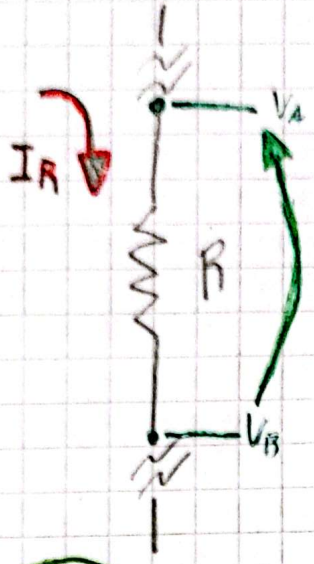
3/3/23

Inductor, capacitor y resistor.

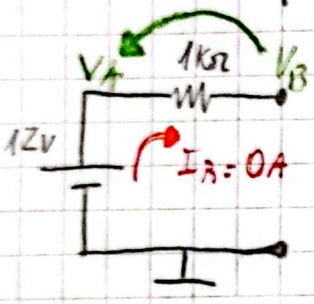


Efecto de tensión opuesta a la de consiste

$V_{AB} = V_A - V_B$

Ley de ohm.

$V_A - V_B = I_R \cdot R$



Circuito abierto

$V_A - V_B = I_R \cdot R$ ← Amor eucacia

$12V - V_B = 0A \cdot 1k\Omega$ ← Intercambiar valores

$12V - V_B = 0V$

$-V_B = 0V - 12V$

$V_B = 12V$

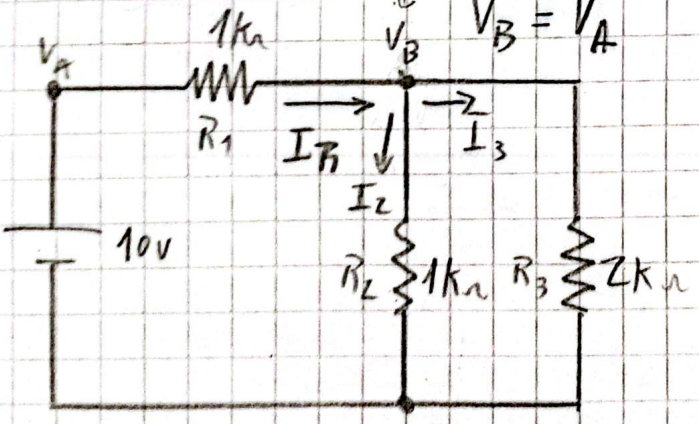
Despeje.

$\frac{V_B}{R_3} = I_3$

$\frac{3{,}99V}{2k\Omega} = I_3 = 1{,}995\ mA$

$3{,}99V$

$V_B = V_A$



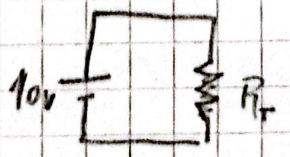
$\frac{1k\Omega \cdot 2k\Omega}{1k\Omega + 2k\Omega} = 666{,}66\Omega$

$1k\Omega + 666{,}66\Omega = 1.666{,}66\Omega = R_T$

$I_R = I_2 + I_3$

$10V - V_B = I_R \cdot 1k\Omega$

$V_B = 3{,}99$



$\frac{10V}{R_T} = 0{,}006000024\ I_R$

17/3/23

$a.x + b.y = J$

$c.x + d.y = K$

x	y	
a	b	J
c	d	K

despeje x

J	b
K	d

a
c

$$\frac{K.b - J.d}{c.b - a.d} = x$$

Dto:

$\bar{Z}_1 = 10 - J5$

$\bar{Z}_2 = -3 + J2$

$\bar{Z}_3 = 5\, e^{J\pi/4}$

$\bar{Z}_4 = 2\, e^{J20°}$

Realizar:

1) $\bar{Z}_1 + \bar{Z}_2$

2) $\bar{Z}_2 + \bar{Z}_3$

3) $\bar{Z}_3 + \bar{Z}_4$

4) $\bar{Z}_1 . \bar{Z}_2$

5) $\bar{Z}_2 . \bar{Z}_4$

6) $\bar{Z}_3 . \bar{Z}_4$

---

7) $\left|\frac{\bar{Z}_3}{\bar{Z}_4}\right|$

8) $\left|\frac{\bar{Z}_1}{\bar{Z}_2}\right|$

9) $\frac{\bar{Z}_1}{\bar{Z}_2}$

10) $\frac{\bar{Z}_2}{\bar{Z}_4}$

11) $\varphi\, \bar{Z}_1 + \bar{Z}_2$

12) $\varphi\, \bar{Z}_3 . \bar{Z}_4$

13) $\varphi\, \frac{\bar{Z}_3}{\bar{Z}_2}$

14) $\varphi\, \bar{Z}_1\, \bar{Z}_2$

15) $\varphi\, \bar{Z}_3\, \bar{Z}_4$

(ángulo entre)

---

1) $(10 - J5) + (-3 + J2)$

$7 - J3$

2) $(-3 + J2) + (5\, e^{J\pi/4})$

coordenada polar

$3,53 + J3,53$

$0,53 + J5,53$

Pasar polar a cartesiana binómica → $Z_x + J.Z_y$

$5\, e^{J\pi/4}$: $|Z|$, ángulo

$|Z| . \cos(\alpha_Z)$

$|Z| . \sin(\alpha_Z)$

ángulo

3) $(5e^{j45°}) + (2e^{j20°})$

$(3,53 + j3,53) + (1,87 + j0,68)$

$5,4 + j4,21$

4) $(10 - j5) \cdot (-3 + j2)$

$= 20 + j35$

$-30 + j20 + j15 - j^2 10$

5) $(-3 + j2) \cdot (2e^{j20°})$

$\hookrightarrow (1,87 + 0,68)$

$-5,61 - j2,04 + j^2 1,36 + j3,74$

$-7,03 + j1,7$

6) $(5e^{j45°}) \cdot (2e^{j20°})$

$(3,53 + j3,53) \cdot (1,87 + j0,68)$

$6,6 + j2,4 + j6,6 + j^2 2,4$ $\quad 4,2 + j9$

9) $\frac{10 - j5}{-3 + j2} \cdot \frac{-3 - j2}{-3 - j2} = \frac{-30 - j20 + j15 + j^2 10}{9 + \cancel{j6} - \cancel{j6} + 4}$

$\frac{-40 + j5}{13} = -3,07 + j0,38$

7) $\frac{3,53 + j3,53}{1,87 + j0,68} \cdot \frac{1,87 - j0,68}{1,87 - j0,68} = 1,8 + j1$

$6,334 - j2,4 + j6,334 - j^2 0,68 = \frac{7,014 + j3,6}{3,96}$

8) $\frac{10 - j5}{-3 + j2} \cdot \frac{-3 - j2}{-3 - j2} = -3,07 + j0,38$

Calcular módulo de Z $(|Z|)$ utilizando estos valores rectangulares

$\sqrt{(Z_x)^2 + (Z_y)^2}$

$\sqrt{3,07^2 + 0,38^2} = 3,09 = \left|\frac{Z_1}{Z_2}\right|$

10) $\frac{-3 \cdot j2}{1,87 + j0,68} \cdot \frac{1,87 - j0,68}{1,87 - 0,68} =$

11) $\varphi\ (10 - j5) + (-3 + j2)$

Ángulo

Rectangular a la suma

$7 - j3$

$\varphi_z = \tan^{-1}\left(\frac{Z_y}{Z_x}\right)$ $\quad \tan^{-1}\left(\frac{-3}{7}\right) = -23,2° = \varphi$

12) $(3,53 + j3,53) \cdot (1,87 + j0,68)$

$4,2 + j9$ $\quad \tan^{-1}\left(\frac{9}{4,2}\right) = 65°$

13) $\frac{3,53 + j3,53}{-3 + j2} \cdot \frac{-3 - j2}{-3 - j2} = 0,27 + j1,36$

$= 3 - j2$

$\frac{-3,53 - j17,65}{13} = -0,27 + j$

$\tan^{-1}\left(\frac{1,36}{0,27}\right) = 78,77°$

14) $\varphi_{z_1} = \tan^{-1}\left(\frac{-5}{10}\right) = -26,56°$

$\varphi_{z_2} = \tan^{-1}\left(\frac{2}{-3}\right) = -33,7°$

$360° - 26,56° = 333,44°$

$180° - 33,7° = 146,3°$

15) $\varphi_{z_3} = \tan^{-1}\left(\frac{3,53}{3,53}\right) = 45°$

$\varphi_{z_4} = \tan^{-1}\left(\frac{0,68}{1,87}\right) = 20°$

$25°$

Escaneado con CamScanner

31/3/23

ω = omega : Velocidad angular

$[\omega] = \frac{rad}{seg} \rightarrow \frac{rad}{segundo} = \frac{rad}{s}$

Unidad de ([.]) omega (ω)

