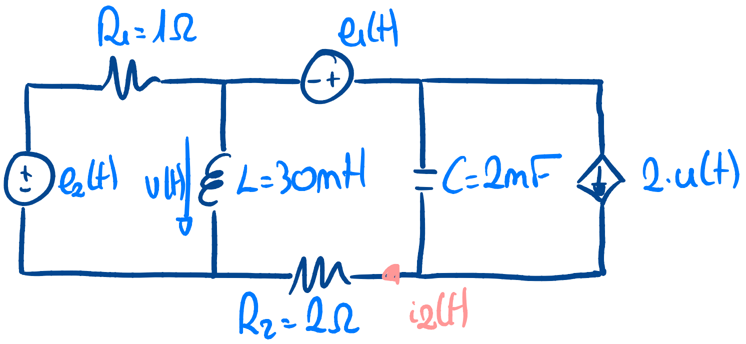
transformada fasoriales senos

Problema 1. $i_2(t)$ mallas



$$e_1(t) = \sqrt{2} \cdot 150 \cdot \cos(\overset{\omega}{100} \cdot t + \tfrac{\pi}{4})$$

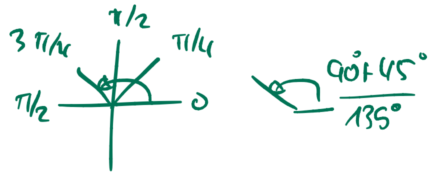
$$e_2(t) = \sqrt{2} \cdot 100 \cdot \mathrm{sen}(\overset{\omega}{100} \cdot t)$$

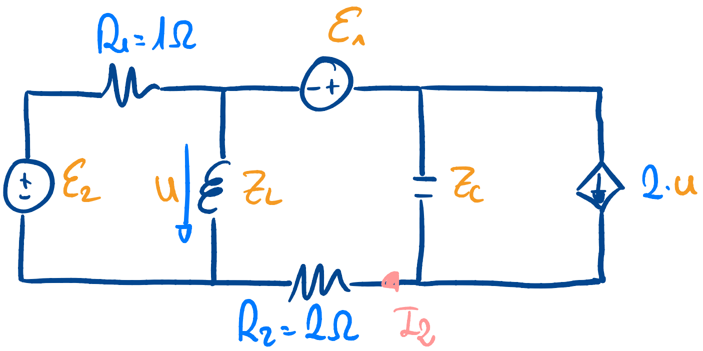
$\omega = 100$

$$e_1(t) = \sqrt{2} \cdot 150 \cdot \cos(100 \cdot t + \tfrac{\pi}{4}) = \sqrt{2} \cdot 150 \cdot \mathrm{sen}(100 \cdot t + \tfrac{\pi}{4} + \tfrac{\pi}{2}) = \sqrt{2} \cdot 150 \cdot \mathrm{sen}(100 \cdot t + \tfrac{3\pi}{4})$$

