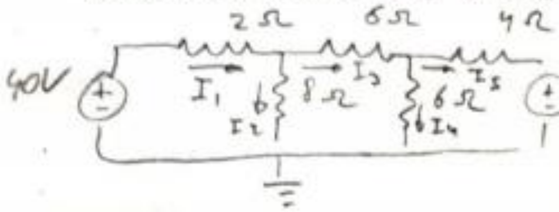
Ej Tema 1

1) Calcular la diferencia de potencial en bornas de la resistencia de 8 Ω



L.K.N

$I_1 = I_2 + I_3$

$I_3 = I_4 + I_5$

$I_1 = \frac{40 - V_x}{2}$ $\quad I_2 = \frac{x}{8}$ $\quad I_3 = \frac{x-y}{6}$ $\quad I_4 = \frac{y}{6}$ $\quad I_5 = \frac{y-20}{4}$

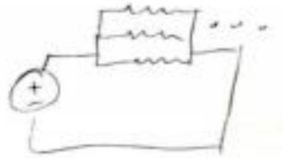
$\frac{40-x}{2} = \frac{x}{8} + \frac{x-y}{6}$ $\qquad \frac{x-y}{6} = \frac{y}{6} + \frac{y-20}{4}$

$\rightarrow 20 - \frac{x}{2} - \frac{x}{8} - \frac{x}{6} + \frac{y}{6} = 0 \rightarrow 20 - \frac{19}{24}x + \frac{y}{6} = 0 \rightarrow 480 - 19x + 4y = 0$

$\rightarrow \frac{x}{6} - \frac{y}{6} = \frac{y}{6} + \frac{y}{4} - 5 \rightarrow \frac{x}{6} - \frac{7y}{12} + 5 = 0 \rightarrow 2x - 7y + 60 = 0$

$+\frac{7}{4}(480 - 19x + \cancel{4y}) + 2x - \cancel{7y} + 60 = 0 \rightarrow 900 - 31'25x \qquad x = \frac{900}{31'25} = 28'8$

2)



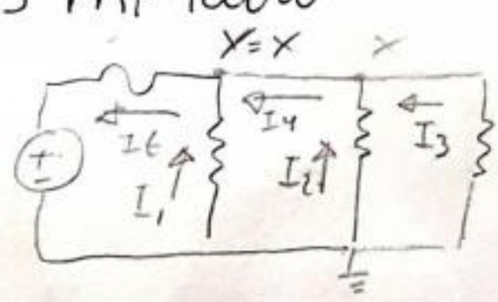
$P = V \cdot I$ (50W, 12)

$\frac{50}{12} = I = 4'1\overline{6}\ A$

$V = I \cdot R \rightarrow R = V/I = 2'88\ Ω$

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$ $\qquad \frac{1}{R_1} = \frac{1}{R_2} = \frac{1}{R_3} \rightarrow \frac{1}{R_{eq}} = 15\ \frac{1}{R} \rightarrow \frac{R}{15} = 2'88 \rightarrow R = $

3 $PR_1 = 1000W$



$P = VI = I^2 R \qquad \sqrt{P/R} = I$

L.K.M

$I_1 R + 120 = 0 \rightarrow I_1 = \frac{-120}{R}$

$I_1 = \sqrt{\frac{P}{R}} = \frac{-120}{R} \rightarrow \frac{P}{\cancel{R}} = \frac{1'44 \cdot 10^4}{R^2} \rightarrow \underline{R = 14'4\ Ω}$

L.K.N $\quad It = I_1 + I_4 \qquad I_4 = I_2 + I_3$

$It = \frac{x}{R} + \frac{x}{R_2} + \frac{x}{R_3} \qquad I_1 = \frac{-120}{R} \qquad x = -120$

$It = \frac{-120}{R} + \frac{-120}{R_2} + \frac{-120}{R_3} = |-15'83| \geq 15$ por tanto se funde

(b)

$15 - \frac{120}{R} - \frac{120}{R_2} = \frac{120}{R_3} \qquad \frac{120}{5/3} = R_3 = 72\ Ω$

7) Se quiere utilizar una bombilla de 3V y 300 mA para iluminar el dial de una radio de 120V ¿Cuál será la resistencia en serie para que la bombilla no estalle?