$T \cdot \omega = 2\pi$

$\omega = \frac{2\pi}{T}$

$[T] = seg = s$

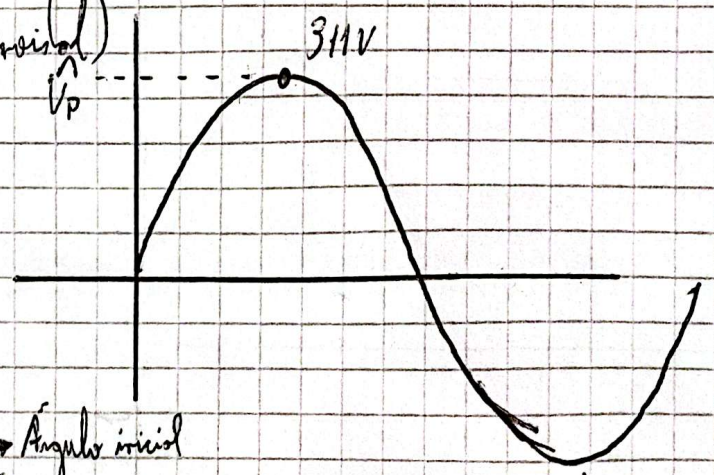
Periodo de repetición

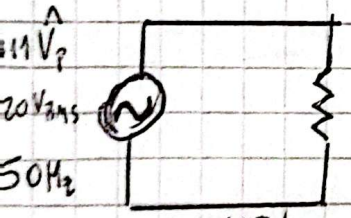
$T = \frac{1}{f}$

$[f] = Hz = \frac{Ciclos}{s}$

Entonces... $\omega = 2\pi \cdot f$

$V_{RMS} = \frac{\hat{V}_p}{\sqrt{2}}$ (Solo si es senoidal)





$v(t) = f = V_p \cdot \cos(\omega t + \varphi) \Longrightarrow \bar{V} = V_{RMS}\, e^{j\varphi}$

amplitud

Ángulo inicial

Velocidad angular.

Fasor asociado a una tensión / corriente.

Variación de la onda senoidal en el tiempo.

Cartesiano a polar $\sqrt{z_x^2 + z_y^2} = |z|$

$\text{Arctan}\left(\frac{z_y}{z_x}\right) = \text{ángulo}$

Escaneado con CamScanner

Exito

La tensión y la corriente en un resistor están en fase.

$$\frac{\bar{V}}{\bar{I}} = R$$

- - - - - -

$$\bar{V} = V_{RMS}\, e^{j\varphi_v}$$

$$\bar{I} = I_{RMS}\, e^{j\varphi_i}$$

$$\bar{Z} = \underbrace{\frac{\bar{V}}{\bar{I}}}_{|\bar{Z}|} = \frac{V_{RMS}}{I_{RMS}}\, e^{j\overbrace{(\varphi_v - \varphi_i)}^{\varphi_z}}$$

si $\varphi_v \neq \varphi_i$

$\rightarrow$ Impedancia (número complejo)

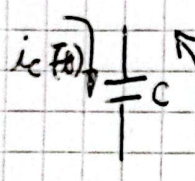
$[\bar{Z}] = \Omega$ → Polar: $\bar{Z} = |\bar{Z}|\, e^{j\varphi_z}$; Cartesiana: $\bar{Z} = R + jX$

R → Resistor*

X → Reactor*

- Capacitor e inductor*

- Resistor*



$$i_c(t) = C\,\frac{d\,v_c(t)}{dt}$$ (aparecen derivadas)

derivada de la tensión. (?)

Fasores

$$\bar{I}_c = C \cdot \bar{V}_c\, j\omega$$

$$\frac{\bar{V}_c}{\bar{I}_c} = \frac{1}{j\omega C} \cdot \frac{j}{j}$$

A veces el (−) sólo se otra.

$$\frac{\bar{V}_c}{\bar{I}_c} = \frac{-j}{\omega C} = \bar{Z}_c$$

$\Omega = X_c$, reactancia capacitiva

$$\bar{Z}_c = \frac{\bar{V}_c}{\bar{I}_c} = \frac{-j}{\boxed{\omega C}}$$

omega

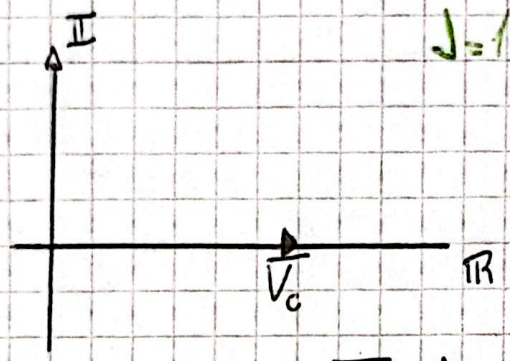
$$\bar{V}_c = -\bar{I}_c \cdot \frac{j}{\omega C}$$

$$\bar{I}_c = \frac{-\omega C}{j} \bar{V}_c \frac{j}{j} = j\omega C \cdot \bar{V}_c$$

$$j = 1 e^{j90°}$$

$$\bar{I}_c = j\omega C \bar{V}_c$$

$$\bar{I}_c = \omega C \bar{V}_c e^{j90°} =$$



$$= \omega C \cdot \bar{V}_c e^{j0°} e^{j90°} = \omega C \bar{V}_c e^{j90°}$$

$$\bar{V}_c = \hat{V}_p \cdot \cos(\omega t)$$

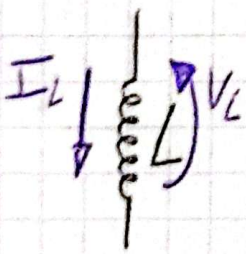
$$\bar{I}_c = \hat{I}_c \cdot \cos(\omega t + 90°)$$

La corriente es un adelanto de 90° a la tensión.

Inductor

$$v_L(t) = L \cdot \frac{di(t)}{dt}$$

Relación de tensión y corriente en un inductor.



$[L] = \text{Henry} = H$

$$\bar{Z}_L = \frac{\bar{V}_L}{\bar{I}_L} = j\omega L$$

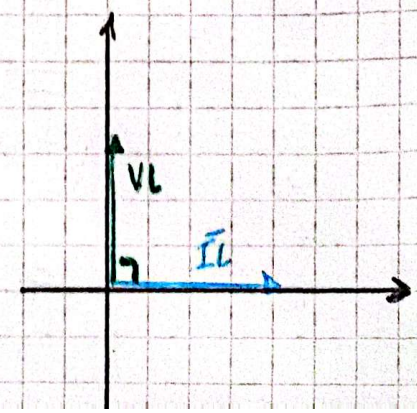
X_L reactancia inductiva

$$\bar{V}_L = j\omega L \, \bar{I}_L$$

$$\omega = 2\pi f$$

$$\bar{V}_L = \omega L \cdot |\bar{I}_L| e^{j\alpha} \, 1 e^{j90°}$$

$$\bar{V}_L = X_L \, |\bar{I}_L| e^{j90°}$$ * (o lo mismo)



Escaneado con CamScanner

(en la misma)

$$\bar{V}_L = \underbrace{X_L \, |\bar{I}_L|}\, e^{j90°}$$

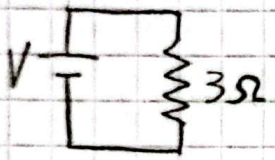
⚠ (Esto es un ejemplo)

$$|\bar{V}_L| = \left(2\pi \cdot 50\,Hz \cdot 1 \cdot 10^{-3}\,H\right) \cdot \frac{1}{\sqrt{2}} =$$

