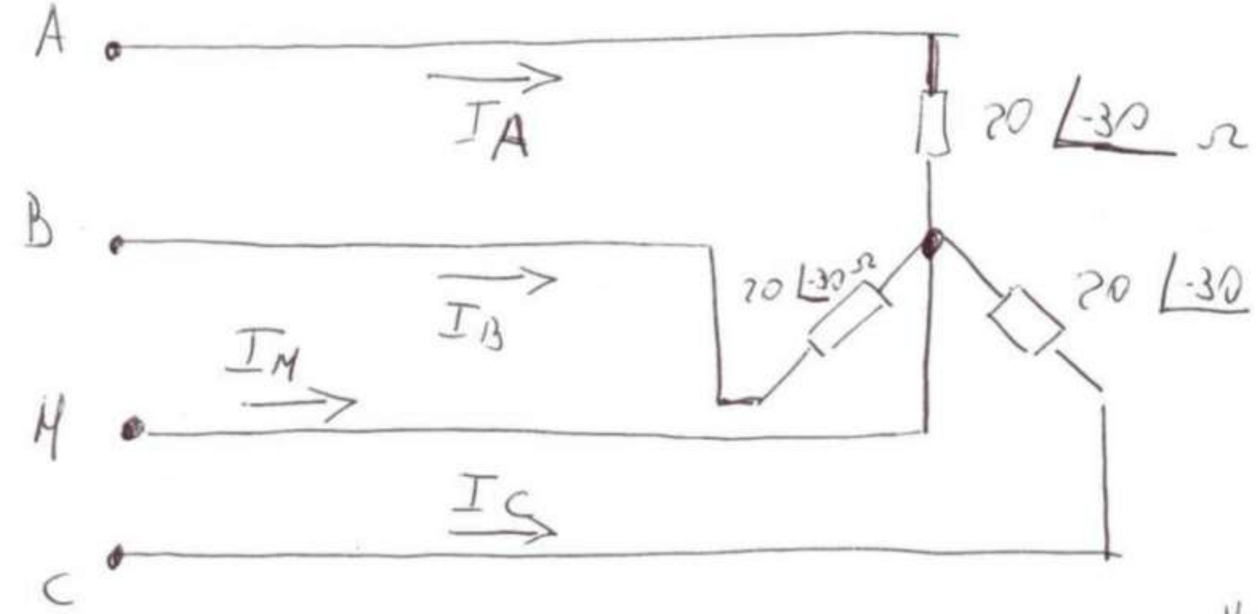
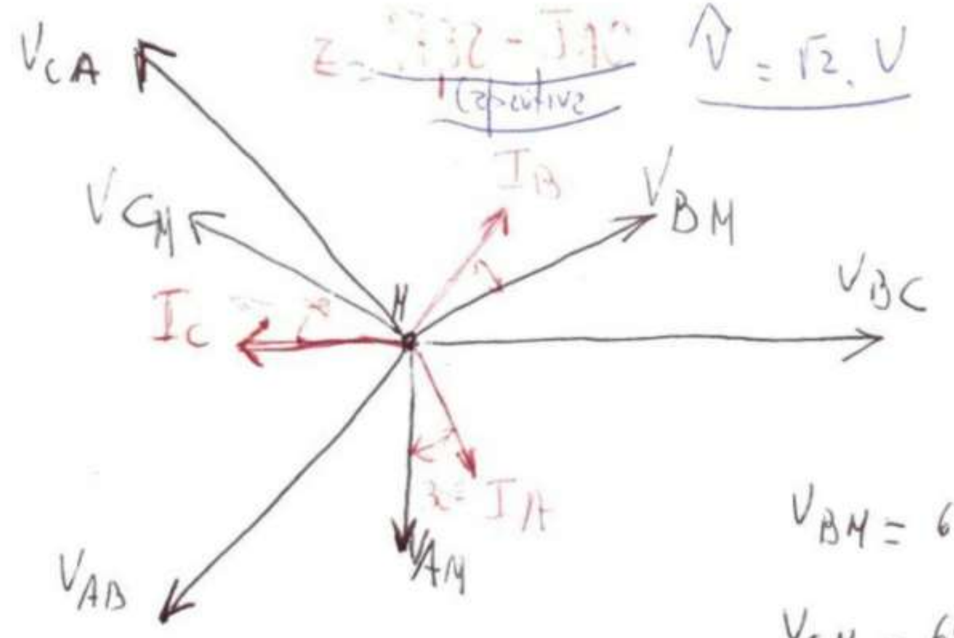
Ejercicio 2 :



Valor eficaz

Sist Trifasico CBA a cuatro hilos $V_L = 120\ V$ tiene tres $Z = 20 \angle -30°$ conectadas en Y. Determinar I_L y representar el diagrama fasorial de tensiones y las intensidades de corrientes. –



$V_{CA} = 120 \angle 120°$

$V_{BC} = 120 \angle 0°$

$V_{AB} = 120 \angle 240°$

$V_{AN} = \frac{120}{\sqrt{3}} \angle -90°\ V.$

$V_{BN} = 69,28 \angle 30°\ V.$

$V_{CN} = 69,28 \angle 150°\ V$

$\hat{V}_{CA} = 169,7 \angle 120°$

$\hat{V}_{BC} = 169,7 \angle 0°$

$\hat{V}_{AB} = 169,7 \angle 240°$;