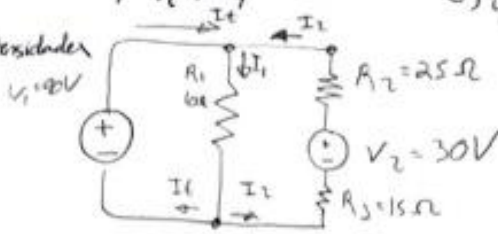
$V_{bombilla} = 3V$ $\quad I_{bombilla} = 300\,mA$ $\quad V_{radio} = 120V$

$R_{bombilla} = \frac{3}{3\cdot10^{-1}} = 10\,\Omega$ $\quad R_{total} = \frac{120}{3\cdot10^{-1}} = 400\,\Omega$

$R_{total} = R_{bombilla} + R_{serie}$ $\quad 400-10 = 390\,\Omega = R_{serie}$

Ej 5 Obtener las corrientes I_1, I_2 (que circulan por las resistencias R_1, R_2 respectivamente) y la tensión V_0 para el circuito de la figura

ⓐ Intensidades



LKN $I_1 = I_t + I_2$

LKM $I_1 R_1 - 90V = 0$

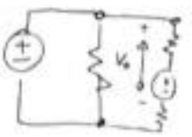
$I_2 R_2 + I_1 R_1 + I_2 R_3 - 30 = 0$

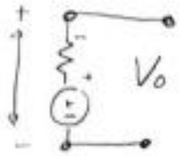
$10 I_1 = 90 \quad I_1 = 9A$

$25 I_2 + 90 + 15 I_2 = 30$

$40 I_2 = 30 - 90 \quad 40 I_2 = -60 \quad I_2 = -1'5A$ (sentido contrario al pintado)

ⓑ Voltaje V_0

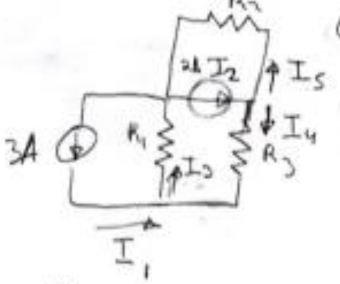




$V_0 + V_{25} - 30 = 0$

$V_0 = 30 - V_{25} = 30 + (25 \cdot 1'5) = 67'5V$

Ej 6 Calcular las corrientes que circulan por cada una de las resistencias del circuito adjunto escribiendo las ecuaciones correspondientes a cada uno de los nodos



LKN $I_2 = I_4 + I_5 \quad I_3 = I_1 + I_4$

LKM $R_1 I_3 - R_2 I_5 + R_3 I_4 = 0$

$2 = I_4 + I_5 \quad I_3 = 3 + I_4 \quad -3 = I_4 - I_3$

$R_1 = 2\Omega$

$R_2 = 5\Omega$

$R_3 = 4\Omega$

$2I_3 - 5I_5 + 4I_4 = 0$

$$\left(\begin{array}{ccc|c} -1 & 1 & 0 & -3 \\ 0 & 1 & 1 & 2 \\ 2 & 4 & -5 & 0 \end{array}\right) \rightarrow \left(\begin{array}{ccc|c} -1 & 1 & 0 & -3 \\ 0 & 1 & 1 & 2 \\ 0 & 6 & -5 & -6 \end{array}\right) \rightarrow$$