21/4/23

9.3

4)



a) $V = 150 \operatorname{sen} 200t$

$$v_p = f = \bar{V} = V_{RMS} \; e^{j\varphi}$$

$$\bar{V} = V_p \cdot \operatorname{sen}(\omega t + \varphi)$$

$$V_{RMS} = \frac{V_p}{\sqrt{2}} = \frac{150\,V}{\sqrt{2}} = 106{,}1\,V \rightarrow 106{,}1\,V\, e^{j0°}$$

$$\boxed{\frac{V_p}{\sqrt{2}} = V_{RMS}} \rightarrow \boxed{\frac{V_{RMS}}{R} = I_{RMS}} \rightarrow \boxed{I_{RMS} \cdot \sqrt{2} = I_p}$$

ó $\frac{V_p}{R} = I_{RMS}$

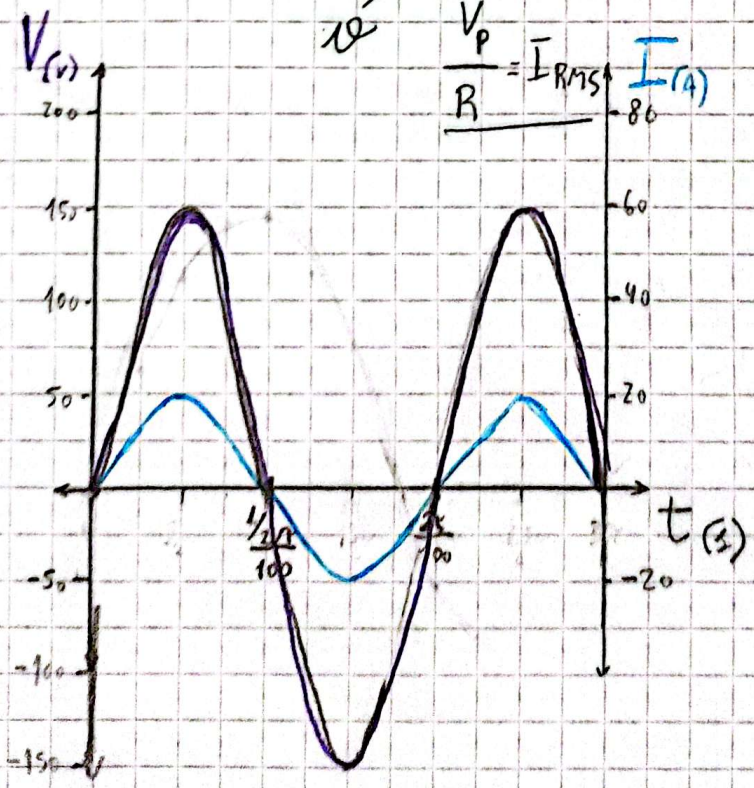
$$\frac{\bar{V}}{R} = \bar{I}$$

⊗ No p

$$\frac{150 \operatorname{sen} 200t}{3\Omega} =$$

$$\frac{106{,}1\,V}{3\,\Omega} = \boxed{35{,}36\,A} = I_{RMS}$$

$$35{,}36\,A \cdot \sqrt{2} = 50\,A \rightarrow I_1$$



t = recorre un ciclo

$$t = \frac{2\pi}{\omega} = \frac{2\pi}{200} = 0{,}031\,s = \frac{\pi}{100}$$

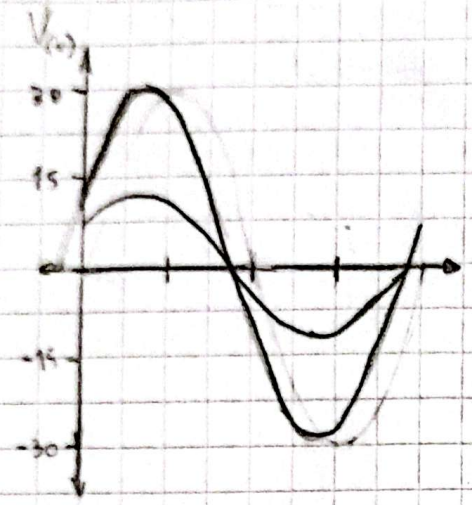
$\omega = 200$

$$f = \frac{\omega}{2\pi} = \frac{150}{2\pi} = 31{,}83\,Hz$$

Escaneado con CamScanner

b) $V = 30 \sin(377t + 20°)$ $\quad t = \frac{2\pi}{377} = 0{,}01666$

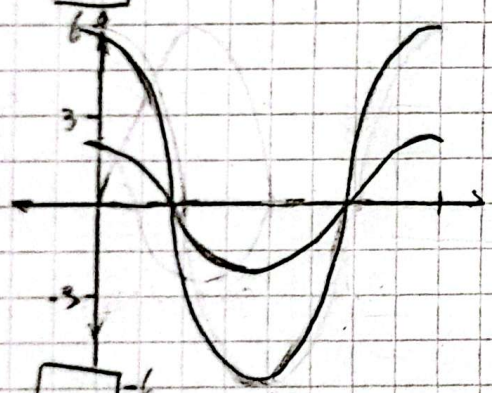
$\frac{30V}{3\Omega} = 10A = I_p$ $\qquad \frac{10}{\sqrt{2}} \cdot e^{j20°} A$



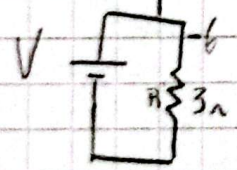
Angulo $\cdot \frac{\pi}{180} = Rad$

c)

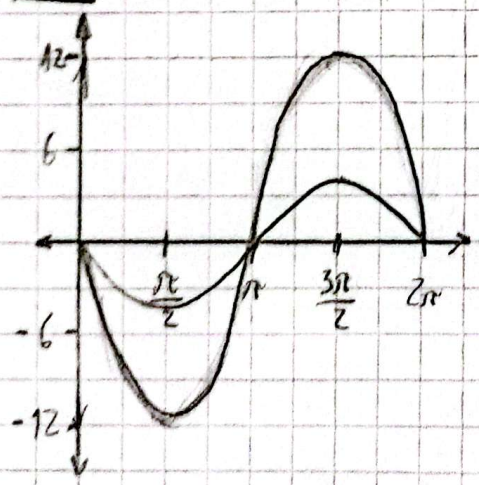
$\frac{6V}{3\Omega} = 2A = I_p$ $\qquad \frac{2}{\sqrt{2}} \cdot e^{j10°} A$



d)



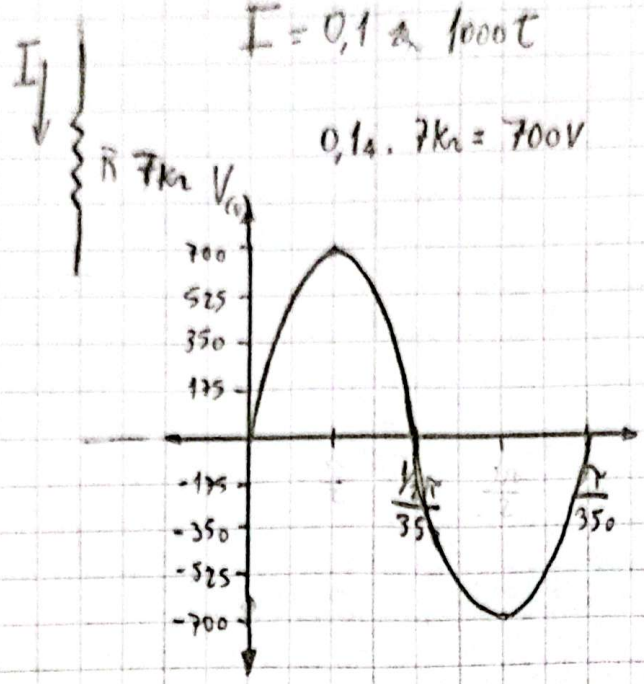
$\frac{-12V}{3\Omega} = -4A = I_p$ $\qquad \frac{-4}{\sqrt{2}} \cdot e^{j40°} A$



Escaneado con CamScanner

5)

a)



$0{,}1 \cdot 7k\Omega = 700V$

$\frac{2\pi}{700} = 8{,}97 \times 10^{-3}$

b)

$2 \cdot 10^{-3} \sin(400t - 120°)$

$2 \cdot 10^{-3} A \cdot 7k\Omega = \boxed{14V}$

6)

a)