$\hat{V}_{AN} = 97,9 \angle -90°$

$\hat{V}_{BN} = 97,9 \angle 30°$

$\hat{V}_{CN} = 97,9 \angle 150°$

$$I_A = \frac{V_{AN}}{Z} = \frac{69{,}28 \angle -90^\circ}{20 \angle -30} = 3{,}46 \angle -60^\circ$$

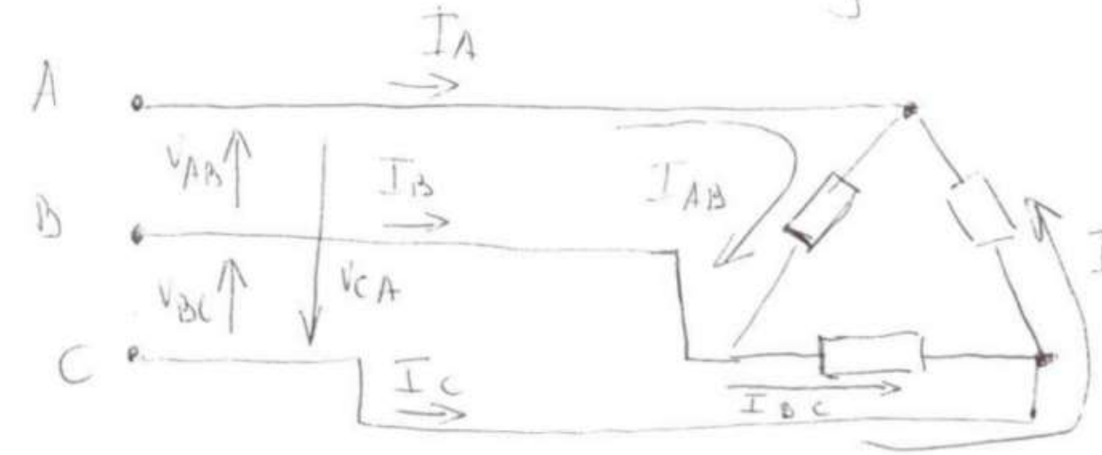
$1{,}73 \; -j2{,}9964$

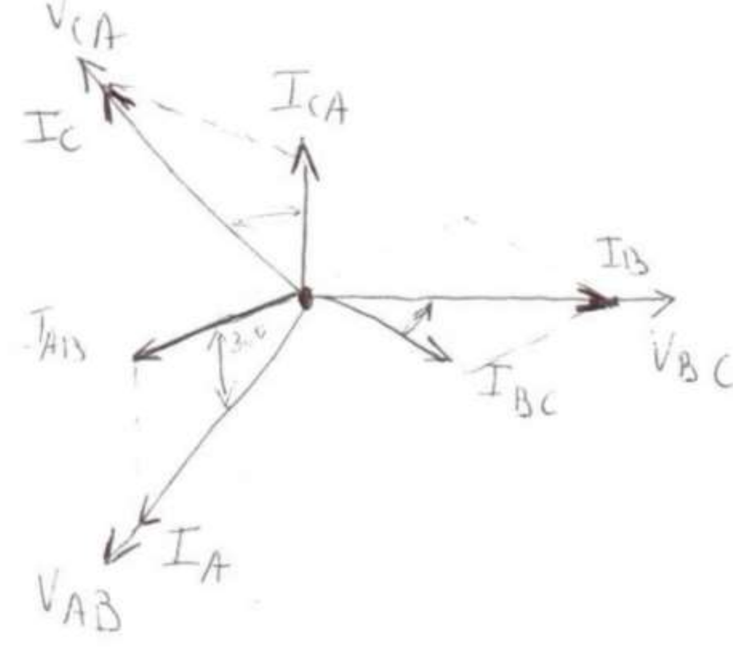
$I_B = 3{,}46 \angle 60^\circ$, $I_C = 3{,}46 \angle 180^\circ$

$I_N = -(I_A + I_B + I_C) = 0$

Ejercicio Complementario (N° 4)

Circuito Trif CBA V_L ef = 141,4 Volt. Δ con $Z = 15 \angle 30° \, \Omega$ Obtener I_L y de fase.





Las Tensiones entre líneas:

$\hat{V}_{CA} = 200 \angle 120°$

$\hat{V}_{BC} = 200 \angle 0°$

$\hat{V}_{AB} = 200 \angle 240°$

$$I_{AB} = \frac{V_{AB}}{Z} = \frac{200 \angle 240°}{15 \angle 30°} = 13{,}33 \angle 210°$$

$$I_{BC} = \frac{V_{BC}}{Z} = \frac{200 \angle 0°}{15 \angle 30°} = 13{,}33 \angle -30° \; / \; I_{CA} = \frac{V_{CA}}{Z} = 13{,}33 \angle 90°$$

Las I de linea:

$$I_A = I_{AB} + I_{AC} = 13{,}33 \angle 210° - 13{,}33 \angle 90° = 23{,}08 \angle -120°$$
$$= -11{,}54 - J6{,}66 - (0 + J13{,}33) = -11{,}54 - J19{,}99$$