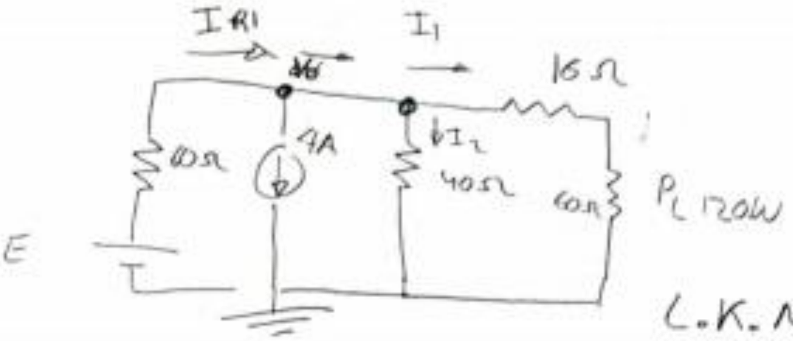
$$\left(\begin{array}{ccc|c} -1 & 1 & 0 & -3 \\ 0 & 1 & 1 & 2 \\ 0 & 0 & -11 & -18 \end{array}\right)$$

$-I_3 + I_4 = -3 \quad I_3 = +3 + I_4 = +3 + (2 - \frac{18}{11}) = 3'36A$

$I_4 + I_5 = 2 \quad I_4 = 2 - \frac{18}{11} = 0'36A$

$-11 I_5 = -18 \quad I_5 = \frac{18}{11} = 1'63A$

Ej7 R_L disipa 120W calcular el valor de E y comprobar con principio de superposición



LKN $I_t = I_1 + I_2$

$P = VI \qquad P = I^2 \cdot R$

$\sqrt{\frac{P}{R}} = I = 1'41421356\ A$

$I_{R1} = 4 + I_1 + I_2$

L.K.N

LKM $16 \cdot (\sqrt{2}) + 60 (\sqrt{2}) - 40 I_2 = 0$ $\qquad \frac{16(\sqrt{2}) + 60(\sqrt{2})}{40} = I_2 = 2'6866\ A$ $\quad \frac{19\sqrt{2}}{10}$

$V_{R1} + I_1(16) + I_1(60) - E = 0 \qquad \cancel{E} - V_0 + (\sqrt{2})(16) + (\sqrt{2})(60) - \cancel{E}$

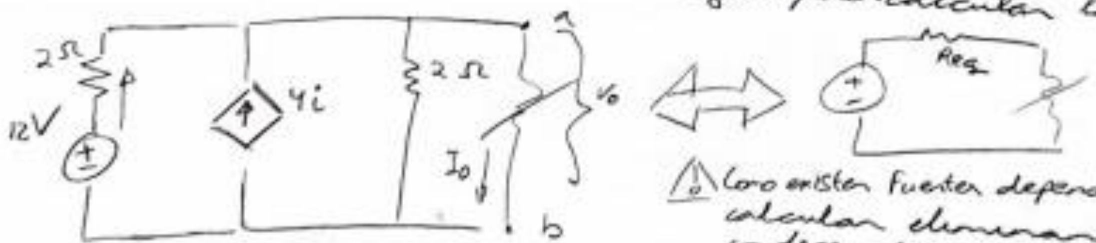
$V_0 = \sqrt{2}(16) + \sqrt{2}(60)$

LKM

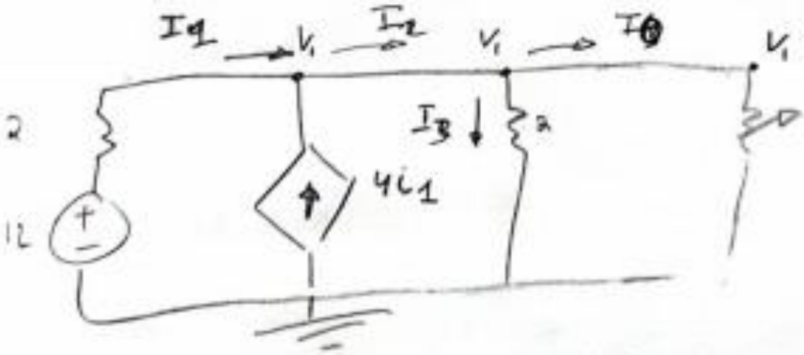
$(\cancel{E} - V_0) + 16(2) + 120(2) - \cancel{E} = 0 \qquad V_0 = 107'480$