$f = 0$

$L = 2mH$

$\frac{\overline{V_L}}{\overline{I_L}} = j\omega L$

0

$\omega = 2\pi \cdot f$

$0 \cdot 2mH = 0\Omega$

b) $60 Hz \cdot 2mH = 0{,}12\Omega$ ó $\underline{120 m\Omega}$

c) $4 KHz \cdot 2mH = \underline{8\Omega}$

d) $1{,}2 MHz \cdot 2mH = \underline{2{,}4 k\Omega}$

7)

a) $\frac{2k\Omega}{14{,}47 KHz} = 0{,}138217$

b) $\frac{40 k\Omega}{5{,}3 KHz} = 7{,}547169811 = \frac{400}{53}$

Escaneado con CamScanner

8)

a) $\frac{10\,\Omega}{1\,mH} = 10\,krad/s$ $\qquad \frac{10\,krad}{2\pi} = 1.591,549431$

b) $\frac{4\,k\Omega}{1\,mH} = 4\,Mrad/s$ $\qquad \frac{4\,Mrad}{2\pi} = 636.619,7324$

c) $\frac{12\,k\Omega}{1\,mH} = 12\,Mrad/s$ $\qquad \frac{12\,Mrad}{2\pi} = 1.909.859,317$

9)

$$\omega . L = X_L \leftarrow \text{Reactancia inductiva}$$

a) $i = 5 \operatorname{sen} \omega t$

$$i . X_L = v_L$$

$$5_A . X_L = v_L$$

$$v_{L(t)} = 5_A . X_L \operatorname{sen}(\omega t + 90°)$$

b) $i = 40 \times 10^{-3} \operatorname{sen}(\omega t + 60°)$

$$v_{L(t)} = 40\,mA . X_L \operatorname{sen}(\omega t + 150°)$$

c) $i = -6 \operatorname{sen}(\omega t - 30°)$

$$v_{L(t)} = -6_A . X_L \operatorname{sen}(\omega t + 60°)$$

$$\frac{V_L}{I_L} = \omega L = \omega . 0{,}1_H = 100 . 0{,}1H = \underline{10\,\Omega}$$

a)

$$\overline{V_L} = X_L . |\overline{I_L}| \, e^{j90°}$$

$0{,}1H$ $\qquad i = 10 \operatorname{sen} 100t$

$$V_{RMS} = \frac{V_P}{\sqrt{2}} = \frac{10}{\sqrt{2}}$$

$$\overline{V_L} = 10\,\Omega . \frac{10}{\sqrt{2}} A = \boxed{\frac{100}{\sqrt{2}} V}$$

V_{RMS}

$$\frac{100}{\sqrt{2}} . \sqrt{2} = 100\,V_P$$

$$v = 100 \operatorname{sen}(100t + 90°)$$

Escaneado con CamScanner

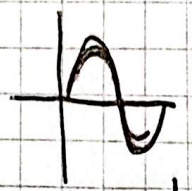
(Capacitivo)

Capacitor Voltaje se adelanta corriente

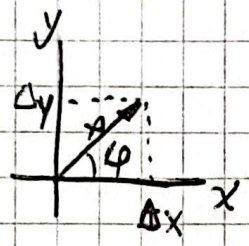
Corriente se adelanta voltaje

Inductor

$\omega = 2\pi . f$



$T = \frac{1}{f}$



$\Delta y = A \sin \varphi$

$\Delta x = A \cos \varphi$

$f = \frac{1}{T}$

9.1: Indica voltaje que pasa por resistor de 10Ω, calcular la expresión de la corriente:

a) $v = 100 . \sin 377 . t$

b) $v = 25 . \sin (377 . t + 75°)$

ángulo de desfase

b) P1

$$I = \frac{\frac{25}{\sqrt{2}} . e^{j75°}}{10\Omega \, e^{j0°}} = \frac{25}{10\Omega . \sqrt{2}} e^{j75°}$$

P3

P2

Su resistor no hay desfase

La corriente tiene el mismo desfase que el voltaje ya que un resistor no cambia el desfase.

Resistencia $\leftarrow \frac{25}{10\Omega}$ P4

$i = 2,5 . \sin (377 t + 75°)$

7.1

Buscar una inductancia con una reactancia de:

2kΩ en f = 14,47 kHz

$X_L = 2\pi f . L$

$$\frac{2000\Omega}{2\pi . 14470 Hz} = L [Hy] = 21,9 mHy$$

Escaneado con CamScanner

20.1

Para las siguientes fuentes de voltaje y corriente indique si el dispositivo instalado es una resistencia, un capacitor o un inductor y determinar su valor.

a) $v = 550 \operatorname{sen}(377.t + 50)$

$i = 11 \operatorname{sen}(377.t - 40^\circ)$

90° grados de diferencia.

Si el voltaje es mayor entonces es inductivo (inductor)

$$X_L = \frac{550v}{11A} = 50\Omega$$

Inductor de...

$$X_L \Rightarrow 50 \qquad L = \frac{50\Omega}{377} = 0{,}132\,Hy$$

$\operatorname{Sen}\alpha \Rightarrow \cos(\alpha - 90^\circ)$

$\cos\alpha \Rightarrow \operatorname{sen}(\alpha + 90^\circ)$

El seno siempre va "rápido" que el coseno.

$X_C = 10\Omega$

$i = 50.10^{-3}(\operatorname{sen} \omega t)$

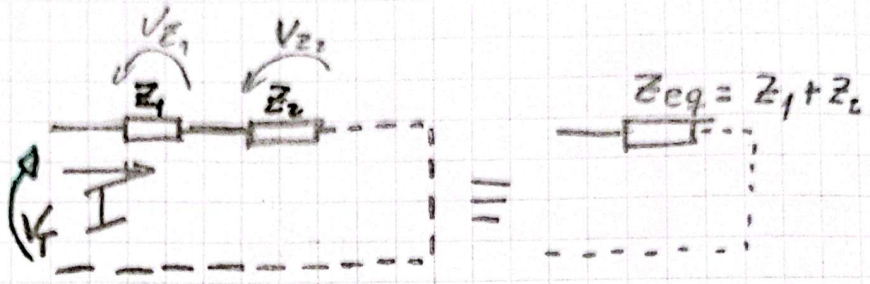
$$\bar{V} = X_C \cdot \bar{I} = \underbrace{0{,}5}_{10.\,50.10^{-3}}\,V \cdot \operatorname{sen}(\omega t - 90)$$

Escaneado con CamScanner

Exito

2/5/23

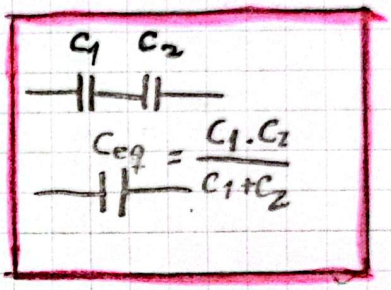
Asociación en serie de impedancia.

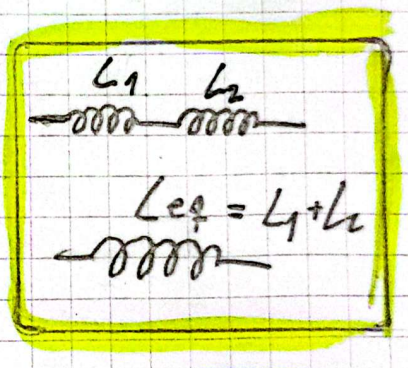


$$V_T = V_{Z_1} + V_{Z_2}$$

$$V_T = I \cdot Z_1 + I \cdot Z_2$$

$$V_T = I \cdot (\underbrace{Z_1 + Z_2}_{Z_{eq}})$$





Si Z_1 y Z_2 son capacitivas

$$Z_T = Z_1 + Z_2$$

$$Z_T = \frac{-j}{\omega C_1} + \frac{-j}{\omega C_2}$$

$$Z_T = \frac{-j}{\omega}\left(\frac{1}{C_1} + \frac{1}{C_2}\right)$$

$$Z_T = \frac{-j}{\omega}\left(\frac{C_2 + C_1}{C_1 \cdot C_2}\right)$$

$$Z_T = \frac{-j}{\omega \cdot \left(\frac{C_1 \cdot C_2}{C_1 + C_2}\right)} \rightarrow C_{eq}$$

Si Z_1 y Z_2 son inductivas

$$Z_T = Z_1 + Z_2$$

$$Z_T = j\omega L_1 + j\omega L_2$$

$$Z_T = j\omega \cdot (\underbrace{L_1 + L_2}_{L_{eq}})$$

Escaneado con CamScanner

Admitancia → $\boxed{Y = \frac{1}{Z}}$ $[Y] = \frac{1}{\Omega}$; Ω^{-1} ; $\mho$ (mho) ; S (Siemens)

Unamos este

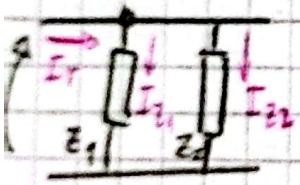
↳ lo opuesto a la ~~[illegible]~~ (Ω) → impedancia.

