40 + j7.2)}{40 - j1659.47}$

$Z_2 = \dfrac{-j66666.8 - j^2 12000.024}{40 - j1659.47}$

$Z_2 = \dfrac{12000.024 - j66666.8}{40 - j1659.47} = \dfrac{67738.2 \ \angle -79.8}{1659.95 \angle -88.62}$

$Z_2 = 40.81 \angle 8.82 \ \rightarrow 40.33 + j6.26 \ \Omega$

$\boxed{Y_{eq} = (124 - j9.49) \times 10^{-4} \ \dfrac{1}{\Omega}}$

3.4) Find $i(t)$ given $V_s(t) = 300 \cos(100t)$ V
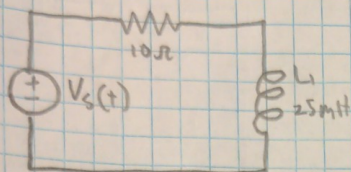
$L_1 = j2.5\,\Omega$

$Z_{eq} = 10 + j2.5\,\Omega = 10.31 \angle 14.04$

$V_s = 300 \angle 0$ V

$$\mathbb{I} = \frac{V_s}{Z_{eq}} = \frac{300 \angle 0}{10.31 \angle 14.04} = 29.1 \angle -14.04$$

$$\boxed{i(t) = 29.1 \cos(100t - 14.04°) \text{ A}}$$