$I_{R1} = \frac{E - V_0}{R} = 4 + \sqrt{2} + \frac{19\sqrt{2}}{10} \qquad E = \left[4 + \sqrt{2} + \frac{19\sqrt{2}}{10}\right] R + V_0 = 593'5\ V$

Ej9 Para el circuito substituir la porción de red encerrada por su equivalente Thévenin y después calcular la tensión E



⚠ Como existen fuentes dependientes, no se puede calcular eliminando fuentes independientes



Ec característica $V_0 = V_{Th} - R_{eq} I_0$

L.K.N. $I_1 + 4i_1 = I_2$

$I_2 = I_3 + I_0$

$5I_1 = I_3 + I_0$

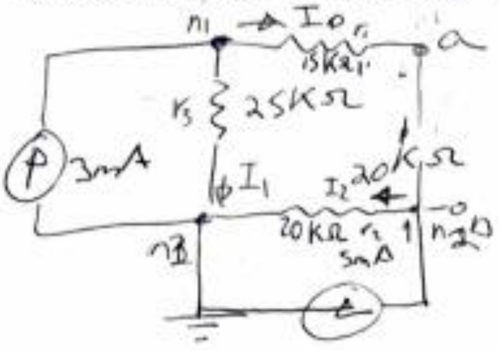
$I_1 = \frac{12 - V_1}{2} \qquad 5\left(\frac{12 - V_1}{2}\right) = \frac{V_1}{2} + I_0 \qquad \frac{12 - V_1}{2} = \frac{V_1}{10} + \frac{I_0}{5}$

$I_3 = V_1/2 \qquad \frac{12 - V_1}{2} - \frac{V_1}{10} = \frac{I_0}{5} \qquad \frac{5(12 - V_1) - V_1}{10} = \frac{I_0}{5}$

$\frac{60 - 5V_1 - V_1}{\cancel{10}\,2} = \frac{I_0}{\cancel{5}} \qquad \frac{60 - 6V_1}{2} = I_0 \qquad 30 - 3V_1 = I_0 \qquad -3V_1 = I_0 - 30$

$V_1 = -\frac{1}{3} I_0 + 10 \qquad R_{eq} = 1/3 \qquad V_{Th} = 1/3$

§8 Calcular el circuito equivalente de Thevenin y Norton



$V_0 = V_{th} - R_{eq} I_0$

L.K.N

n1 $3\cdot10^{-3} = I_0 + I_1 \rightarrow I_1 = (3\cdot10^{-3} - I_0)$

n2 $I_2 = I_0 + 5\cdot10^{-3} \rightarrow I_2 = (I_0 + 5\cdot10^{-3})$

n3 $I_1 + I_2 = 8\cdot10^{-3}$

L.K.M $I_0 R1 + V_0 + I_2 R_2 - I_1 R_3 = 0$

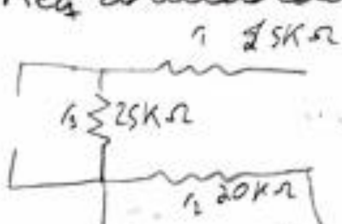
$$15\cdot10^3 I_0 + V_0 + (I_0 + 5\cdot10^{-3})(20\cdot10^{+3}) - (3\cdot10^{-3} - I_0)(25\cdot10^3) = 0$$

$$\underbrace{15\cdot10^3 I_0} + V_0 + \underbrace{20\cdot10^{+3} I_0} + 10^2 - 75 + \underbrace{25\cdot10^3 I_0} = 0$$

$$6\cdot10^4 I_0 + V_0 + 25 = 0 \qquad 6\cdot10^4 I_0 + 25 = -V_0$$

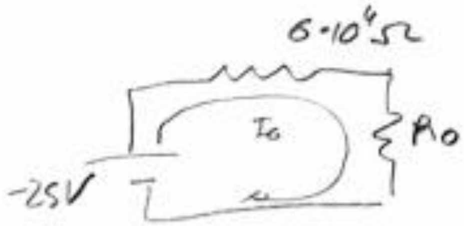
$$V_0 = \underbrace{-6\cdot10^4}_{R_{eq} = 6\cdot10^4\Omega} I_0 \underbrace{-25}_{V_{th} = -25V}$$