$Z = R + jX$ ~ Reactancia ≅ ... Estar ... ≅ $\boxed{Y = \frac{1}{R + jX}} = G + jB^*$

1 Resistencia

* Susceptancia
Parte imaginaria de la admitancia.

Conductancia
Facilita el paso de la corriente
Inverso de la resistencia



$I_T = I_{Z_1} + I_{Z_2}$

$I_T = \frac{V_Z}{Z_1} + \frac{V_Z}{Z_2}$

$I_T = V_Z \cdot \left(\frac{1}{Z_1} + \frac{1}{Z_2}\right)$

$Z_T = \frac{-j}{\omega C} \Rightarrow Y_C = \frac{\omega C}{-j} \cdot \frac{j}{j} \Rightarrow j\omega C \rightarrow B$

$= \boxed{Y_T = \frac{1}{Z_1} + \frac{1}{Z_2}}$

$Y_T = Y_1 + Y_2$

$Z_T = \frac{V_Z}{I_T} = \frac{1}{\underbrace{\left(\frac{1}{Z_1} + \frac{1}{Z_2}\right)}_{Y_T}}$

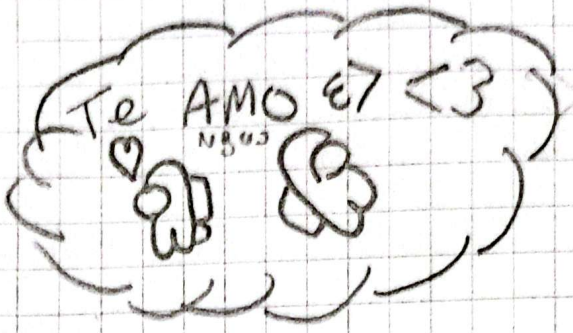
Exito

Si Y_1 e Y_2 son capacitivas

$$Y_T = Y_1 + Y_2$$

$$Y_T = j\omega C_1 + j\omega C_2$$

$$Y_T = j\omega \cdot \underbrace{(C_1 + C_2)}_{C_{eq}}$$



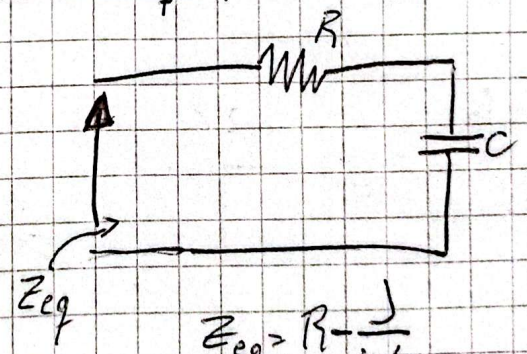
Si Y_1 e Y_2 son inductivas:

$$L_{eq} = \frac{L_1 \cdot L_2}{L_1 + L_2}$$

Impedancia/admitancia

Serie $Z_{eq} = Z_1 + Z_2 + \dots + Z_n$

Paralelo $Y_{eq} = Y_1 + Y_2 + \dots + Y_n$



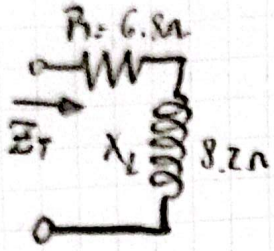
$$Z_{eq} = R - \frac{j}{\omega C}$$

Escaneado con CamScanner

Serie 10.3

4. Serie

a)

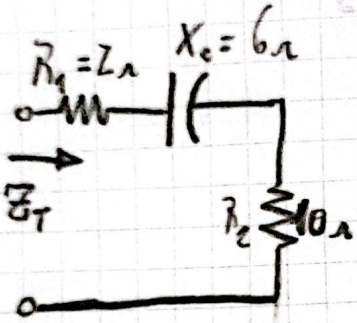


$Z_{eq} = Z_1 + Z_2$

$Z_{eq} = R + jX_L$

$Z_{eq} = 6{,}8\Omega + j8{,}2\Omega$ → Polar

b)

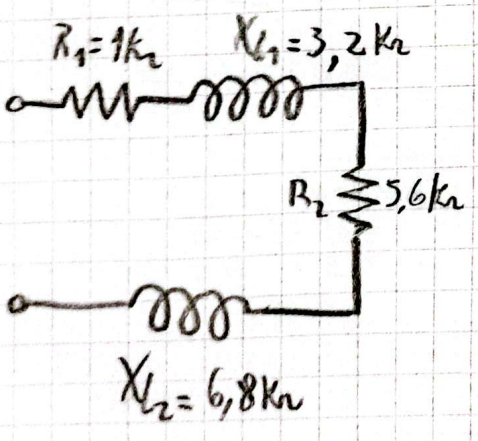


$Z_{eq} = Z_1 + Z_2 + Z_3$

$Z_{eq} = R_1 + R_2 + \frac{-j}{\omega X_c}$

$Z_{eq} = 12\Omega - j6\Omega$

c)



$Z_{eq} = 6{,}6k\Omega + j10k\Omega$

Exito

9/6/23

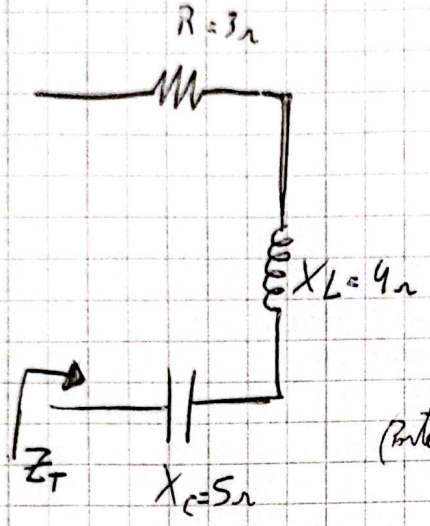
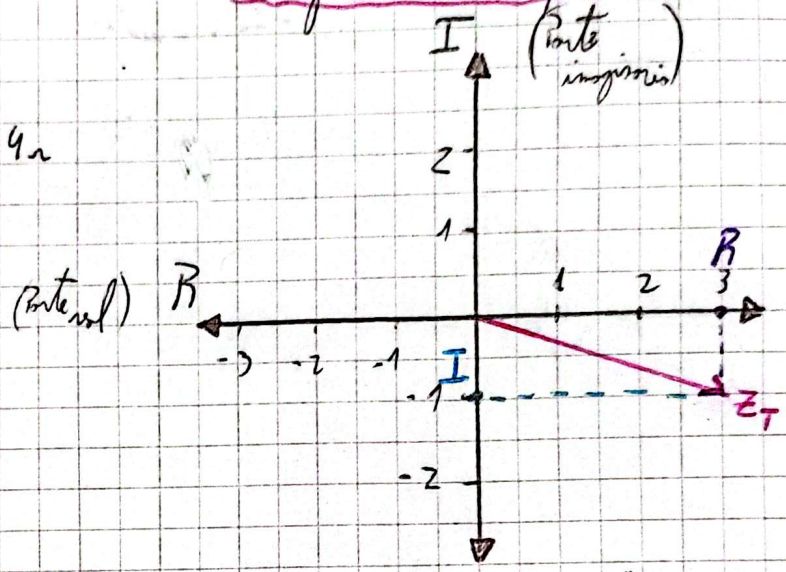


Diagrama de impedancia



$$Z_T = R + jX_L - jX_C$$

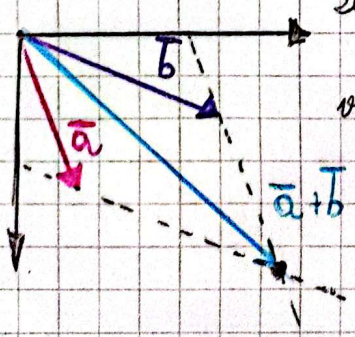
$$Z_T = \underbrace{R}_{\text{Real}} + \underbrace{j(X_L - X_C)}_{\text{Imaginaria.}}$$

$$Z_T = \boxed{3} + \boxed{j}\ \Omega$$

(Se dibuja como vector)

Suma gráfica de vectores

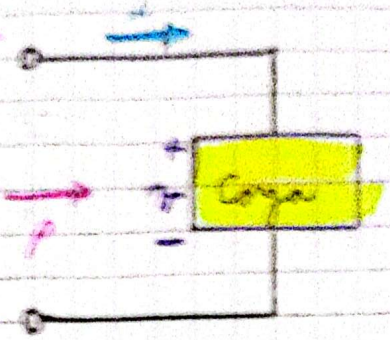
1 regla del paralelogramo



Se dibuja una paralela al otro vector que toque el último punto.