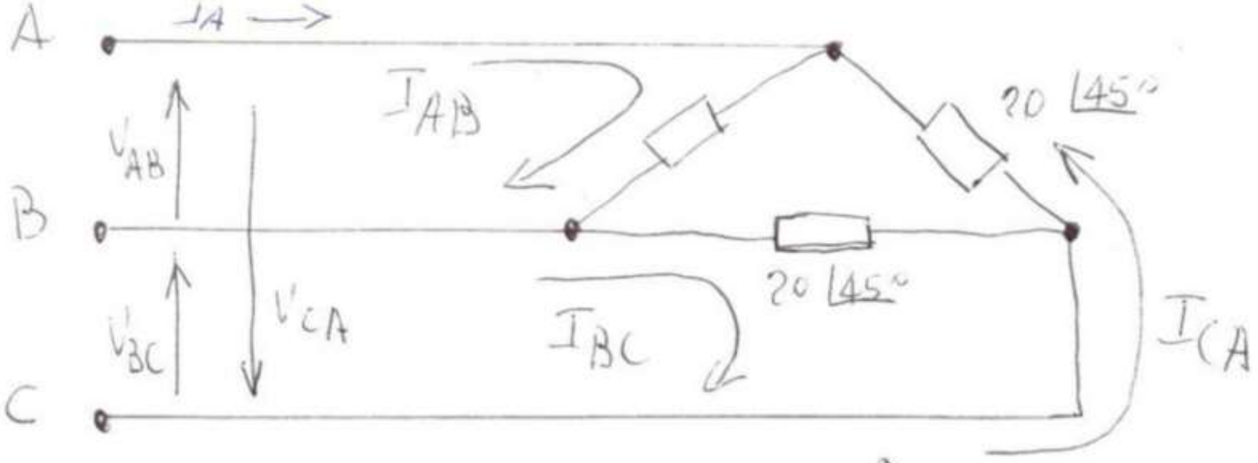
$$I_B = I_{BC} + I_{BA} = 13{,}33 \angle -30° - 13{,}33 \angle 210° = 23{,}08 \angle 0°$$
$$= 11{,}54 - J6{,}66 - (-11{,}54 - J6{,}66) = 23{,}08 + J0$$

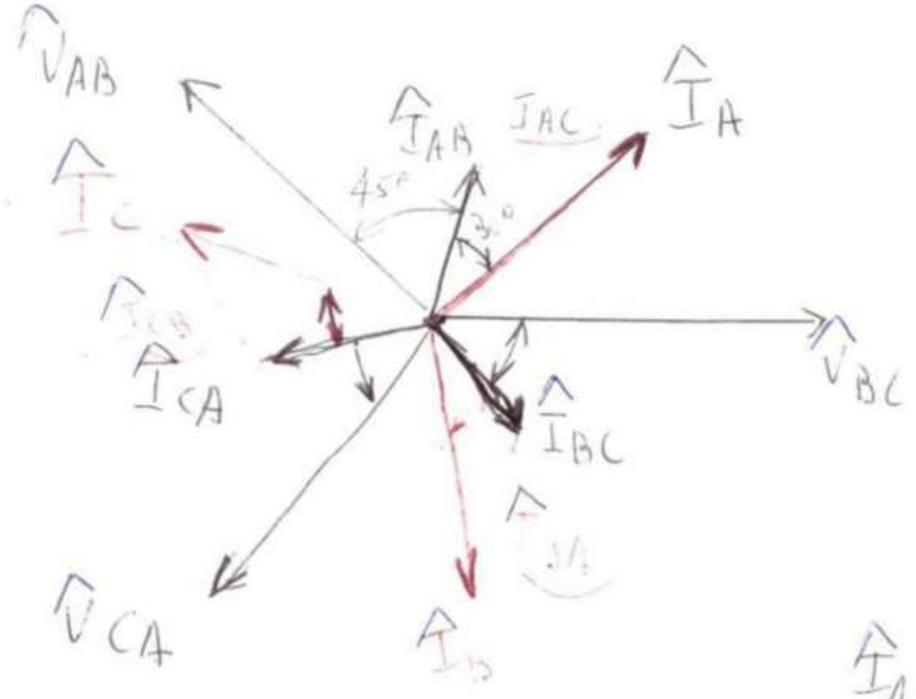
$$I_C = I_{CA} + I_{CB} = 13{,}33\angle 90^\circ - 13{,}33\angle -30^\circ = 23{,}08\angle 120^\circ$$

$$= 0 + J13{,}33 - (11{,}54 - J6{,}66) = -11{,}54 + J20$$

Ejercicio Nº3

Un sistema Trifásico ABC con una tensión de valor eficaz 70,71V tiene una carga equilibrada conectada en triángulo con $Z = 20\angle 45^\circ$. Obtener las intensidades de línea y dibujar el diagrama fasorial de tensiones y corrientes.