Al no haber fuentes dependientes se puede calcular la Req anulando fuentes independientes



todas están en serie → $15 + 25 + 20 = R_{eq} = 60$

b Usar el equivalente para calcular la Io cuando la resistencia de carga vale 0,10 y 50 KΩ

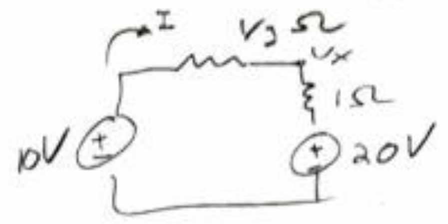


$6\cdot10^4 I_0 + R_0 I_0 + 25 = 0$

$I_0 (6\cdot10^4 + R_0) = -25$

$$I_0 = \frac{-25}{6\cdot10^4 + R_0}$$

6-10-2020



L.K.M

$\frac{1}{3} I + I + 20 - 10 = 0$

$\frac{4}{3} I = -10 \qquad I = \frac{-30}{4}$

$V = IR \qquad V = -\frac{30}{4} = -7'5V$

10 Calcular los equivalentes Norton y Thevenin entre los terminales a y b

△ como hay fuentes dependientes no se

Colocamos una resistencia de carga y buscamos la ecuación característica

L.K.N $\quad I_1 = I_2 + I_3$

$I_2 = I_o + I_4$

L.K.M $\quad 6I_4 - 4I_3 - 2I_4 = 0$

$3I_o + V_o - 6I_4 = 0$

$I_1 = 10A \qquad I_3 = \frac{V_a}{4} \qquad I_4 = \frac{V_b}{6}$

$V(I) = V_{Th} - R_{eq} I$

$I_1 = I_o + I_4 + I_3$

$10 = I_o + \frac{V_b}{6} + \frac{V_a}{4} \qquad \cancel{6}\frac{V_b}{\cancel{6}} - \frac{\cancel{4}V_a}{\cancel{4}} - \frac{2V_b}{6} = 0$

$\frac{2}{3} V_b - V_a = 0 \qquad \frac{2}{3} V_b = V_a \qquad 3I_o + V_o - 6I_4 = 0$

$3I_o + V_o = 6I_4$

$\frac{3I_o + V_o}{6} = \frac{V_a}{4} \qquad 4\left(\frac{3I_o + V_o}{6}\right) = V_a$

$10 = I_o + \frac{\frac{3}{2}V_a}{6} + \frac{V_a}{4} \qquad 10 = I_o + \frac{V_a}{4} + \frac{V_a}{4}$

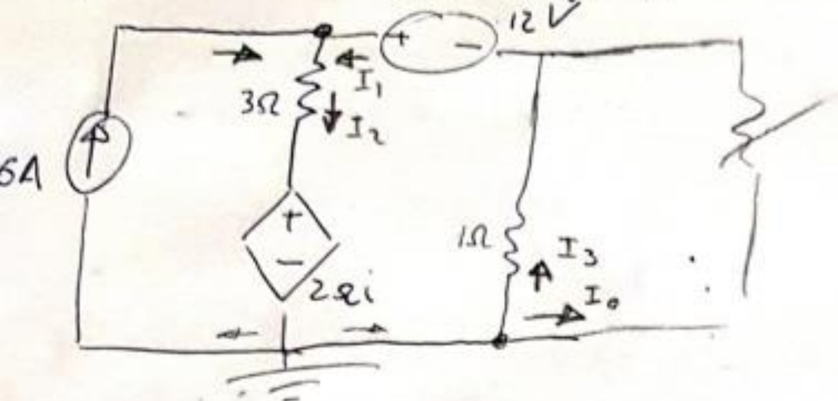
$10 = I_o + \frac{V_a}{2} \qquad 10 = I_o + \frac{\cancel{4}^{2}}{\cancel{2}}\left(\frac{3I_o + V_o}{6}\right)$

