(1) $P_L = R_L I_L^2 \Rightarrow 300 = 4 I_L^2 \Rightarrow \boxed{I_{aA} = I_{bB} = I_{cC} = I_L = 5\sqrt{3}\ A_{(rms)}}$

$\Downarrow$

$I_{AC} = I_{CB} = I_{BA} = \frac{\sqrt{3}}{3} I_L = 5\ A_{(rms)}$

$S_2 = \frac{S}{3} = 800 + j700\ VA$

$\hookrightarrow S_2 = Z|I|^2 \Rightarrow 800 + j700 = Z \times 5^2 \Rightarrow \boxed{Z = 32 + j28}$

$\overline{V}_{ac} = 4(\overbrace{\overline{I}_{aA} - \overline{I}_{cC}}^{3\overline{I}_{AC}}) + Z\overline{I}_{AC} = (12 + 32 + j28)\overline{I}_{AC} = (44 + j28)\overline{I}_{AC}$

$\Rightarrow \angle\overline{I}_{AC} = \angle\overline{V}_{ac} - \angle 44 + j28 = 20^\circ - 32.5^\circ = -12.5^\circ \Rightarrow \boxed{\overline{I}_{AC} = 5\angle -12.5^\circ\ A}$

$\Rightarrow \angle\overline{I}_{CB} = \angle\overline{I}_{AC} - 120^\circ = -132.5^\circ \rightarrow \boxed{\overline{I}_{CB} = 5\angle -132.5^\circ\ A}$

$\angle\overline{I}_{aA} = \angle\overline{I}_{AC} - 30^\circ = -42.5^\circ \rightarrow \boxed{\overline{I}_{aA} = 5\sqrt{3}\angle -42.5^\circ\ A} \Rightarrow \boxed{\overline{I}_{bB} = 5\sqrt{3}\angle 77.5^\circ\ A}$

$\overline{V}_{ac} = (44 + j28)\overline{I}_{AC} = 52.15\angle 32.5^\circ\, 5\angle -12.5^\circ \Rightarrow \boxed{\overline{V}_{ac} = 260.75\angle 20^\circ}$

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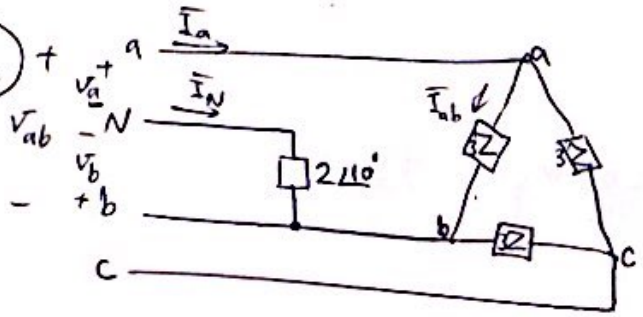
(2)



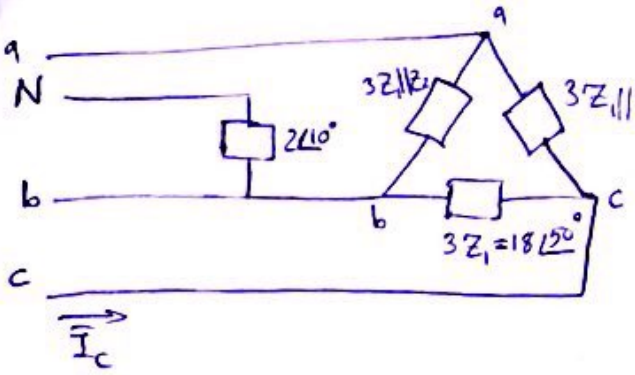
$Z = Z_1 \,||\, \frac{Z_2}{3} \simeq \frac{8\angle 75^\circ}{7.23\angle 45.5^\circ} \simeq 1.1\angle 29.5^\circ$ (Y-Δ)

$\overline{V}_{ab} = (\sqrt{3}\angle 30^\circ)\overline{V}_a \Rightarrow \overline{V}_a = \frac{208}{\sqrt{3}}\angle -30^\circ$

$\Rightarrow \overline{V}_b = \frac{208}{\sqrt{3}}\angle +150^\circ$

$\overline{V}_b = -2\angle 110^\circ \overline{I}_N \Rightarrow \boxed{\overline{I}_N = \frac{104}{\sqrt{3}}\angle 20^\circ}$

$\overline{I}_{ab} = \frac{\overline{V}_{ab}}{3Z} = \frac{208\angle 0}{3.3\angle 30^\circ} = 63\angle -30^\circ \Rightarrow \overline{I}_a = \sqrt{3}\angle -30^\circ\, \overline{I}_{ab} \Rightarrow \boxed{\overline{I}_a \simeq 109.2\angle -60^\circ}$



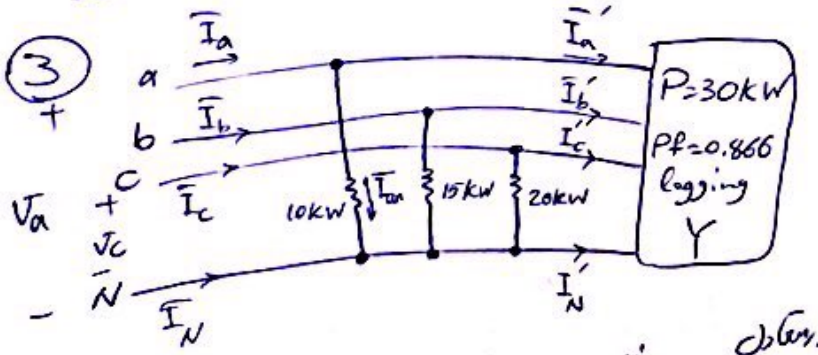
$3Z_1 \| 3Z_2 = 3.3\angle 30^\circ$

$\bar{I}_c = \bar{I}_{ca} - \bar{I}_{bc}$

$$\bar{I}_{ca} = \frac{\bar{V}_{ca}}{3.3\angle 30^\circ} = \frac{208\angle 120^\circ}{3.3\angle 30^\circ} = 63\angle 90^\circ = j63$$