39/5/12

Eq. 1



Estamos p

$$p = \frac{E}{t} \quad E \text{ Trabajo}$$

La potencia suministrada a una carga es en cualquier instante es... $p = v \cdot i$

En la Eq. 1 podemos ver que v e i son estrictamente periódicas...

(sinusoidales)

$$i = I_m \sin \omega t$$

$$v = V_m \sin(\omega t + \theta)$$

Rel. fundamental... → Inductiva θ es positivo (v adelanta a i)

↳ Capacitiva θ es negativo (i adelanta a v)

Por ser estas p es...

$$p = V_m I_m \sin \omega t \sin(\omega t + \theta)$$

Si se aplica identidad trigonométrica para simplificar...

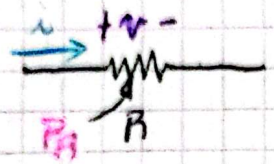
Convertir

$$p = VI \cos\theta (1 - \cos 2\omega t) + VI \sin\theta (\sin 2\omega t)$$

$$p = \underbrace{VI\cos\theta}_{\text{Promedio}} - \underbrace{VI\cos\theta}_{\text{Pico}} \cos 2\omega t + \underbrace{VI\sin\theta}_{\text{Pico}} \sin 2\omega t$$

* Los altos 2 terminos varian a una frecuencia 2 veces el voltaje o la corriente

Circuito Resistivo



v e i están en fase.

$\theta = 0°$

$$P_R = VI \cos(0°)(1-\cos 2\omega t) + VI \sin(0°) \sin 2\omega t$$

$$P_R = VI(1-\cos 2\omega t) + 0$$

o tambien..

$$\boxed{P_R = VI - VI \cos 2\omega t}$$

VI, termino promedio o termino cd

$-VI \cos 2\omega t$, es una onda de coseno negativo con dos veces la frecuencia de (v) o (i) y su valor pico de VI.

T_1 = periodo de las cantidades de entrada

T_2 = periodo de la curva de potencia P_R

La curva de potencia oscila sobre ciclo y se torna a su valor promedio de VI por cada ciclo de v o i

$$T_1 = 2T_2 \quad o \quad f_2 = 2f_1$$

Consideramos que los valores pico y promedio de la curva de potencia son los mismos, la curva aparece siempre por encima del eje horizontal.

Esto nos indica que

La potencia total suministrada por un resistor se disipa en forma de calor.

La potencia suministrada a la fuente está representada por la parte de la curva debajo del eje, la cual se ve cero a cero.

La potencia disipada por el resistor en cualquier instante t_1

$$P = VI = \frac{V_m I_m}{2} = I^2 R = \frac{V^2}{R}$$

La energía disipada por el resistor (W_R) durante un ciclo completo del voltaje aplicado es el área bajo la curva de potencia.

Se determina así: $W = P t$ → Periodo del voltaje aplicado

Valor promedio

$$W_R = VIT_1 \quad (J, \text{joule})$$

y como $T_1 = 1/f_1$

$$W_R = \frac{VI}{f_1}$$

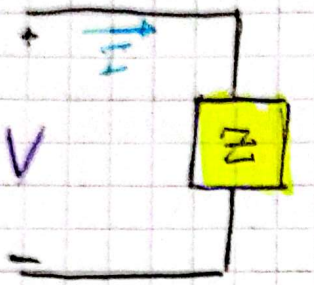
Potencia Aparente.

Se representa por S^*

$$S = VI$$

Su unidad son volt-amperes (VA)

... puesto que ...



$$V = IZ \quad e \quad I = \frac{V}{Z}$$

... entonces ... $S = I^2 Z$

y

$$S = \frac{V^2}{Z}$$

La potencia promedio suministrada a la carga Z es,

$$P = VI \cos\theta$$

sin embargo $\rightarrow S = VI$

entonces

$$P = S \cos\theta$$

y el factor de potencia de un sistema F_p es

$$F_p = \cos\theta = \frac{P}{S}$$

El factor de potencia de un circuito es la relación de la potencia promedio a la potencia aparente

P_S = potencia aparente.

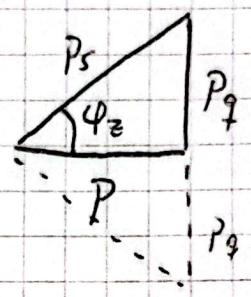
$$P_S = \underbrace{V \cdot I^{*}}_{\text{Fasor}} = V_{RMS}\, e^{j\varphi_V} \cdot I_{RMS}\, e^{-j\varphi_I} = \underbrace{V_{RMS} \cdot I_{RMS}}_{|P_S|}\, e^{j\underbrace{(\varphi_V - \varphi_I)}_{\varphi_Z}}$$

I^{*} = conjugado

$$P_S = \underbrace{V_{RMS} \cdot I_{RMS} \cos(\varphi_Z)}_{P} + \underbrace{j\, V_{RMS} \cdot I_{RMS} \sin(\varphi_Z)}_{P_q}$$

$$|P_S| = \sqrt{P^2 + P_q^2}$$

Triangulo de potencia



Factor de potencia:

$$F_P \text{ o } P_F = \frac{P}{|P_S|} = \frac{\cancel{V_{RMS}} \cdot \cancel{I_{RMS}} \cos\varphi}{\cancel{V_{RMS}} \cdot \cancel{I_{RMS}}} = \cos\varphi$$

Adelanto capacitivo.

Atraso inductivo.

Rellena

1.

a) $60W + 45W + 25W = \underline{130W}$

b) Pot. reactiva Resistivo: $\varphi = 0$

$V_{ras} \cdot I_{ras} \cdot \sin(\varphi) = 0$ $\sin 0 = 0$

Pot. aparente $\cos 0 = 1$ $P = V \cdot I$

$V_{Ras} I_{Ras} \cos(\varphi)$ $\frac{P}{V} = I$

$\downarrow$

$V \cdot I$ $\frac{130W}{240V} = 0{,}542A$

$240V \cdot 0{,}542A = 130VA$

c) $I_f = 0{,}542A$

$\underbrace{V_R \cdot I = 60W}_{\text{pinza } R}$ (1) $\frac{V}{I} = R \quad \frac{110{,}7V}{0{,}542A} = 204{,}2\Omega$

e. d) $V \cdot I = W$

$V_R =$

Despeje del circuito

$\downarrow$

(2)

$240 = I_f \cdot R + I_1 \cdot R_1$

$240V = V_R + V_{R1}$

$240V - 110{,}7 = V_{R1} = 129{,}3V$

$V_R = \underbrace{\frac{60W}{I}}_{\text{despeje}} = \frac{60W}{0{,}542A} = 110{,}7V$

analogo

(3)

$V \cdot I = P$

$\frac{P}{V}$

$I_1 = \frac{45W}{129{,}3V} = \underline{0{,}348A}$

$I_2 = \frac{25W}{129{,}3V} = \underline{0{,}19A}$

(4) $\frac{V}{I} = R$

$\frac{129{,}3V}{0{,}348A} = \underline{371{,}5\Omega}$

$\frac{129{,}3V}{0{,}19A} = \underline{680{,}5\Omega}$

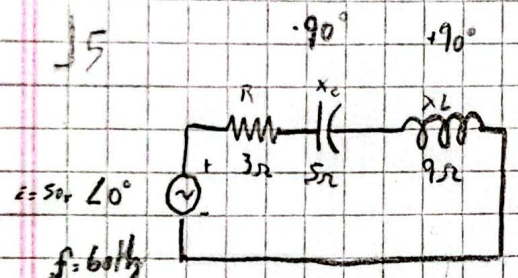
2)

