1\. Matric number: A0199806L

$R = 06 = 6\Omega$

$C = (019) \times 2 = 38\mu F$

a. $I = \frac{V}{Z} = \frac{V}{R - \frac{j}{\omega C} + j\omega L}$

$= \frac{230}{6 - j\left(\frac{1}{50 \times 38 \times 10^{-6}}\right) + j(50)(0.8)}$

$\approx \frac{230}{6 - j486.31579} \approx \frac{230\angle 0^\circ}{486.3528\angle -89.29314^\circ}$

$\approx 0.4729\angle 89.29314^\circ$

$= 0.473\angle 89.3^\circ A$ (3s.f.)

b. $I_C = I_L = I_R = I_s = 0.4729\angle 89.29314^\circ = 0.473\angle 89.3^\circ A$

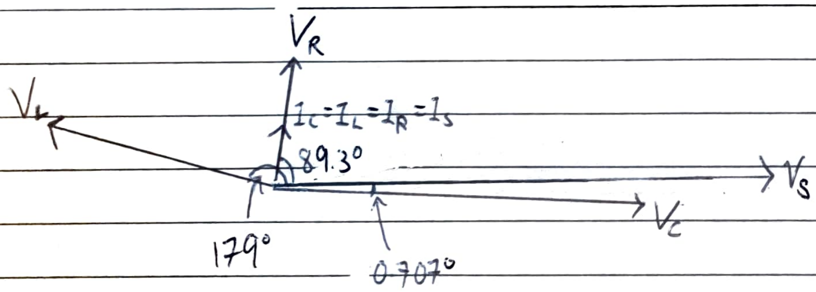
$V_s = 230\angle 0^\circ V$

$V_C = I_C\left(-\frac{j}{\omega C}\right) = (0.4729\angle 89.29314^\circ)\left(\frac{1}{50 \times 38 \times 10^{-6}}\angle -90^\circ\right)$

$= 249\angle -0.707^\circ V$ (3s.f.)

$V_L = I_L(j\omega L) = (0.4729\angle 89.29314^\circ)(j\,50 \times 0.8) = 18.9\angle 179^\circ V$ (3s.f.)

$V_R = I_R R = (0.4729\angle 89.29314^\circ)(6) = 2.84\angle 89.3^\circ V$ (3s.f.)



Date No.

c. I is max when Z is min and $Z = R + \frac{1}{j\omega C} + j\omega L$ is min when

$$\frac{1}{j\omega C} + j\omega L = 0$$

$$\frac{1}{j\omega C} = -j\omega L$$

$$\omega^2 LC = 1$$

$$\omega = \sqrt{\frac{1}{LC}} = \sqrt{\frac{1}{0.8(38\times10^{-6})}}$$

$$= 181 \text{ Hz} \quad (3s.f.)$$

2 Matric number: A0199806L

Nusnet id: e0406787

$A = 87 \times 2 = 174$ kW

$B = 0.7$

a. $V_{line-neutral} = \frac{|V_{line-line}|}{\sqrt{3}} \angle 0^\circ = \frac{420}{\sqrt{3}} \angle 0^\circ$

$\approx 242.487 \angle 0^\circ$ V

Load 1

$Z_{y,1} = \frac{Z_{\Delta,1}}{3} = \frac{15 \angle 20^\circ}{3} = 5 \angle 20^\circ \, \Omega$

$I_1 = \frac{V_{line-neutral}}{Z_{y,1}} = \frac{242.487 \angle 0^\circ}{5 \angle 20^\circ}$

$= 48.4974 \angle -20^\circ$ A

$S_{3\phi,1} = 3(V_{line-neutral})(I_1^*) = 3(242.487 \angle 0^\circ)(48.4974 \angle 20^\circ)$

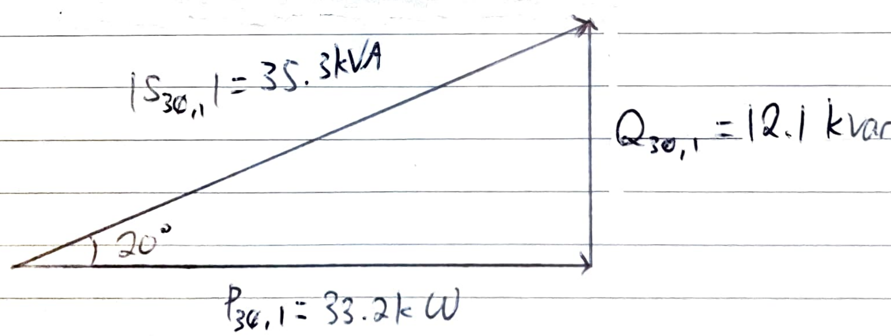
$\approx 35.27997 \angle 20^\circ$ kVA

$|S_{3\phi,1}| = 35.3$ kVA (3 s.f.)

$\theta_1 = 20^\circ$

$P_{3\phi,1} = 35.27997 \cos(20^\circ) = 33.2$ kW (3 s.f.)

$Q_{3\phi,1} = 35.27997 \sin(20^\circ) = 12.1$ kvar (3 s.f.)