$10 = I_o + \frac{6I_o}{6} + \frac{2V_o}{6} \qquad 10 - \frac{2V_o}{6} = I_o + I_o \qquad -\frac{2V_o}{6} = 2I_o - 10$

$V_o = 10 \cdot 3 - 6I_o \qquad V_o = 30 - 6I_o \qquad V_{Th} = 30V \qquad R_{eq} = 6\,\Omega$

9-Octubre-2020

Ej 11 Calcular V_{Th}, I_N y R_{eq} entre los terminales A y B



L.K.N

$6+I_1 = I_2$

$I_2 = I_{aux} + 6$

$I_{aux} = I_3 + I_0$
$I_3 + I_0 = I_1$ } $I_1 = I_{aux}$

$I_{aux} = x_4$
$I_0 = x_5$

$I_1 = I_{aux}$ $\quad 6+I_1 = I_2$ $\quad I_1 - I_0 = I_3$

L.K.M

$\rightarrow 3I_2 + 2I_1 + I_3 - 12 = 0 \rightarrow 3(I_1+6) + 2I_1 + I_1 - I_0 - 12 = 0$

$\rightarrow V_0 - I_3R_3 = 0 = V_0 - I_3 \rightarrow I_3 = V_0$ $\quad 3I_1 + 18 + 2I_1 + I_1 - I_0 - 12 = 0$

$\rightarrow 3I_2 + 2I_0 + V_0 - 12 = 0$ $\quad 6I_1 + 6 = I_0$

$6I_1 = I_0 + 6$

$3(6+I_1) + 2I_0 + V_0 - 12 = 0$

$I_1 = \frac{I_0 - 6}{6}$

$3\left(6 + \frac{I_0-6}{6}\right) + 2I_0 + V_0 - 12 = 0$

$18 + \frac{I_0-6}{2} + 2I_0 - 12 = -V_0$

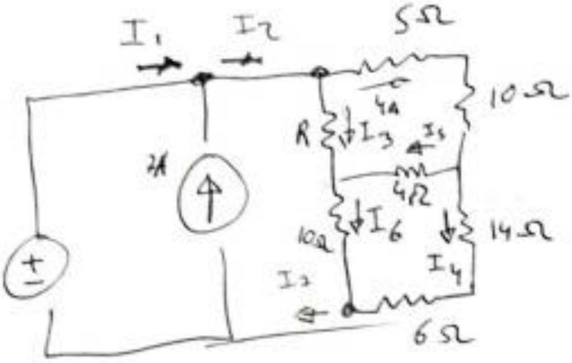
$6 - \frac{6}{2} + \frac{I_0}{2} + 2I_0 = -V_0$

$3 + \frac{5}{2}I_0 = -V_0$

) En el circuito de la figura

ⓐ Valor resistencia R

ⓑ Potencia suministrada



L.K.N

$I_1 + 7 = I_2 \rightarrow 7 = I_2 - I_1$

$I_2 = 4 + I_3 \rightarrow 4 = I_2 - I_3$

$4 = I_5 + I_4 \rightarrow 4 = I_5 + I_4$

$I_3 + I_5 = I_6 \rightarrow I_3 + I_5 - I_6 = 0$

$I_4 + I_6 = I_7 \rightarrow I_4 + I_6 - I_7 = 0$

$I_7 = I_1 + 7 \rightarrow I_7 - I_1 = 7$

LKM

$-4I_5 + 14I_4 + 6I_4 - 10I_6 = 0 \rightarrow -4I_5 + 20I_4 - 10I_6 = 0$

$20 + 40 + 14I_4 + 6I_4 - 240 = 0 \rightarrow 180 = 20I_4 \quad 9 = I_4$

$I = \begin{cases} 1-22 \\ 2-29 \\ 3-25 \\ 4-9 \\ 5-(-5) \\ 6-20 \\ 7-29 \end{cases}$