$$Z_L = j \cdot \omega \cdot L = j \cdot 100 \cdot 0.03 = j3$$

$$Z_C = j \frac{-1}{\omega C} = j \frac{-1}{100 \cdot 2 \cdot 10^{-3}} = -j5$$

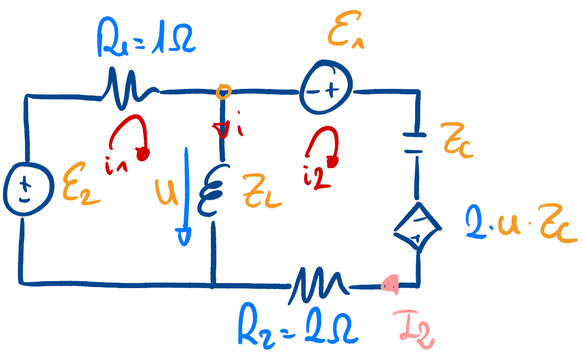


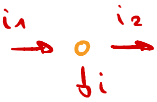


$$\mathcal{E}_1 = 150 \angle 3\pi/4 \equiv 150 \angle 135°$$

$$\mathcal{E}_2 = 100 \angle 0 \equiv 100 \angle 0°$$

$\Downarrow$





$$i_1 = i_2 + i \rightarrow i = i_1 - i_2$$

i_1: $$\mathcal{E}_2 = i_1 (R_1 + Z_L) - i_2 Z_L$$

i_2: $$\mathcal{E}_1 + 2 u Z_C = i_2 (R_2 + Z_L + Z_C) - i_1 Z_L$$

$$u = i \cdot Z_L \rightarrow u = (i_1 - i_2) Z_L$$

$$\mathcal{E}_1 + 2(i_1 - i_2) Z_L Z_C = i_2 (R_2 + Z_L + Z_C) - i_1 Z_L \rightarrow$$
$$\mathcal{E}_1 = i_2 (R_2 + Z_L + Z_C) - i_1 Z_L - 2(i_1 - i_2) Z_L Z_C \rightarrow$$
$$\mathcal{E}_1 = i_2 (R_2 + Z_L + Z_C + 2 Z_L Z_C) - i_1 Z_L (1 + 2 Z_C)$$

Manteniendo letras

Como $i_2 = I_2$

i_1: $\mathcal{E}_2 = i_1 (R_1 + Z_L) - I_2 Z_L$

i_2: $\mathcal{E}_1 = -i_1 Z_L (1 + 2 Z_C) + I_2 (R_2 + Z_L + Z_C + 2 Z_L Z_C)$

$$I_2 = \frac{\begin{vmatrix} (R_1+Z_L) & \mathcal{E}_2 \\ -Z_L(1+2Z_C) & \mathcal{E}_1 \end{vmatrix}}{\begin{vmatrix} R_1+Z_L & -Z_L \\ -Z_L(1+2Z_C) & R_2+Z_L+Z_C+2Z_LZ_C \end{vmatrix}} =$$

$$= \frac{(R_1+Z_L)\mathcal{E}_1 + \mathcal{E}_2 Z_L (1+2Z_C)}{(R_1+Z_L)(R_2+Z_L+Z_C+2Z_LZ_C) + Z_L^2(1+2Z_C)}$$

$$= \frac{(1+j3)150\angle 135^\circ + 100\,j3(1+2(-j5))}{(1+j3)(2+j3-j5+2j3(-j5)) - (j3)^2(1+2(-j5))}$$

$$= \frac{(1+j3)75\sqrt{2}(\overset{\text{cos}}{-1} + j\overset{\text{sen}}{1}) + j300(1-j10)}{(1+j3)(2-j2+30)+9(1-j10)} = \frac{-75\sqrt{2} - 75\sqrt{2}\,j - 225\sqrt{2}\,j + 225\sqrt{2} + j300 + 3000}{(1+j3)(32-j2)+9-j90}$$

$$= \frac{300(10-\sqrt{2}) + j(300-150\sqrt{2})}{32-j2+j96+6+9-j90} = \frac{300(10-\sqrt{2}) + j(300-150\sqrt{2})}{47+j4}$$

$$\underset{\text{Pol}(x,\,x_j)}{=} \frac{2577.23\angle 1.95^\circ}{47.17\angle 4.86^\circ} = 54.64\angle -2.91^\circ$$

Por lo tanto

$$i_2(t) = \sqrt{2}\cdot 54.64\cdot \text{sen}\Big(\overbrace{100}^{w}t - \overbrace{\frac{2.91\pi}{180}}^{\text{a rad}}\Big)$$

Sustituyendo ASAP

Como $i_2 = I_2$

i_1: $\mathcal{E}_2 = i_1(R_1 + Z_L) - I_2 Z_L$

i_2: $\mathcal{E}_1 = -i_1 Z_L (1 + 2Z_C) + I_2(R_2 + Z_L + Z_C + 2Z_L Z_C)$

i_1: $100\angle 0^\circ = i_1(1 + j3) - I_2\, j3 \to 100 = i_1(1+j3) - I_2\, j3$

i_2: $150\angle 135^\circ = -i_1\, j3(1 + 2(-j5)) + I_2(2 + j3 - j5 + 2\, j3(-j5)) \to$
$\to 75\sqrt{2}(j-1) = -i_1\, j3(1 - j10) + I_2(2 - j2 + j6(-j5)) \to$
$\to 75\sqrt{2}(j-1) = -i_1(j3 + 30) + I_2(2 - j2 + 30) \to 75\sqrt{2}(j-1) = -i_1 3(j+10) + I_2\, 2(16-j)$