~~a)~~

$$\frac{50V\angle 0^\circ}{3\Omega + j5\Omega + j9\Omega} \qquad \frac{50V\angle 0^\circ}{5\Omega\angle -53{,}13^\circ} = 10A\angle 53{,}13$$

$$\sqrt{3^2 + (-4)^2} = 5\Omega \quad \Big| \quad \tan^{-1}\left(\frac{X_C - X_L}{R}\right) = \tan^{-1}\left(\frac{\overset{9\Omega - 5\Omega}{\cancel{5\Omega - 9\Omega}}}{3\Omega}\right) = 53{,}13$$

$j5$



$5A\angle 53{,}13^\circ$

Se suma

$V_R = (5A\angle -53{,}13^\circ)\cdot(3\Omega\angle 0^\circ)$

Se multiplica

$15V\angle -53{,}13^\circ = V_R$

$$V_C = (5A\angle -53{,}13)\cdot(5\Omega\angle -90) = 25V\angle -143{,}13$$

$$V_L = (5A\angle -53{,}13)(9\Omega\angle 90) = 45V\angle 36{,}87$$

$\tan^{-1}((\cancel{XC}(XL-XC)\div R) =$

$$\frac{V^2}{R} = \frac{50V\angle 0^\circ}{}$$

$V_{RMS}\cdot I_{RMS} = P_{promedio}$.

a) $I_{max} \cdot V_{max} = P_{max}$

$Z = 5\angle$

$\cos(0)$

$(10_A)^2 \cdot 3_\Omega = 300W$

$(10_A)^2 \cdot S_\Omega \cdot \sin(90) = 0_W$

$\frac{50_V \angle 0^\circ}{5_\Omega \angle 53{,}13} = 10_A \angle -53{,}13$

$V_I \cdot \sin\theta$

Por X_L y X_C es 0° porque $\sin(90) = 0_W$

b) (Reactiva) La $\vec{n}$ es Tres

$I^2 \cdot X_C \sin(\theta)$ $\quad 10_A^2 \cdot 5_\Omega \cdot \sin(-90) = 500 VAR$

$I^2 \cdot X_L \sin(\theta)$ $\quad 10_A^2 \cdot 9_\Omega \cdot \sin(90) = 900 V_{AR}$

c) (Aparente) $= \sqrt{P^2 + VAR^2}$

VA

$\vec{n} = \sqrt{300W^2 + 0^2} = 300 V_A$

$X_C = \sqrt{0^2 + 500^2} = 500 V_A$

$X_L = \sqrt{0^2 + 900^2} = 900 V_A$

Escaneado con CamScanner

d)

Watts totales = 300W (P_T)

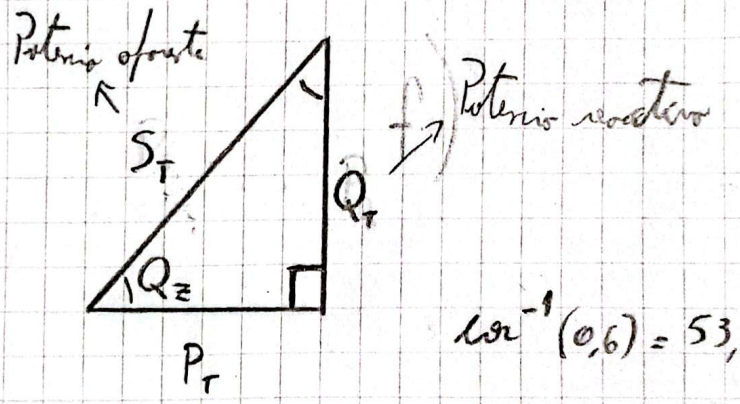
VAR totales = 400VAR (Q_T) → las reactivas se restan ($\underset{900VAR}{X_L} - \underset{500VAR}{X_C}$)

VA totales = 500VA (S_T) $\sqrt{P_T^2 + VAR_T^2} = \sqrt{300W^2 + 400VAR^2} = 500VA$

Factor de potencia: (F_P)

$$\frac{P_T}{S_T} \quad \text{TOTALES} \qquad \frac{300W}{1500VA} = 0{,}6\,F_P$$

e)



$S = P + Q$

$\Downarrow$

$S^2 = P^2 + Q^2$

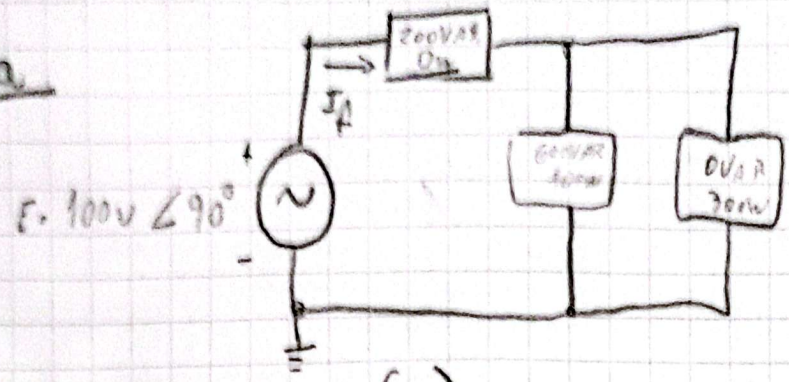
$\cos^{-1}(0{,}6) = 53{,}13^\circ = Q_z$

f)

$$\frac{V \cdot I}{2 \cdot F} = \text{Energía disipada en un ciclo.} = \frac{50V \cdot 10A}{2 \cdot 60Hz} = 4{,}16J$$

Escaneado con CamScanner

3 a



$P_T = 100W + 300W = 400W \ (P_T)$

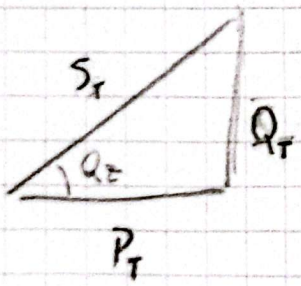
$Q_T = 200VAR - 600VAR = -400VAR \ (Q_T)$

$S_T = \sqrt{400W^2 + (-400W)^2} = 565,63VA \ (S_T)$

$F_p = \frac{W_T}{VA_T} = \frac{400W}{565,63VA} = 0,7 \ F_p$

b

$\cos^{-1}(F_p) = Q_z$



$\cos^{-1}(0,7) = 45,57°$

c

I_f

$S_T = V.I$

$I = \frac{S_T}{V} = \frac{565,63VA}{100V} = 5,6563 \ A$

$\cos^{-1}(F_p) =$ Angulo φ

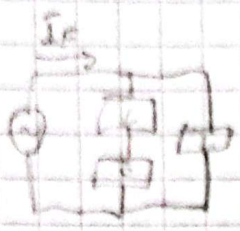
$\cos^{-1}(0,7) = 45,57°$

$45,57° + 90° = -135,57$

$5,6563A \angle 135,57$

Escaneado con CamScanner

4



a)

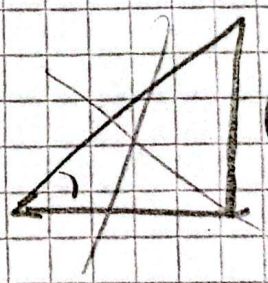
P_T = suma de "W" = 600W + 500W + 100W = 1200W

Q_T = suma de "VAR" = 1200VAR - 1800VAR + 600VAR = 0 VAR

$S_T = \sqrt{P_T^2 + Q_T^2} = \sqrt{1200^2 + 0^2} = 1200 VA$

b) $\frac{P_T}{S_T} = \frac{1200W}{1200VA} = 1$

c)



$\cos^{-1}(1) = 0 = Q_T$

Por lo tanto no hay angulo.

d) $I_f = 6A \angle 0°$

$S_T = V \cdot I \quad I = \frac{S_T}{V} = \frac{1200VA}{200V} = 6A$

Escaneado con CamScanner

5)

a) $P_T = 350W$

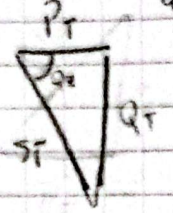
$Q_T = -450\,VAR$

$S_T = \sqrt{350_W^2 - 450_{VAR}^2} = 570\,VA$

b)