LKM $\quad 20 + 40 + 4(-5) - 25(R) = 0$

$40 = 25R$

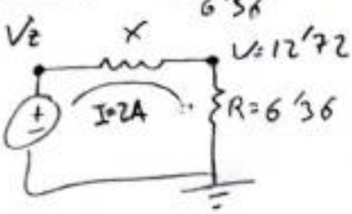
$R = \frac{40}{25} = 1'6$

$P_{fuente} = V_{fuente} \cdot I_{fuente} = 240 \cdot I_1 = 240 \cdot 22 = 5'28 \cdot 10^3$

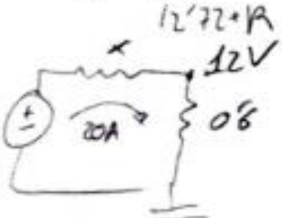
13 Se conecta a una radio de automovil una bateria, proporciona 12'72V a la radio.
Cuando se conectan un par de faros, proporciona 12V a los mismos.
Supongase que se puede modelar la radio como una resistencia de 6'36Ω y los faros como una resistencia de 0'6Ω. ¿Cuáles son los equivalente de Th y Norton de la bateria?

La batería debe tener una resistencia interna pues si fuera ideal entregaría siempre el mismo V

$I = V/R \qquad I_{radio} = \frac{12'72}{6'36} = 2A \qquad I_{faros} = \frac{12}{0'6} = 20A$



$2 = \frac{V}{12'72 + R}$



LKM

$2x + 2(6'36) - V_z = 0$

$2x + 12'72 - V_z = 0$

$20x + 12 - V_z = 0$

$20x = V_z - 12 \qquad x = \frac{V_z - 12}{20}$

$\cancel{2}^{10}\left(\frac{V_z - 12}{\cancel{20}}\right) + 12'72 - V_z = 0$

9-Octubre-2020

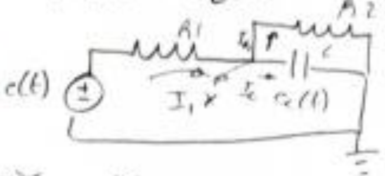
$$\frac{V_z-12}{10}+12'72-V_z=0$$

$$-\frac{9}{10}V_z+11'52=0 \qquad -\frac{9}{10}V_z=-11'52 \qquad V_z=11'52\cdot\frac{10}{9}$$

$$V_z=12'8\,V \qquad V=IR \qquad \frac{V}{I}=R \qquad \frac{12'8-12}{20}=R=4\cdot10^{-2}\,\Omega$$

15 La tensión e(t) del generador es $e(t) = 1V \cos(10^2 t)$
hallar $e_c(t)$

$V_p = 1[\underbrace{\cos(0^\circ)}_{1} + j \underbrace{\text{sen}(0^\circ)}_{0}] = 1$



LKN $I_1 = I_{R_2} + I_c$ $\qquad \frac{1-x}{R_1} = \frac{x}{R_2} + \frac{x}{Z_c}$

$\frac{1-x}{R_1} = \frac{x}{R_2} + \frac{x}{\frac{1}{jwc}} \rightarrow \frac{1-x}{R_1} = \frac{x}{R_2} + jwcx \qquad \cancel{R_1}\left(\frac{1-x}{\cancel{R_1}}\right) = \cancel{R_1}\left(\frac{x}{\cancel{R_2}}\right) + R_1 jwcx$

$1-x = x + R_1 jwcx \qquad 1 = 2x + R_1 jwcx \qquad 1 = x(2 + R_1 jwc)$

$x = \frac{1}{2 + \underbrace{(R_1)}_{1} jwC} \qquad x = \frac{1}{2 + jwc} \qquad \alpha = -\text{arctg}\left(\frac{jwc}{2}\right) = -4'636 \cdot 10^{-1} \text{rad}$