$\hat{V}_{AB} = 100\angle 120^\circ$

$\hat{V}_{BC} = 100\angle 0^\circ$

$\hat{V}_{CA} = 100\angle 240^\circ$

Fasor de tensión

$$\hat{V} = \sqrt{2}\, V_{ef} = 100\,V.$$

$$\hat{I}_{AB} = \frac{\hat{V}_{AB}}{Z} = \frac{100\angle 120^\circ}{20\angle 45^\circ} = 5\angle 75^\circ$$

$$\hat{I}_{BC} = \frac{\hat{V}_{BC}}{Z} = \frac{100\angle 0^\circ}{20\angle 45^\circ} = 5\angle -45^\circ \qquad \hat{I}_{CA} = \frac{\hat{V}_{CA}}{Z} = \frac{100\angle 240^\circ}{20\angle 45^\circ}$$

$$\hat{I}_{CA} = 5\angle 195^\circ$$

$$\vec{I}_A = I_{AB} + I_{AC} = 5\angle 75^\circ - 5\angle 195^\circ$$

$$= 1{,}29 + J4{,}82 - (-4{,}82 - J1{,}29) =$$

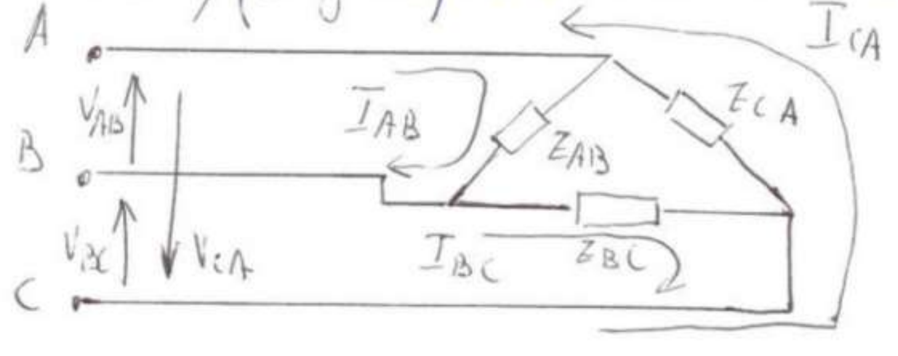
$$= 6{,}11 + J6{,}11 = 8{,}64\angle 45^\circ$$

$$I_B = I_{BC} + I_{BA} = 5\angle{-45} - 5\angle{75^\circ}$$
$$= 8{,}64\angle{-75^\circ}$$
$$I_C = I_{CA} + I_{CB} = 5\angle{195^\circ} - 5\angle{-45^\circ}$$
$$= 8{,}64\angle{165^\circ}$$

EJ. N° 6

Carga Desequilibrada

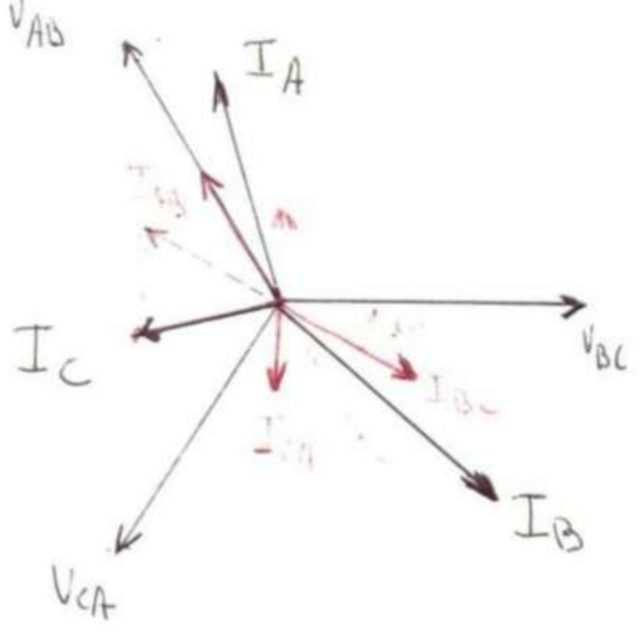
Sist. Trifásico Secuencia Directa ABC de $V_L = 339{,}4\,V$ tiene una carga en Δ con Z_{AB}, Z_{BC}, Z_{CA}. Obtener I_f, I_L, (diagrama). Por método Analítico y Vectorial -



$Z_{AB} = 10\ \angle 0°$

$Z_{BC} = 10\ \angle 30°$

$Z_{CA} = 15\ \angle -30°$



$$I_{AB} = \frac{V_{AB}}{Z_{AB}} = \frac{339{,}4\ \angle 120°}{10\ \angle 0°}$$

$$I_{AB} = 33{,}94\ \angle 120°$$

$$I_{BC} = \frac{V_{BC}}{Z_{BC}}$$

$$I_{BC} = 33{,}94\ \angle -30°$$

$$I_{CA} = \frac{V_{CA}}{Z_{CA}} = \frac{339{,}4\ \angle 240°}{15\ \angle -30°} = 22{,}63\ \angle 270°$$

$$I_A = I_{AB} + I_{AC} = 33{,}94\ \angle 120° - 22{,}63\ \angle 270° = -17 + J29{,}39 - (0 - J22{,}63) = -17 + J52{,}02 = 54{,}72\ \angle 108{,}1°$$

