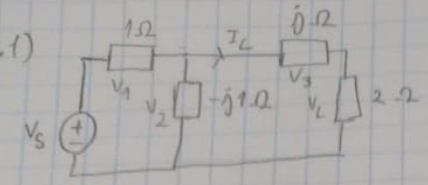
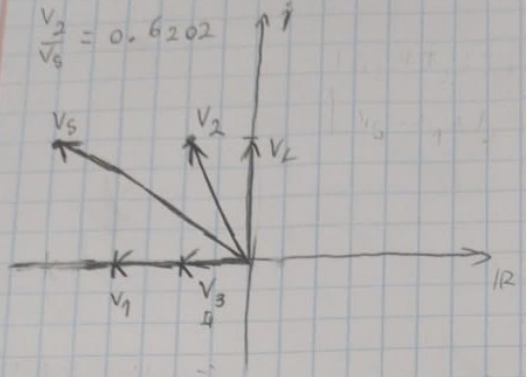
6.1)



$\frac{V_1}{V_S} = \frac{V_L}{V_S} = \frac{2}{\sqrt{13}} = 0.5547$

$\frac{V_2}{V_S} = 0.6202$



$I_L = j$

$V_L = I_L \cdot Z_L = 2j$ Mod 2

$V_3 = I_L \cdot Z_3 = -1$ Mod 1

$V_2 = V_3 + V_L$

$V_2 = -1 + 2j$ Mod $\sqrt{5}$

$I_1 = I_L + I_2 \iff$

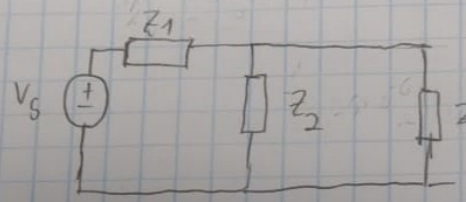
$I_1 = j + \frac{V_2}{Z_2} \iff I_1 = -2$

$V_1 = Z_1 \cdot I_1 = -2 \cdot 1 = -2$ Mod 2

$V_S = V_1 + V_2 = -1 + 2j - 2 = -3 + 2j$

Mod $\sqrt{13}$

6.2)



$Z_1 = j\omega L$ (6.1) b)

$Z_2 = \frac{1}{j\omega C}$

$Z_3 = R$

$$V_0 = V_S \cdot \frac{Z_2 // Z_3}{Z_1 + Z_2 // Z_3}$$

$$F(\omega) = \left| \frac{Z_2 // Z_3}{Z_1 + Z_2 // Z_3} \right| = \left| \frac{\left(j\omega C + \frac{1}{R}\right)^{-1}}{j\omega L + \left(j\omega C + \frac{1}{R}\right)^{-1}} \right| = \left| \frac{1}{\left(j\omega C + \frac{1}{R}\right) j\omega L + 1} \right| =$$

$$\frac{1}{-\omega^2 LC + \frac{j\omega L}{R} + 1} = \left| \frac{1}{1 - \omega^2 LC + \frac{j\omega L}{R}} \right| = \frac{1}{\sqrt{(1-\omega^2 LC)^2 + \left(\frac{\omega L}{R}\right)^2}} //$$

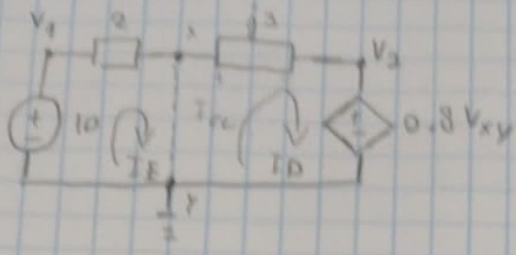
$L = 2 \times 10^{-3}$ H

$C = 125 \times 10^{-6}$ F

$R = 4\,\Omega$

6.3) $V_{oc} = V_{xy}$

$I_{cc} =$



V_{oc}

$V_1 = 10$ → $V_1 = 10$

$V_2 = 7.86 + 1.08i$

V_x:

$\frac{V_x - V_1}{2} + \frac{V_x - V_2}{3j} = 0$

$\boxed{V_x = 9.825 + 1.310i}$

$V_2 = 0.8V_x$

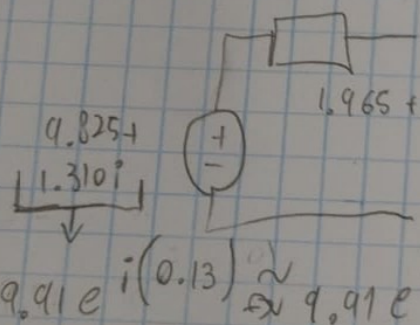
I_{cc}: I_E:

$I_E = I_{cc} = 5$

$-10 + 2 \cdot I_E = 0$

$j3(I_0) = 0$

$Z_{th} = \frac{V_{oc}}{I_{cc}} = \frac{9.825 + 1.310i}{5} = 1.965 + 0.262i$



$9.91 e^{i(0.13)} \approx 9.91 e^{i8^\circ} \cdot \frac{\pi}{180}$

6.4)

a) $V_2 = 0$

$V_1 = V_-$

V_- : $\frac{V_-}{R_3} + \frac{V_- - V_0}{R_4} \Leftrightarrow R_4\left(\frac{V_-}{R_3} + \frac{V_-}{R_4}\right) = V_0$

V_+ : $\frac{V_+}{R_2} + \frac{V_+ - V_1}{R_1} = 0 \Leftrightarrow V_+\left(\frac{1}{R_2} + \frac{1}{R_1}\right) = \frac{V_1}{R_1} \Leftrightarrow \left(\frac{R_1\left(\frac{1}{R_2} + \frac{1}{R_1}\right)}{V_1}\right)^{-1} = V_+$

$\frac{V_1}{R_1\left(\frac{1}{R_2} + \frac{1}{R_1}\right)} = V_+ \rightarrow R_4\left(V_-\left(\frac{1}{R_3} + \frac{1}{R_4}\right)\right) = V_0$

$R_4\left(\frac{V_1}{R_1\left(\frac{1}{R_2} + \frac{1}{R_1}\right)}\left(\frac{1}{R_3} + \frac{1}{R_4}\right)\right) = V_0$

$V_1 \frac{R_4}{R_1}\frac{\left(\frac{1}{R_3} + \frac{1}{R_4}\right)}{\left(\frac{1}{R_2} + \frac{1}{R_1}\right)} = V_0 \Leftrightarrow V_1 \frac{R_3 + R_4}{R_3}\frac{R_2}{R_1 + R_2} = V_0$

b) $V_1 = 0$

$V_- = V_1 = 0$ $\quad \frac{V_- - V_2}{R_3} + \frac{V_- - V_0}{R_4} = 0 \Leftrightarrow V_0 = -\frac{R_4}{R_3}V_2$

c) Dado ser uma aproximação ideal fomos que $V_0 = -\frac{R_4}{R_3}V_2 + V_1\frac{R_3 + R_4}{R_3}\frac{R_2}{R_1 + R_2}$

d) $\begin{cases} \frac{R_4}{R_3} = 2 \\ \frac{R_3 + R_4}{R_3}\cdot\frac{R_2}{R_1 + R_2} = 2 \end{cases} \Leftrightarrow \begin{cases} R_4 = 2R_3 \\ \frac{R_2}{R_1 + R_2} = \frac{2}{3} \Leftrightarrow R_2 = 2R_1 \end{cases}$ Logo $\begin{cases} R_4 = 2R_3 \\ R_2 = 2R_1 \end{cases}$

6.4)

$V_+ = V_-$

$V_- : \frac{V_- - V_S}{R_1} + \frac{V_- - V_O}{R_2} = 0 \Leftrightarrow V_- \left(\frac{1}{R_1} + \frac{1}{R_2}\right) = \frac{V_S}{R_1} + \frac{V_O}{R_2} \Leftrightarrow V_- = \left(\frac{V_S}{R_1} + \frac{V_O}{R_2}\right)\left(\frac{R_1 R_2}{R_1 + R_2}\right)$

$V_+ : \frac{V_+}{R_3} + \frac{V_+ - V_O}{R_4} = I_L \Leftrightarrow$

$\Leftrightarrow I_L = \frac{V_O}{R_4} - V_+ \left(\frac{1}{R_3} + \frac{1}{R_4}\right)$

$I_L = \frac{V_O}{R_4} - \left(\frac{V_S}{R_1} + \frac{V_O}{R_2}\right)\left(\frac{R_1 R_O}{R_1 + R_2}\right)\left(\frac{R_3 + R_4}{R_3 R_4}\right)$

$V_O\left(\frac{1}{R_4} - \frac{1}{R_2}\left(\frac{R_1 R_2}{R_1 + R_2}\right)\left(\frac{R_3 + R_4}{R_3 R_4}\right)\right) =$

$\frac{1}{R_4} - \frac{R_1 R_3 + R_1 R_4}{R_3 R_4 R_1 + R_2 R_3 R_4}$

$\frac{R_2}{R_1} = \frac{R_4}{R_3} \rightarrow R_2 R_3 = R_4 R_1$

$\frac{\left(\frac{1}{R_4} - \frac{R_1(R_1 + R_2)}{R_3 R_1 (R_1 + R_2)}\right)}{V_O \cdot \frac{1}{V_O}}$

$I_L = -\frac{V_S}{R_1}\left(\frac{R_1 R_2}{R_1 + R_2}\right)\left(\frac{R_3 + R_4}{R_3 R_4}\right) = -V_S \frac{R_2 R_3 + R_2 R_4}{R_3 R_4 R_1 + R_2 R_3 R_4} = -V_S \frac{R_4(R_1 + R_2)}{R_4(R_1 + R_2)R_3}$

$I_L = -\frac{V_S}{R_3}$ //