$$I_2 = \frac{\begin{vmatrix} 1+j3 & 100 \\ -3(j+10) & 75\sqrt{2}(j-1) \end{vmatrix}}{\begin{vmatrix} 1+j3 & -j3 \\ -3(j+10) & 2(16-j) \end{vmatrix}} = \frac{(1+j3)(75\sqrt{2}(j-1)) + 100\cdot 3(j+10)}{(1+j3)(2(16-j)) - j3\cdot 3(j+10)} =$$

$$= \frac{75\sqrt{2}(j-1) + 75\sqrt{2}\, j3(j-1) + j300 + 3000}{32 - j2 + j96 + 6 + 9 - j90} =$$

$$= \frac{j75\sqrt{2} - 75\sqrt{2} - 3\cdot 75\sqrt{2} - j3\cdot 75\sqrt{2} + j300 + 3000}{47 + j4} =$$

$$= \frac{-j2\cdot 75\sqrt{2} - 4\cdot 75\sqrt{2} + j300 + 3000}{47+j4} = \frac{-300\sqrt{2} + 3000 + j(300 - 150\sqrt{2})}{47 + j4} =$$

$$= \frac{2577.23\angle 1.95^\circ}{47.17\angle 4.86^\circ} = 54.64\angle -2.91^\circ$$

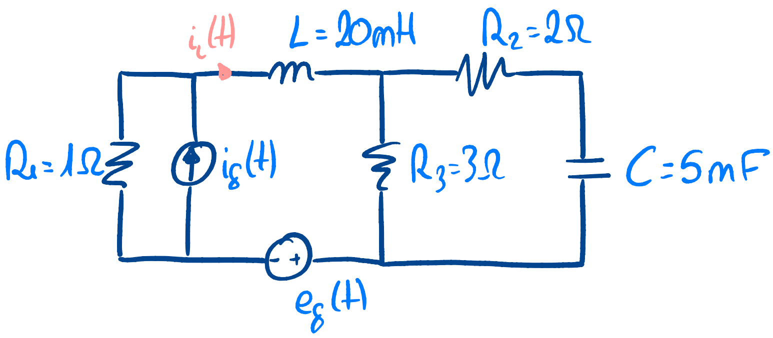
pol(x,xj)

Por lo tanto

$$i_2(t) = \sqrt{2}\cdot 54.64\cdot \text{sen}\left(\overset{w}{100}t - \overbrace{\frac{2.91\pi}{180}}^{\text{a rad}}\right)$$

$$i_2(t) = 77.27\ \text{sen}(100t - 0.016\pi) = 77.27\ \text{sen}(100t - 0.051)$$

Problema 2. $i_L(t)$ nudos



$e_g(t) = \sqrt{2}\,60\cos(\overset{\omega}{\overbrace{200}}t)$

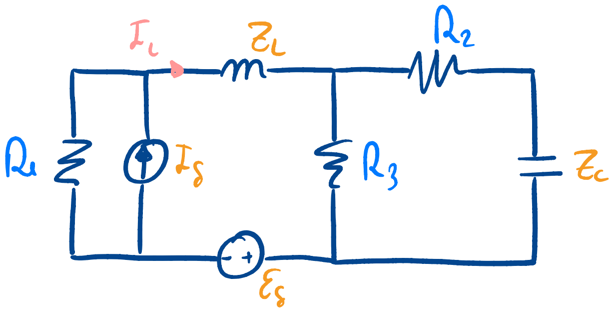
$i_g(t) = \sqrt{2}\,10\,\text{sen}(\overset{\omega}{\overbrace{200}}t + \frac{\pi}{2})$

$\omega = 200$

$e_g(t) = \sqrt{2}\,60\cos(200t) = \sqrt{2}\,60\,\text{sen}(200t + \frac{\pi}{2})$