$$\bar{I}_{bc} = \frac{\bar{V}_{bc}}{18\angle 50^\circ} = \frac{208\angle -120^\circ}{18\angle 50^\circ} = 11.6\angle -170^\circ = -11.4 - j2.0$$

$$\Rightarrow \boxed{\bar{I}_c = 11.4 + j65 = 66\angle 80^\circ \text{ A}}$$



$P_{3\phi} = \sqrt{3}\, V_L I' \text{p.f}$

$30k = \sqrt{3} \times 230 \times 0.866\, I'$

$\Rightarrow I' = 50.2 = |\bar{I}'_a| = |\bar{I}'_b| = |\bar{I}'_c|$

Obvious $\Rightarrow |\bar{I}'_N| = 0$ ①

$$V_{LN} = \frac{V_{LL}}{\sqrt{3}} = \frac{230}{\sqrt{3}}$$

$\alpha - \beta = \cos^{-1} 0.866 = 30^\circ$

$\bar{V}_{an} = \frac{230}{\sqrt{3}}\angle 0^\circ \Rightarrow \bar{V}_{ab} = 230\angle 30^\circ$

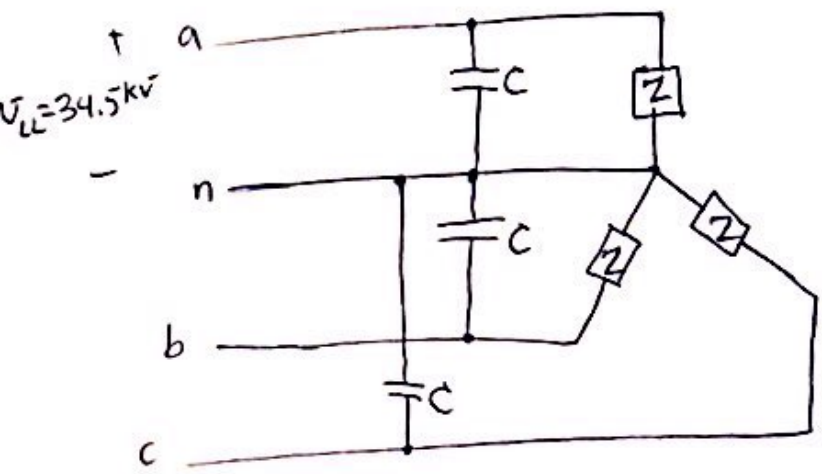
$\angle \bar{I}'_a = -30^\circ$ ① $\Rightarrow \bar{I}'_a = 50.2\angle -30^\circ \Rightarrow \begin{cases} \bar{I}'_b = 50.2\angle -150^\circ \\ \bar{I}'_c = 50.2\angle 90^\circ \end{cases}$

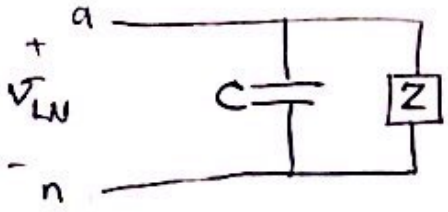
$P_R = VI \Rightarrow I_{an} = \frac{P_R}{V_{LN}} = \frac{10k}{230/\sqrt{3}} = 43.5\sqrt{3}$, $I_{bn} = 65.2\sqrt{3}$, $I_{cn} = 87.0\sqrt{3}$

$\angle \bar{I}_{an} = \angle \bar{V}_{an} = 0^\circ \Rightarrow \bar{I}_{an} = 43.5\sqrt{3}\angle 0$, $\bar{I}_{bn} = 65.2\sqrt{3}\angle -120^\circ$, $\bar{I}_{cn} = 87.0\sqrt{3}\angle 120^\circ$

$\bar{I}_a = \bar{I}'_a + \bar{I}_{an} \Rightarrow \boxed{\bar{I}_a = 121.43\angle -12^\circ}$, $\boxed{\bar{I}_b = 158.4\angle 51^\circ}$, $\boxed{\bar{I}_c = 195.78\angle -67^\circ}$

$-\bar{I}_N = \bar{I}_a + \bar{I}_b + \bar{I}_c = 308.87\angle -11^\circ \Rightarrow \boxed{\bar{I}_N = 308.87\angle 169^\circ}$





$V_{LL}=34.5\,kV \longrightarrow V_{LN}=11.5\sqrt{3}\,kV$

$$|S|=24MVA=\frac{|\bar{V}|^2}{|Z|}=\frac{(11.5\sqrt{3}\times10^3)^2}{|Z|}\Rightarrow |Z|=\frac{3\times132.25}{24}\Rightarrow |Z|\simeq16.5$$

$p.f.=0.78$

$$Z=R+jX \Rightarrow \begin{cases} R=12.87 \\ X=10.33 \end{cases}$$

$$\frac{-1}{\omega C}=X_C=\frac{R^2+X^2}{R\tan(\cos^{-1}p.f_{new})-X}=\frac{16.5^2}{-12.87\times0.363-10.33}\Rightarrow \omega C=0.0551$$

$$f=60\,Hz \Rightarrow C=\frac{0.0551}{2\pi60}=1.46\times10^{-4}\Rightarrow \boxed{C=146\,\mu F}$$