Load 2

$Z_2 = 6+8j\,\Omega \approx 10\angle 53.13^\circ\,\Omega$

$$I_2 = \frac{V_{line\text{-}neutral}}{Z_2} = \frac{242.487\angle 0^\circ}{10\angle 53.13^\circ}$$
$$= 24.2487\angle -53.13^\circ \text{ A}$$

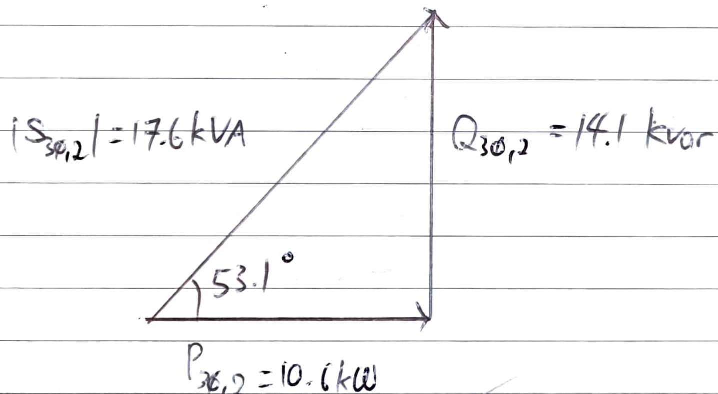
$$S_{3\phi,2} = 3V_{line\text{-}neutral}\, I_2^* = 3(242.487\angle 0^\circ)(24.2487\angle 53.13^\circ)$$
$$\approx 17.63998\angle 53.13^\circ \text{ kVA}$$

$|S_{3\phi,2}| = 17.6$ kVA (3s.f)

$\theta = 53.1^\circ$ (3s.f.)

$P_{3\phi,2} = 17.63998 \cos(53.13^\circ) = 10.6$ kW (3s.f.)

$Q_{3\phi,2} = 17.63998 \sin(53.13^\circ) = 14.1$ kvar (3s.f.)



Load 3

$P_{3\phi,3} = 174\text{kW}$

$p.f._3 = 0.7$

$\theta = \cos^{-1} 0.7 \approx 45.573° = 45.6° \text{ (3s.f)}$

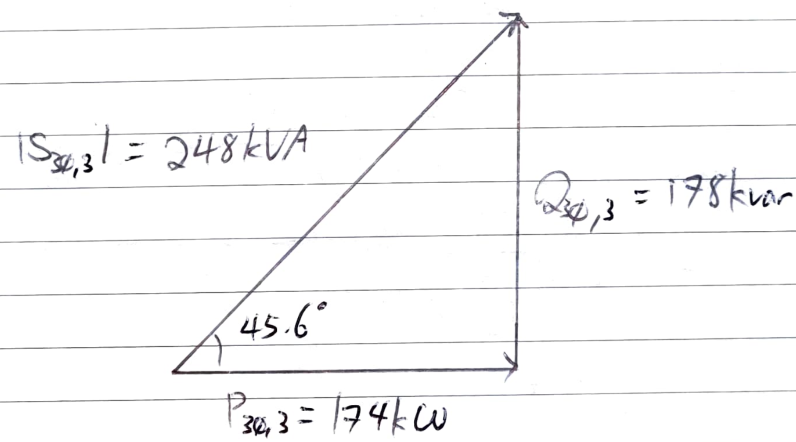
$Q_{3\phi,3} \; P_{3\phi,3} \tan\theta = 174 \tan(45.573°)$

$\approx 177.5155 \text{ kvar}$

$= 178 \text{ kvar (3s.f)}$

$|S_{3\phi,3}| = \sqrt{174^2 + 177.5155^2}$

$= 248 \text{ kVA (3s.f)}$



b. $P_s = P_{3\phi,1} + P_{3\phi,2} + P_{3\phi,3} = 33.2 + 10.6 + 174$
$= 217.8 \text{ kW}$

$Q_s = Q_{3\phi,1} + Q_{3\phi,2} + Q_{3\phi,3} = 12.1 + 14.1 + 178$
$= 204.2 \text{ kvar}$

$$S_s = \sqrt{217.8^2 + 204.2^2} \angle \tan^{-1}\left(\frac{204.2}{217.8}\right)$$

$$\approx 298.55 \angle 43.154^\circ$$
$$= 299 \angle 43.2^\circ \text{ kVA} \quad (3\text{s.f})$$

c.

Since unity, $\theta = 0^\circ$,

$Q_{C,3\phi} = -Q_s = -204.2 \text{kvar}$

$Q_{C,1\phi} = \frac{-Q_s}{3} \approx -68.06667 \text{ kvar}$

$$X_{C,1\phi} = \frac{|V_{line-line}|^2}{Q_{C,1\phi}} = \frac{420^2}{-68.06667 \times 10^3} \approx -2.591577 \Omega$$

Assuming $\omega = 50\text{Hz}$,

$$|X_{C,1\phi}| = \frac{1}{\omega C}$$

$$2.591577 = \frac{1}{50C}$$

$$C = 130 \text{ F} \quad (3\text{s.f.})$$

$$|P_s| = 3|V_{line-neutral}||I_{ph}|\cancel{\cos\theta}^{1}$$

$$|I_{line}| = |I_{ph}| = \frac{|P_s|}{3|V_{line-neutral}|} = \frac{217.8 \times 10^3}{3\left(\frac{420}{\sqrt{3}}\right)}$$

$$= 299 \text{ A} \quad (3\text{s.f})$$