$Z_L = j\,\omega L = j\,200 \cdot 0.02 = j4$

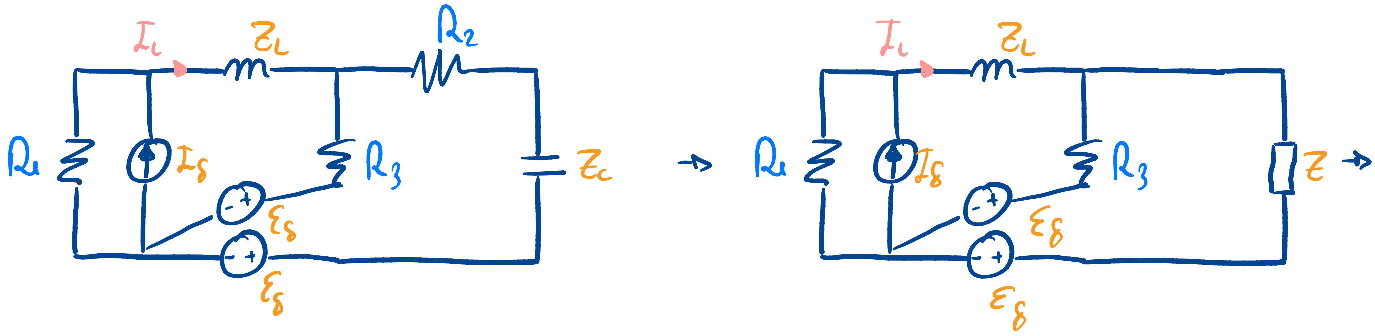
$Z_C = -j\frac{1}{C\omega} = -j\frac{1}{0.005 \cdot 200} = -j\frac{1}{1} = -j$

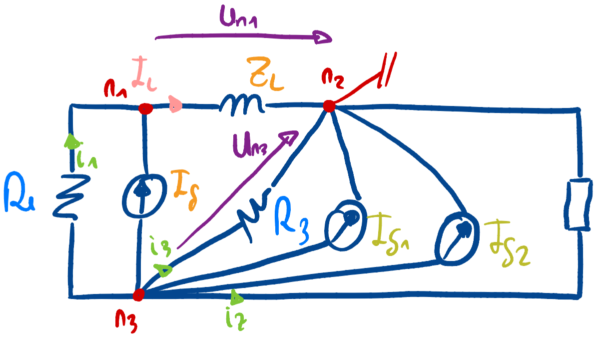


$I_g = 10\angle 90^\circ$

$\mathcal{E}_g = 60\angle 90^\circ$

$Z = Z_C + R_2 = -j + 2$





$I_{S1} = \frac{\mathcal{E}_g}{R_3} = \frac{60\angle 90^\circ}{3} = 20\angle 90^\circ$

$I_{S2} = \frac{\mathcal{E}_g}{Z} = \frac{60\angle 90^\circ}{2-j} = \frac{j\,60(2+j)}{(2-j)(2+j)} = \frac{60(j2-1)}{4+\cancel{j2}-\cancel{j2}+1}$

$= \frac{60(j2-1)}{5} = 12(j2-1)$

Manteniendo letras

$n_1.\ i_1 + I_g = I_L \rightarrow \frac{(U_{n3}-U_{n1})}{R_1} + I_g = \frac{U_{n1}}{Z_L} \rightarrow I_g = U_{n1}\left(\frac{1}{R_1}+\frac{1}{Z_L}\right) - \frac{U_{n3}}{R_1}$

$n_3.\ 0 = i_1 + I_g + i_3 + I_{g1} + I_{g2} + i_Z \rightarrow 0 = \frac{(U_{n3}-U_{n1})}{R_1} + I_g + I_{g1} + I_{g2} + U_{n3}\left(\frac{1}{R_3}+\frac{1}{Z}\right) \rightarrow$