$F_P = \frac{P_T}{S_T} = \frac{350_W}{570\,VA} = 0{,}61$

c) $\cos^{-1}(0{,}61) = -52{,}4° = Q_Z$



d) I_f $\quad S_T = V.I$

$\frac{S_T}{V} = \frac{570_{VA}}{50V} = 11{,}4$

$11{,}4 \angle -112{,}4°$

6)

a)

$W = \frac{V^2}{R} = \frac{60_V^2}{20_\Omega} = 180W = P_T$ $\quad Q_T = VAR = 0$ ya que las resistencias no tienen potencia reactiva

$S_T = \sqrt{W^2} = 180VA$

b) $Q_T = \frac{V^2}{R} = 360_{VAR}$ $\quad S_T = \sqrt{Q_T^2} = 360\,VA$

Un inductor no tiene W

c)

$P_T = 580W$

$Q_T = 960\,VAR$

$S_T = \sqrt{P_T^2 + Q_T^2} = 1{,}121{,}6\,VA$

d) I_f $\quad \frac{S_T}{V} = 18{,}6$

$18{,}6_A \angle 30°$

Escaneado con CamScanner

7)

a)

(R)

$W = \frac{V^2}{R} = \frac{20V^2}{2\Omega} = 200W$

(Xc)

W = No tiene

(XL)

W = No tiene

b)

(R)

VAR = No tiene

(Xc)

$VAR = \frac{V^2}{R} = 80VAR$

(XL)

$VAR = \frac{V^2}{R} = 100VAR$

c)

(R)

$\sqrt{200W^2} = 200VA = S_R$

(Xc)

$S_C = 80VA$

(XL)

$S_L = 100VA$

d)

$P_T = 200W$

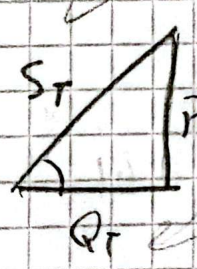
[VAR]

$Q_T = 100 - 80 = 20VAR$

$S_T = \sqrt{200W^2 + 20VAR^2} = 200VA$

e)

$F_P = \frac{P_T}{S_T} =$



Vaya al FP=1 es Ady iguals.

$F_P = 1$

f) I_f

$\frac{S_T}{V} = \frac{200VA}{20V} = 10A$

8)

a.

R-

$W = \frac{V^2}{R} = 833,3W$

C-

W = 0W

L-

W = 0W

$F_P = 0,99$

b.

R-

VAR = NO TIENE

C-

$VAR = \frac{V^2}{R} = 250VAR$

L-

$VAR = \frac{V^2}{R} =$

c.

R-

833,3VA

C-

250VA

L-

277,7VA

d

$P_T = 833,3W$

$Q_T = 27,7VAR$

$S_T =$

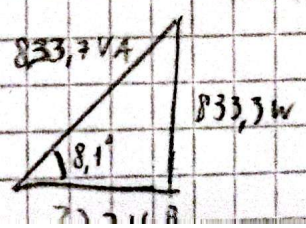
V-V.I=

f) I_f

$\angle 60°$

?

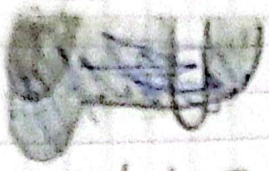
e)



$\frac{S_T}{V} =$

Escaneado con CamScanner

9)



$F = 60\,Hz$

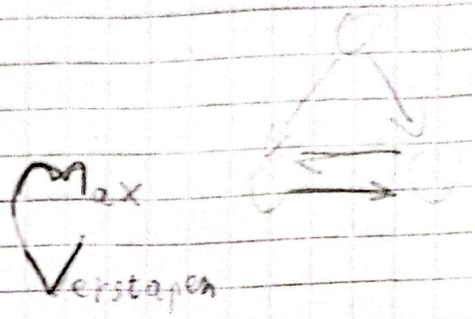
a)

$\omega = 2.\pi.F$

Como hallar X_L $\quad \omega = 2\pi.60 = 377\,rad/s$ ← Tiene carga

$\omega . L$

$377\,rad/s . 0{,}1H = 37{,}7\,\Omega$



Como hallar X_C

$\frac{1}{\omega C}$ $\quad \frac{1}{377\,rad/s . 100\mu F} = 26{,}5\,\Omega$

* $P_{fasorial}$

b) $R = \text{no } T_{ex}$

$C = \text{no } T_{ex}$

$L = \text{no } T_{ex}$

$R = \frac{V^2}{R} = 83{,}3\,W$

$C = \frac{V^2}{R} = 94{,}3\,VAR$

$L = \frac{V^2}{R} = 66{,}3\,VAR$

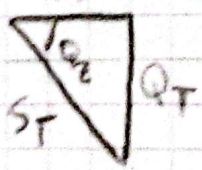
c)

$R = 83{,}3\,VA \quad C = 94{,}3\,VA \quad L = 66{,}3\,VA$

d)

$P_T = 83{,}3\,W \quad Q_T = -28\,VAR \quad S_T = 87{,}87\,VA \quad F_P = \frac{P_T}{S_T} = 0{,}94$

e)



$\cos^{-1}(FP) = Q_z = 19{,}94°$

f) $\frac{V.I}{2.F} = \frac{50V.1{,}75A}{2.60Hz} = 0{,}73\,J$

$I_f = \frac{S_T}{V} = 1{,}75A$

Escaneado con CamScanner

Éxito

19 SEP 2021

g)

Energía almacenada

$$\frac{L \cdot I_{RMS}^2}{2} \qquad \frac{C \cdot V_{RMS}^2}{2}$$

$$\frac{0{,}1H \cdot 1{,}75A^2}{2} = 0{,}15J \qquad \frac{100\mu F \cdot 1{,}75^2}{2} = 153\mu J$$

$\approx 0{,}15$

R 7/10/23

Ej 1 (1)

220v, 50Hz, $\overbrace{5{,}2Kw}^{P_T}$, Fp 0,80, ~~~

$Fp = 0{,}80$

$\cos(\varphi) = Fp$

$\cos^{-1}(Fp) = \varphi$

$\varphi \approx 36{,}9°$

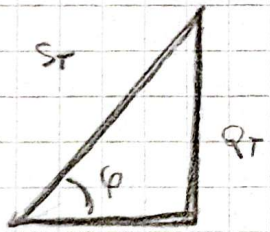
$\sin(\varphi) \cdot S_T = Q_T$

$\Downarrow$

3.902,7 VAR

$\Downarrow$

Q_{T_1}



$P_T = 5{,}2Kw$

$$\frac{P_T}{S_T} = Fp$$

$$\frac{P_T}{Fp} = S_T \Rightarrow 6.500 VA$$

$Fp = 0{,}95$

$\varphi = 18{,}2$

$S_T = 5.473{,}6$

$Q_T = 1.709{,}6 \Rightarrow Q_{T_2}$

$Q_{T_1} - Q_{T_2} = Q_C$

$3902{,}7 VAR - 1.709{,}6 VAR = 2.193{,}1 = Q_C$

Escaneado con CamScanner

(.2)

2193,1 VAR

Subrogados S_T / φ | $Q_{C_{TM}}/Q_{C_{TT}}$

P_T

12kW/7,8kW

$$X_C = \frac{V^2}{Q_C} = \frac{220v^2}{2193,1VAR} = 22,07\,\Omega$$

144,22 μf

$$C = \frac{1}{2\pi \cdot f \cdot X_C} = \frac{1}{2\pi \cdot 50Hz \cdot 22,07\Omega} = 0,144\,mf$$

12kW · 65% = 7,8kW

Ejercicio 2.

	FP=0,95	FP=0,65	FP=0,75
$\cos^{-1}(FP)=\varphi$	18,19	49,45	41,41
$\frac{P_T}{FP}=S_T$	12.631,6 → $\frac{7,8kW}{0,95}$ → 8210,5VA	18.961,5	10.400
$\sin(\varphi).S_T=Q_T$	3943,2 ⇑ Q_1	14.027,76 ⇑ Q_{2M}	6.879 ⇑ Q_{2T}

$Q_2 - Q_1 = Q_C$

1C = 10 KVAR ⇑

Q_C Turno Mañana = 14.027,76 − 3943,2 = 10.084,56 VAR

Q_C turno tarde = 6.879 − 2563,06 = 4.315,94 (2C = 2KVAR y 1C