$e_c = \left|\frac{1}{2+jwc}\right) \cos(10^2 t - 0'464 \text{rad})$

16 Tres elementos en serie $I = 10 \,\text{sen}(400t + 70)$ $\quad I = 4/9$
$V = 50 \,\text{sen}(400t + 15)$

$I = 10 \sin(400t + 70)$
$V = 50 \,\text{sen}(400t + 15)$

$i = 10 \angle 70 \qquad v = 50 \angle 15 \qquad R = \frac{v}{i} =$

$= \frac{50 \angle 15}{10 \angle 70} = \frac{50[\cos(15) + j\,\text{sen}(15)]}{10[\cos(70) + j\,\text{sen}(70)]} = \frac{48'3 + 13j}{3'42 + 9'369j} =$

$= \frac{48'3 + 13j}{3'42 + 9'369j} \frac{(3'42 - 9'369j)}{(3'42 - 9'369j)} = \frac{(48'3 + 13j)(3'42 - 9'369j)}{100} =$

$= \frac{165'186 - 452'52j + 44'6j + 121'797}{100} =$

$= \frac{286'983 - 407'92j}{100} = 2'86983 - 4'0792j$

$Z_{eq} = \underbrace{Z_1}_{2'86983} + Z_2 + Z_3 \qquad Z_2 + Z_3 = -4'0792j \qquad Z_2 = jwL = 6'4j$

$Z_2 + Z_3 - Z_2 = -4'0792j - Z_2 \qquad Z_3 = -10'4792j$

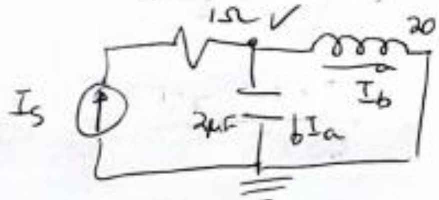
18) Determinar la impedancia Z que hace max la potencia transferida por el circuito

5 y 20 están en paralelo $Z_{eq}: 4\,\Omega$ está a su vez en serie con la bobina $Z_{eq_2}: 4+3j\,\Omega$ y finalmente en paralelo con el condensador

$$\frac{(4+3j)(-6j)}{4+3j-6j} = \left(\frac{-24j+18}{4-3j}\right)\left(\frac{4+3j}{4+3j}\right) = \frac{-96j+72+72+54j}{25} =$$

$$= \frac{144}{25} - \frac{42}{25}j \quad \cdot \quad P_{max} \text{ será cuando } Z = r_{eq} = \frac{144}{25} - \frac{42}{25}j$$

20 $I_s(t) = 10'5 \cos(10^5 t)$ A, siendo $w = 10^5$ rad/s encontrar el valor para Ia, Ib y la tensión en bornas del condensador



$$Z_L = jwL = j\,10^5 \cdot 20 \cdot 10^{-6} = 2j$$

$$Z_C = \frac{-j}{wC} = \frac{-j}{10^5 \cdot 2 \cdot 10^{-6}} = -5j$$

L.K.N $\quad I_s = I_b + I_a \qquad 10'5\angle 0 = I_b + I_a$

$$10'5\angle 0 = \frac{V}{2j} + \frac{V}{-5j} \qquad 10'5 = \frac{3x}{10j}$$

$$-105j = 3x \qquad 35j = x \qquad V = 35\cos(10^5 t + \pi/2)$$

$$I_b = \frac{35j}{2j}\,\frac{(-2j)}{(-2j)} = \frac{70}{4} = 17'5\angle 0 \qquad I_b = 17'5\cos(10^5 t)$$

$$I_a = \frac{35j}{-5j}\,\frac{(5j)}{(5j)} = -\frac{175}{25} = -7 = 7\angle_{180} \quad I_a = 7\cos(10^5 t + \pi)$$