$I_g + I_{g1} + I_{g2} = \frac{U_{n1}}{R_1} - U_{n3}\left(\frac{1}{R_1}+\frac{1}{R_3}+\frac{1}{Z}\right)$

$$U_{n1} = \frac{\begin{vmatrix} I_g & -\frac{1}{R_1} \\ I_g+I_{g1}+I_{g2} & -\left(\frac{1}{R_1}+\frac{1}{R_3}+\frac{1}{Z}\right)\end{vmatrix}}{\begin{vmatrix} \frac{1}{R_1}+\frac{1}{Z_L} & -\frac{1}{R_1} \\ \frac{1}{R_1} & -\left(\frac{1}{R_1}+\frac{1}{R_3}+\frac{1}{Z}\right)\end{vmatrix}} =$$

$$= \frac{-I_g\left(\frac{1}{R_1}+\frac{1}{R_3}+\frac{1}{Z}\right) + \frac{1}{R_1}\left(I_g+I_{g1}+I_{g2}\right)}{-\left(\frac{1}{R_1}+\frac{1}{Z_L}\right)\left(\frac{1}{R_1}+\frac{1}{R_3}+\frac{1}{Z}\right)+\frac{1}{R_1^2}} = \frac{I_g\left(\cancel{\frac{1}{R_1}}+\frac{1}{R_3}+\frac{1}{Z}\right) - \frac{1}{R_1}\left(\cancel{I_g}+I_{g1}+I_{g2}\right)}{\frac{1}{R_1R_3}+\frac{1}{R_1Z}+\frac{1}{Z_LR_1}+\frac{1}{Z_LR_3}+\frac{1}{Z_LZ}}$$

$$= \frac{10\angle 90^\circ\left(\frac{1}{3}+\frac{1}{2-j}\right) - \frac{1}{1}\left(20\angle 90^\circ + 12(j2-1)\right)}{\frac{1}{1\cdot 3}+\frac{1}{1(2-j)}+\frac{1}{j4\cdot 1}+\frac{1}{j4\cdot 3}+\frac{1}{j4(2-j)}}$$

$$= \frac{j10\left(\frac{1}{3}+\frac{2+j}{(2-j)(2+j)}\right) - 1(j20+j24-12)}{\frac{1}{3}+\frac{2+j}{(2-j)(2+j)}+\frac{-j4}{j4(-j4)}+\frac{-j12}{j12(-j12)}+\frac{1}{j8+4}} = \frac{j10\left(\frac{1}{3}+\frac{2+j}{4+1}\right)-(j44-12)}{\frac{1}{3}+\frac{2+j}{4+1}-\frac{j}{4}-\frac{j}{12}+\frac{4-j8}{(j8-4)(4-j8)}}$$

$$= \frac{j10\left(\frac{1}{3}+\frac{2+j}{5}\right)-j44+12}{\frac{1}{3}+\frac{2+j}{5}-\frac{j}{4}-\frac{j}{12}+\frac{4-j8}{64+16}} = \frac{j10\left(\frac{5+3(2+j)}{15}\right)-j44+12}{\frac{80+48(2+j)-j60-j20+3(4-j8)}{240}}$$

$$= \frac{j\frac{10}{15}(5+6+j3) + \frac{-j660+180}{15}}{\frac{80+96+j48-j60-j20+12-j24}{240}} = \frac{\frac{j110-30-j660+180}{15}}{\frac{188-j56}{240}} = \frac{\frac{-j550+150}{15}}{\frac{47-j14}{60}}$$

$$= \frac{\frac{-j110+30}{3}}{\frac{47-j14}{60}} = \frac{60(-j110+30)}{3(47-j14)} = \frac{20(-j110+30)}{47-j14} = \frac{-j2200+600}{47-j14}$$

$$= \frac{2280.35\angle -74.74^\circ}{49.04\angle -16.59^\circ} = 46.50\angle -58.15^\circ$$

$Rl(x, x_j)$

Por lo tanto

$$I_L = \frac{U_{n1}}{Z_L} = \frac{46.50 \angle -58.15°}{j4} = \frac{46.50 \angle -58.15°}{4 \angle 90°} = 11.625 \angle -148.15°$$