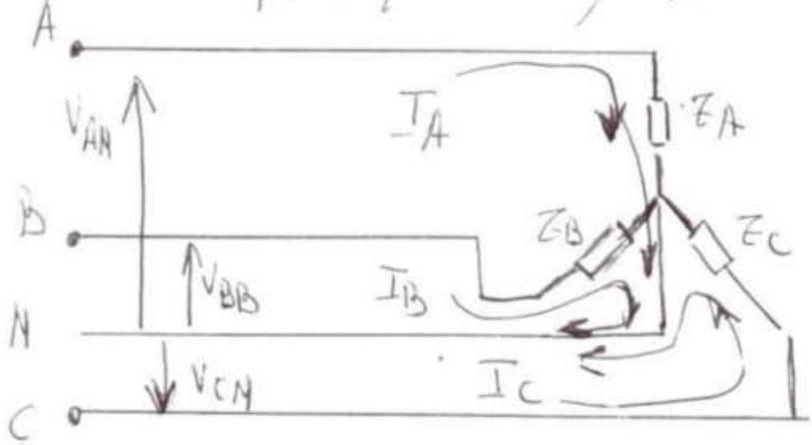
$$I_B = I_{BC} + I_{BA} = 33{,}94\ \angle -30° - (33{,}94\ \angle 120°) = 29{,}39 - J17 - (-17 + J29{,}39) = 46{,}39 - J46{,}39 = 65{,}6\ \angle -45°$$

$$I_C = I_{CA} + I_{CB} = 22{,}63\ \angle 270° - (33{,}94\ \angle -30°) = 0 - J22{,}63 - (29{,}39 - J17) = -29{,}39 - J5{,}63 = 29{,}92\ \angle -169{,}1°$$

Ej. Nº 7 :

Un sistema Trifasico CBA a cuatro hilos se conecta una carga en λ, calcular I_L y representar diagrama fasorial.

$V_f = 86{,}6$ Volt ; $V_L = 150$ Volt.



$Z_A = 6 \angle 0^\circ$

$Z_B = 6 \angle 30^\circ$

$Z_C = 5 \angle 45^\circ$

$$I_A = \frac{V_{AN}}{Z_A} = \frac{86{,}6 \angle -90^\circ}{6 \angle 0^\circ}$$

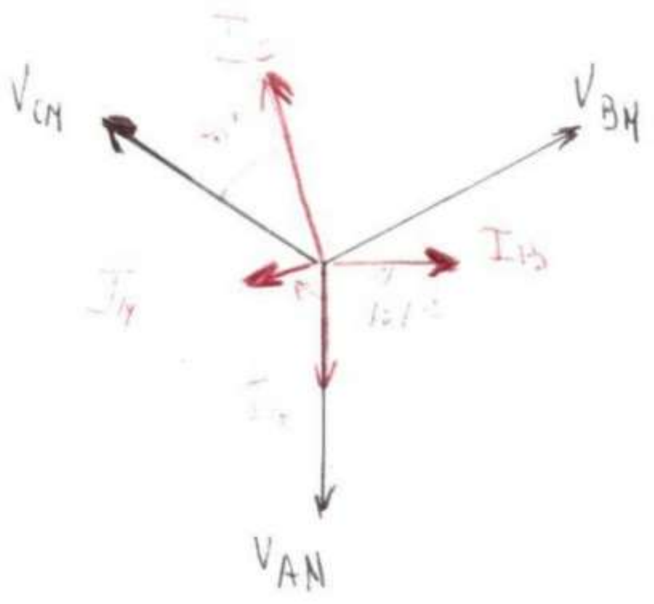
$$I_A = 14{,}43 \angle -90^\circ$$

$$I_B = \frac{V_{BN}}{Z_B} = \frac{86{,}6 \angle 30^\circ}{6 \angle 30^\circ}$$

$$I_B = 14{,}43 \angle 0^\circ$$

$$I_C = \frac{V_{CN}}{Z_C} = \frac{86{,}6 \angle 150^\circ}{5 \angle 45^\circ}$$

$$I_C = 17{,}32 \angle 105^\circ$$



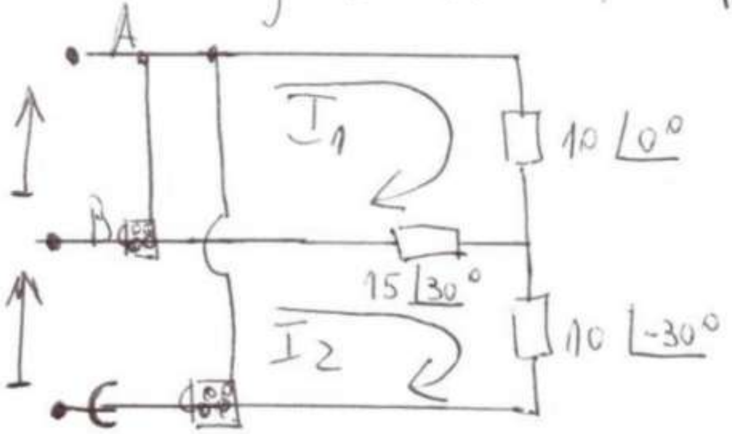
$$I_N = -(I_A + I_B + I_C) = -(14{,}43 \angle -90^\circ + 14{,}43 \angle 0^\circ + 17{,}32 \angle 105^\circ)$$

$$= -(0 - J14{,}43 + 14{,}43 + J0 - 4{,}48 + J16{,}73) = -(9{,}95 + J2{,}$$

$$= 10{,}21 \angle -167^\circ \text{ Amp.}$$

Ejercicio 8:

Carga conectada en Y, secuencia ABC de tres hilos [Calcular] con $V_{BC} = 208 \angle 0°$. Obtener Tensiones en los extremos de las cargas y V_{OM}. Potencia activa total con la coloc. de Wattímetros / de la figura (linea B y C). Triangulo de Tensiones - Diagrama Vectorial - ~~Triangulo de Potencia~~ "Metodo Corriente de Malla" - Medición de Potencia con otra conexión.



$$\begin{bmatrix} 10\angle 0° + 15\angle 30° & -(15\angle 30°) \\ -(15\angle 30°) & 15\angle 30° + 10\angle -30° \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 208\angle 120° \\ 208\angle 0° \end{bmatrix}$$

$I_1 = 14{,}16 \angle 86{,}09°$; $I_2 = 10{,}21 \angle 52{,}41°$

$I_A = I_1 = 14{,}16 \angle 86{,}09°$;

$I_B = I_2 - I_1 = 6{,}23 + J\,8{,}09 - (0{,}96 + J14{,}13)$

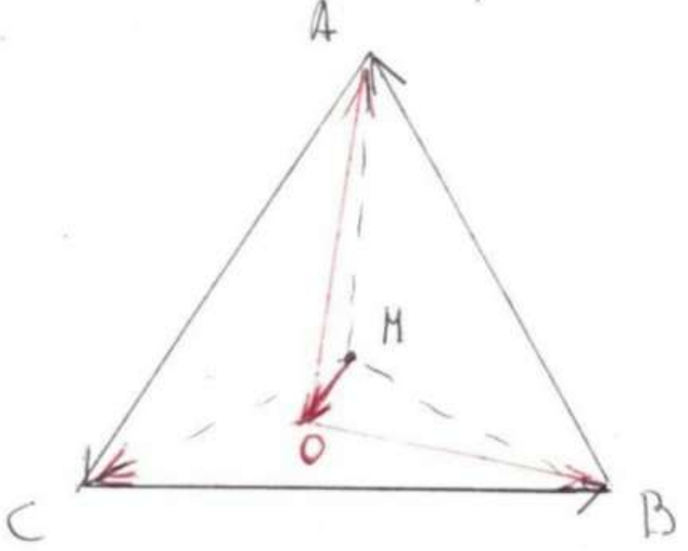
$= 5{,}27 - J6{,}04 = 8{,}01 \angle -48{,}9°$

$I_C = -I_2 = 10{,}21 \angle -127{,}59°$

$V_{AO} = I_A \cdot Z_A = 141{,}6 \angle 86{,}09^\circ$

$V_{BO} = I_B \; Z_B = 120{,}15 \angle -98{,}9^\circ$

$V_{CO} = I_C \cdot Z_C = 102{,}1 \angle -157{,}59^\circ$



$V_{OM} = V_{OA} + V_{AM} = 141{,}6 \angle -93{,}91 + 120{,}1 \angle 90^\circ$

$= 23{,}3 \angle -114{,}53^\circ$ Volt.

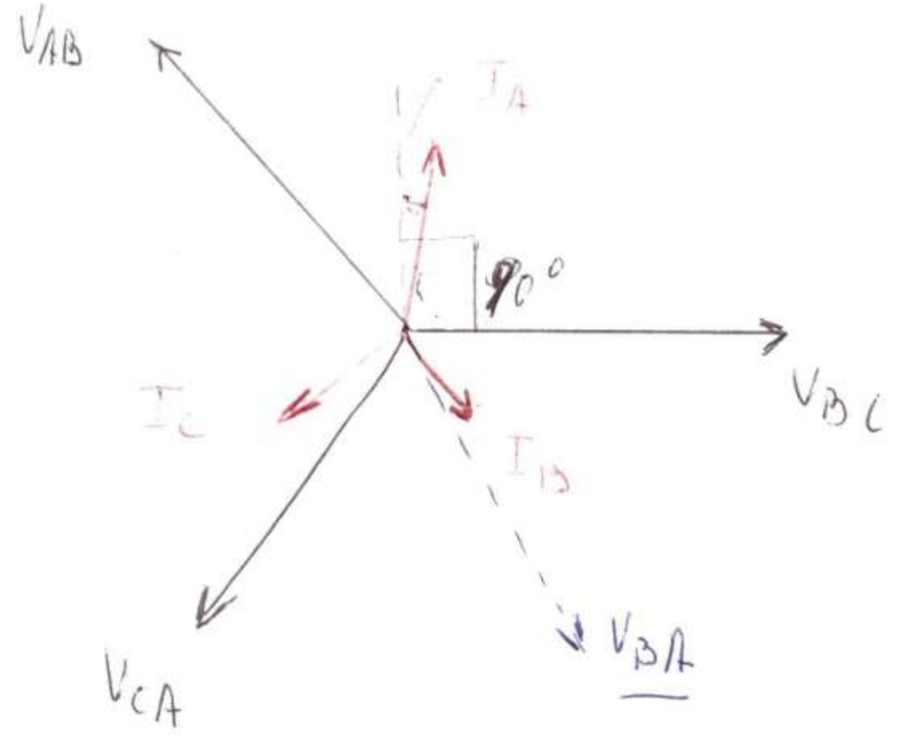
Potencia: Verificamos, la potencia que consume cada Z