Por lo tanto

a rad

$$i_L(t) = \sqrt{2}\,|I_L|\,\text{sen}(\omega t + \alpha(I_L)) = \sqrt{2} \cdot 11.625\,\text{sen}(\overset{\omega}{200}t - \frac{148.15 \cdot \pi}{180})$$

$$i_L(t) = 16.44\,\text{sen}(200t - 0.82\pi) = 16.44\,\text{sen}(200t - 2.59)$$

Sustituyendo ASAP

n_1.
$$I_g = U_{n1}\left(\frac{1}{R_1} + \frac{1}{Z_L}\right) - \frac{U_{n3}}{R_1} \rightarrow 10^{\angle 90°} = U_{n1}\left(\frac{1}{1} + \frac{1}{j4}\right) - U_{n3}\frac{1}{1} \rightarrow$$

$$\rightarrow j10 = U_{n1}\left(1 - \frac{j}{4}\right) - U_{n3} \rightarrow j10 = U_{n1}\left(\frac{4-j}{4}\right) - U_{n3}$$

n_3.
$$I_g + I_{g1} + I_{g2} = \frac{U_{n1}}{R_1} - U_{n3}\left(\frac{1}{R_1} + \frac{1}{R_3} + \frac{1}{Z}\right) \rightarrow$$

$$\rightarrow 10^{\angle 90°} + 20^{\angle 90°} + 12(j2-1) = U_{n1}\frac{1}{1} - U_{n3}\left(\frac{1}{1} + \frac{1}{3} + \frac{1}{2-j}\right) \rightarrow$$

$$\rightarrow j10 + j20 + j24 - 12 = U_{n1} - U_{n3}\left(1 + \frac{1}{3} + \frac{2+j}{5}\right) \rightarrow$$

$$\rightarrow j54 - 12 = U_{n1} - U_{n3}\frac{15 + 5 + 3(2+j)}{15} \rightarrow j54 - 12 = U_{n1} - U_{n3}\frac{26 + j3}{15}$$

$$U_{n1} = \frac{\begin{vmatrix} j10 & -1 \\ j54-12 & -\frac{26+j3}{15} \end{vmatrix}}{\begin{vmatrix} \frac{4-j}{4} & -1 \\ 1 & -\frac{26+j3}{15} \end{vmatrix}} = \frac{-j10\,\frac{26+j3}{15} + 1\cdot(j54-12)}{-\frac{4-j}{4}\,\frac{26+j3}{15} + 1\cdot 1} = \frac{\frac{-j260 + 30 + 15(j54-12)}{\cancel{15}}}{\frac{-104 - j12 + j26 - 3 + 60}{\cancel{15}\cdot 4}} =$$

$$= \frac{4\cdot(30 - j260 + j810 - 180)}{-47 + j14} = \frac{4(j550 - 150)}{j14 - 47} = \frac{j2200 - 600}{j14 - 47} =$$

Pol(x, x_j)

$$= \frac{2280.35 \angle 105.26°}{49.04 \angle 163.41°} = 46.50 \angle -58.15°$$

Por lo tanto

$$I_L = \frac{U_{n1}}{Z_L} = \frac{46.50\angle -58.15^\circ}{j4} = \frac{46.50\angle -58.15^\circ}{4\angle 90^\circ} = 11.625\angle -148.15^\circ$$

Por lo tanto

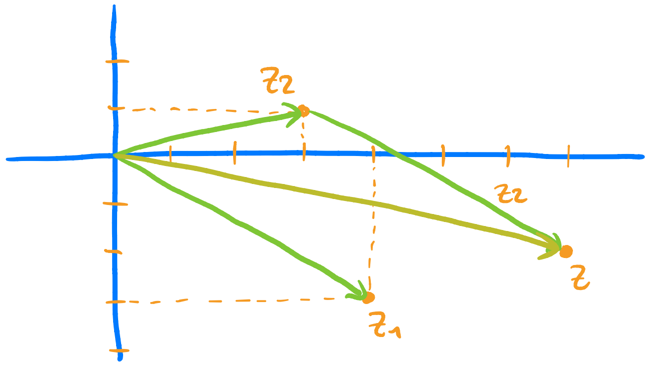
$$i_L(t) = \sqrt{2}\,|I_L|\,\text{sen}(\omega t + \alpha(I_L)) = \sqrt{2}\cdot 11.625\,\text{sen}(\overset{\omega}{\overline{200}}\,t - \overbrace{\frac{148.15\cdot\pi}{180}}^{\text{a rad}})$$

$$i_L(t) = 16.44\,\text{sen}(200t - 0.82\pi) = 16.44\,\text{sen}(200t - 2.59)$$

Complejos $z_1 = 4 - j3$; $z_2 = 3 + j$

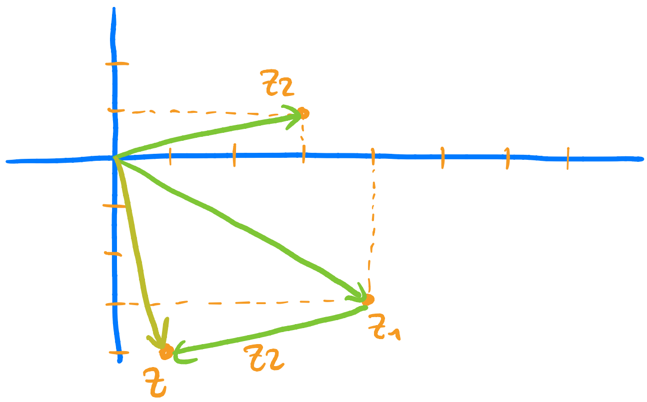
Suma

$z = z_1 + z_2 = 7 - j2$



Resta

$z = z_1 - z_2 = 1 - j4$



Multiplicación

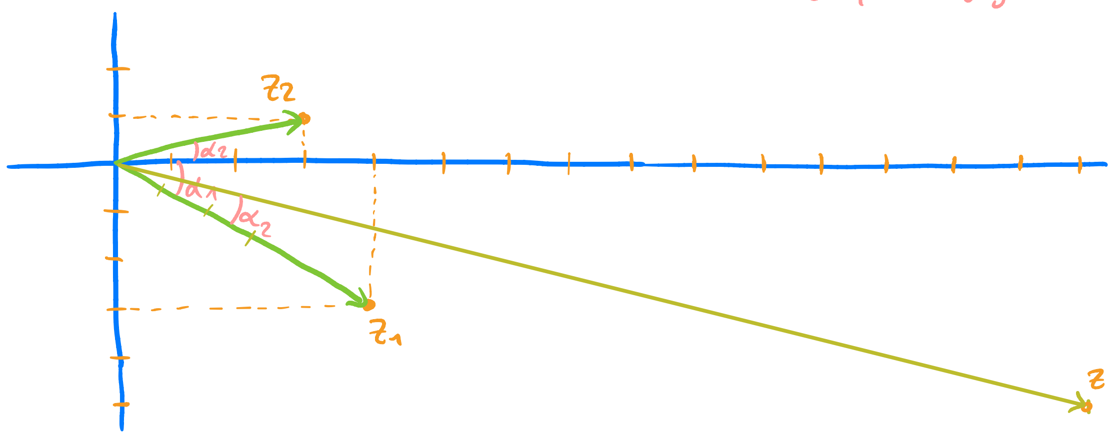
$z = z_1 \cdot z_2 = (4-j3)(3+j) =$
$12 + j4 - j9 + 3 = 15 - j5$

$\alpha_1 = atg \frac{-3}{4} \sim -36.87^\circ$ $\quad |z_1| = \sqrt{4^2 + (-3)^2} = 5$

$\alpha_2 = atg \frac{1}{3} \sim 18.43^\circ$ $\quad |z_2| = \sqrt{1^2 + 3^2} = \sqrt{10}$

$|z_1| \cdot |z_2| = 5\sqrt{10} \sim 15.81$

$\alpha_1 + \alpha_2 = atg \frac{-3}{4} + atg \frac{1}{3} \sim -18.43^\circ$



División

$$z = \frac{z_1}{z_2} = \frac{(4-j3)}{(3+j)} = \frac{(4-j3)(3-j)}{(3+j)(3-j)} =$$

$$\frac{12-j4-j9-3}{9+1} = \frac{9-j13}{10}$$

$\alpha_1 = atg\,\frac{-3}{4}$ $\sim -36.87°$ $\quad |z_1| = \sqrt{4^2+(-3)^2} = 5$

$\alpha_2 = atg\,\frac{1}{3}$ $\sim 18.43°$ $\quad |z_2| = \sqrt{1^2+3^2} = \sqrt{10}$

$|z_1|/|z_2| = 5/\sqrt{10} = 5\sqrt{10}/10 = \sqrt{10}/2$

$\alpha_1 - \alpha_2 = atg\,\frac{-3}{4} - atg\,\frac{1}{3} \sim -55.30°$