$P_A = I_{Aef}^2 \cdot R_A = \left(\frac{14{,}16}{\sqrt{2}}\right)^2 (10) = 1002{,}5\ W$

$P_B = I_{Bef}^2 \cdot R_B = \left(\frac{8{,}01}{\sqrt{2}}\right)^2 (15 \cos 30^\circ) = 417\ W$

$P_C = I_{Cef}^2 \cdot R_C = \left(\frac{[illegible]}{\sqrt{2}}\right)^2 (10 \cdot \cos 30^\circ) = 451{,}4\ W$

$P_T = 1.870{,}9\ W$



$$W_B = \underline{V_{BA}} \cdot I_B \cos\measuredangle = \frac{208}{\sqrt{2}} \cdot \frac{8{,}01}{\sqrt{2}} \cos(11{,}1^\circ)$$

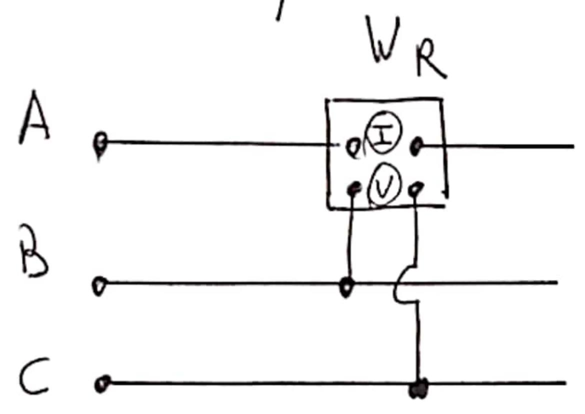
$$= 814{,}46 \text{ W}$$

$$W_C = V_{CA} \cdot I_C \cos\measuredangle = \frac{208}{\sqrt{2}} \cdot \frac{10{,}21}{\sqrt{2}} \cos(7{,}59^\circ)$$

$$= 1.052{,}54$$

$$P_T = W_B + W_C = 1.867 \text{ W}$$

Con la carga indicada y con una nueva conexión indicar que mide el Wattímetro.



$$W_R = V_{BC} \cdot I_A \cos \measuredangle$$

$$= V_L \cdot I_L \cos(90° - \varphi) = V_L\, I_L \operatorname{sen} \varphi$$

$$= V_L \cdot I_L \cdot \operatorname{sen} 3{,}91° = \frac{208}{\sqrt{2}} \cdot \frac{14{,}16}{\sqrt{2}} \operatorname{sen} 3{,}91°$$

$$W_R = 100{,}4\ [VAR]$$

$$\left[\begin{aligned} Q_T &= \sqrt{3} \cdot V_L\, I_L \operatorname{sen}\varphi \\ &= \sqrt{3} \cdot 100{,}4 = 173{,}92\ [VAR] \end{aligned}\right.$$

No es correcto, ecuación carga equilibrada!!

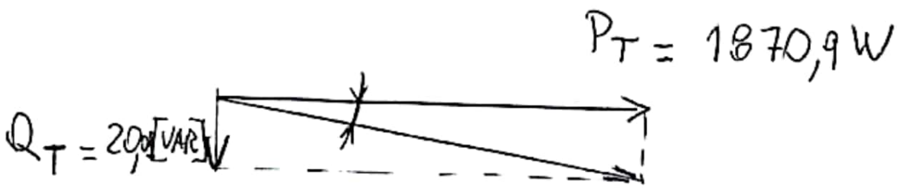
Calculo la Potencia Reactiva Total

$$Q_A = \frac{\hat{I}_A}{\sqrt{2}} \cdot \frac{141{,}6}{\sqrt{2}} \operatorname{sen} 0° = 1002{,}53 \times 0 = 0$$

$$Q_B = \frac{\hat{I}_B}{\sqrt{2}} \cdot \frac{120{,}15}{\sqrt{2}} \operatorname{sen} 30° = 481{,}20 \times 0{,}5 = 240{,}60$$

$$Q_C = \frac{\hat{I}_C}{\sqrt{2}} \cdot \frac{102{,}1}{\sqrt{2}} \operatorname{sen}(-30°) = 521{,}22 \times (-0{,}5) = -260{,}61$$

$$Q_T = -20{,}01 \text{ [VAR]}$$

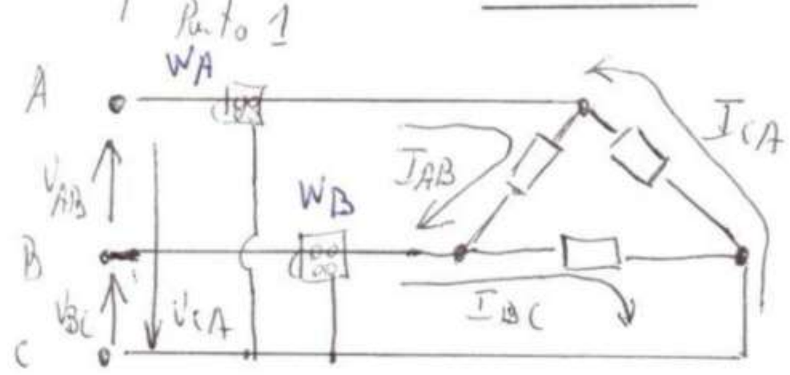


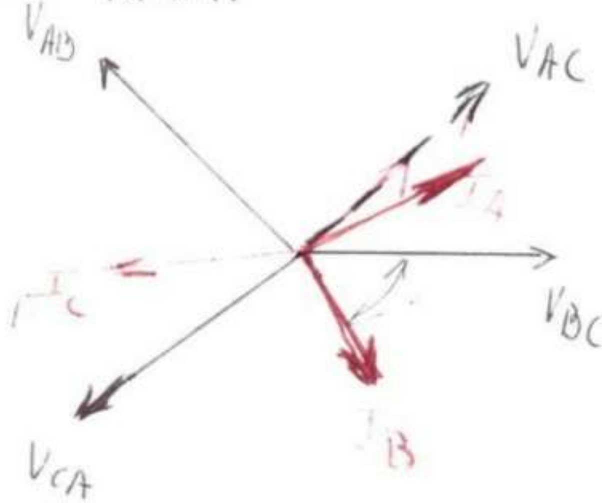
$$S_T = 1871 \angle -0{,}61$$

Ej. N° 9

Un fuente trifásica secuencia ABC con una $V_{L\,ef} = 240\,V$ tiene una carga desequilibrada en Δ. Obtener Intensidades de línea (I_L) y la potencia total con triángulo de potencia. – **Verificar** Valores Pot. Act.

Punto 1





$$I_{AB\,ef} = \frac{240}{25} = 9{,}6\ Amp.$$

$$I_{BC\,ef} = \frac{240}{15} = 16\ Amp\ ,\quad I_{CA\,ef} = \frac{240}{20} =$$

$$Z_{AB} = 25\,\angle 90^\circ\ ;\quad Z_{BC} = 15\,\angle 30^\circ\ ;\quad Z_{CA} = 20\,\angle 0^\circ$$

$\boxed{2}$ Las pot. complejas en la tres fases son:

Aparentes

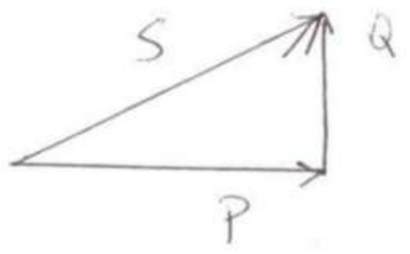
$$S_{AB} = (9{,}6)^2\,(25\,\angle 90^\circ) = 2304\,\angle 90^\circ = 0 + J\,2304$$

$$S_{BC} = (16)^2\,(15\,\angle 30^\circ) = 3840\,\angle 30^\circ = 3325 + J\,1920$$

$$S_{CA} = (12)^2\,(20\,\angle 0^\circ) = 2880\,\angle 0^\circ = 2880 + J\,0$$

$$S_T = 7506{,}27\ VA \Rightarrow \quad S_T = 6205 + J\,4224$$

$$P_T = 6205\ W\ ,\quad Q_T = 4224\ VAR$$



$\boxed{1}$

$$I_{AB} = \cancel{339} \frac{240 \angle 120^\circ}{25 \angle 90^\circ} = 9,6 \angle 30^\circ = 8,31 + J4,8$$

$$I_{BC} = \frac{240 \angle 0^\circ}{15 \angle 30^\circ} = 16 \angle -30^\circ = 13,85 - J8$$

$$I_{CA} = \frac{240 \angle 240^\circ}{20 \angle 0^\circ} = 12 \angle 240^\circ = -6 - J10,39$$

$$I_A = I_{AB} + I_{AC} = 14,31 + J15,18 = 20,90 \angle 46,7$$

$$I_B = I_{BC} + I_{BA} = 13,93 \angle -66,7^\circ$$

$$I_C = I_{CA} + I_{CB} = 20,01 \angle -173,1^\circ$$

Punto 2

Potencia de Acuerdo Ubicacion Wattmetros

$$② \; W_A = \mathbb{R}e\left(V_{AC\,ef} \times I^*_{A\,ef}\right) \qquad * : \text{conjugado}$$

$$= \mathbb{R}\left(240 \angle 60^\circ \cdot 20,9 \angle -46,7\right)$$

$$= \mathbb{R}\left(5016 \angle 13,3^\circ\right) = 4882\ W$$

$$① \; W_A = V_{AC} \cdot I_A \cos \overset{(60^\circ - 46,7^\circ)}{13,3^\circ} = 4.882\ V$$

$$② \; W_B = \mathbb{R}e\left(V_{BC\,ef} \times I^*_{B\,ef}\right) = \mathbb{R}\left(240 \angle 0^\circ \times 13,93 \angle 66,7^\circ\right)$$

$$= \mathbb{R}e\left(3343,20 \angle 66,7^\circ\right) = 1322,38\ W$$

$$① \; W_B = V_{BC} \cdot I_B \cos\left[0^\circ - (-66,7^\circ)\right]$$

$$W_B = 1322,38\ W$$

$$W_T = W_A + W_B = \underline{\underline{6204,38\ W}}$$