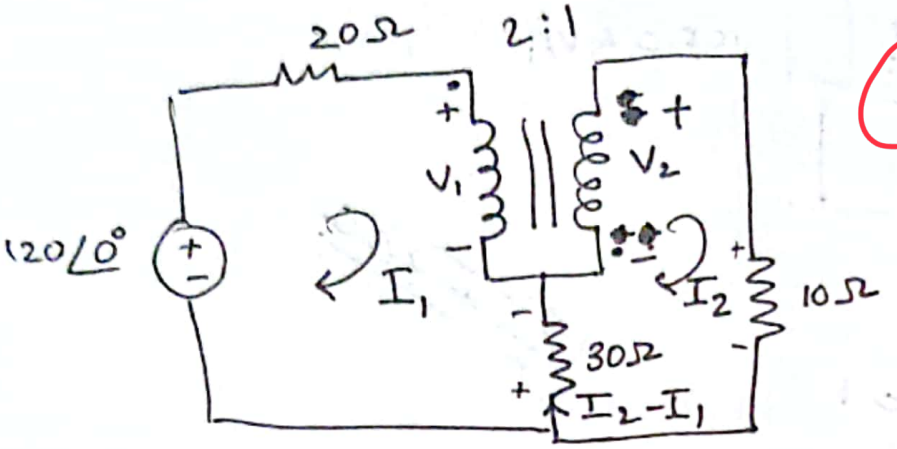
Quiz

19D170027
Samidhya



12
good

Applying KVL

$120\angle 0^\circ - 20I_1 - V_1 - 30(I_2 - I_1) = 0$ ——— ①

Applying KVL

check sign

$-V_2 + 10I_2 - 30(I_2 - I_1) = 0$ ——— ②

And, $\frac{V_1}{-V_2} = \frac{2}{1}$ and $\frac{I_1}{I_2} = \frac{1}{2}$

$\Rightarrow V_1 = -2V_2$ $\Rightarrow 2I_1 = I_2$

Substituting in ①

$120\angle 0^\circ - 20I_1 + 2V_2 - 30(I_1) = 0$

$\Rightarrow 120\angle 0^\circ = 50I_1 - 2V_2$

Substituting in ②

$-V_2 - \frac{2}{50}I_1 - 30(I_1) = 0$

$\Rightarrow V_2 = -\frac{50}{50}I_1$

$\therefore 120 = V_2 - 2V_2$ (2)

$\Rightarrow V_2 = -120\ V$

$\therefore V_1 = 240\ V$

$\Rightarrow I_1 = \frac{V_2}{50} = -2.4\ A$

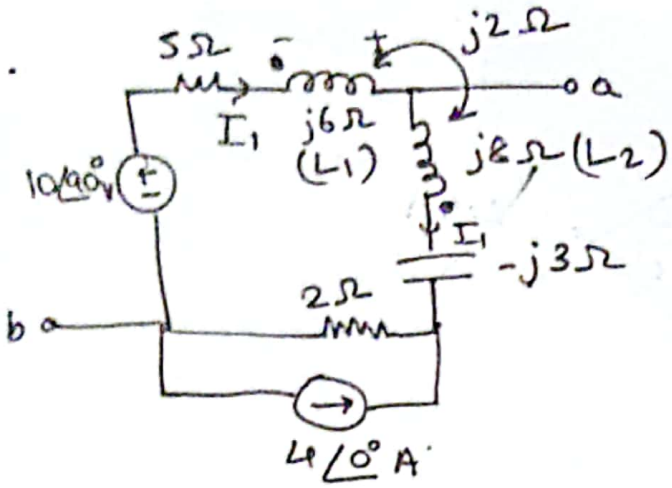
$I_2 = 2I_1 = -4.8\ A$

$P_{10\Omega} = I_2^2 R$

$= 4.8^2 \times 10 = 23.04 \times 10$

$= 230.4\ \Omega$

2.



For R_{th}

$L_1' = L_1 - j2\,\Omega$

$= j6 - j2$

$= j4\,\Omega$

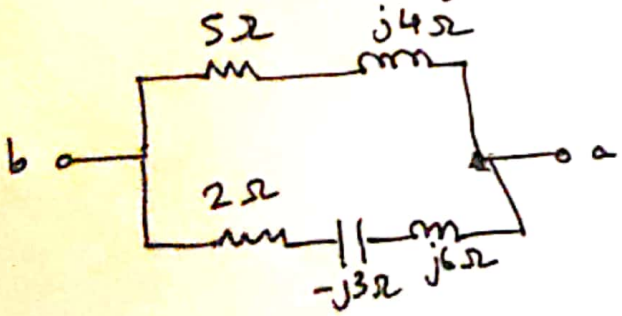
$L_2' = L_2 - j2\,\Omega$

$= j8 - j2$

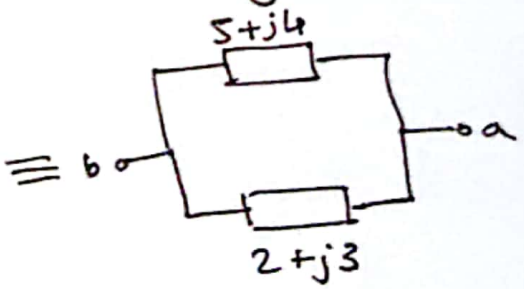
$= j6\,\Omega$

$\therefore L_1' + L_2' = j4 + j6$

$= j10\,\Omega$



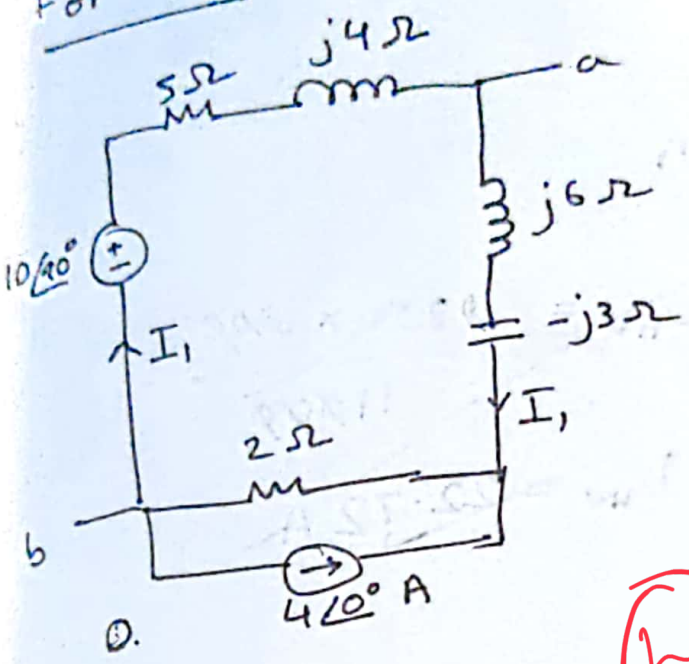
Redrawing



$\Rightarrow R_{th} = \dfrac{(2+j3)(5+j4)}{7+j7}$

$= 2.33 \angle 49.97^\circ\,\Omega$

For V_{th}



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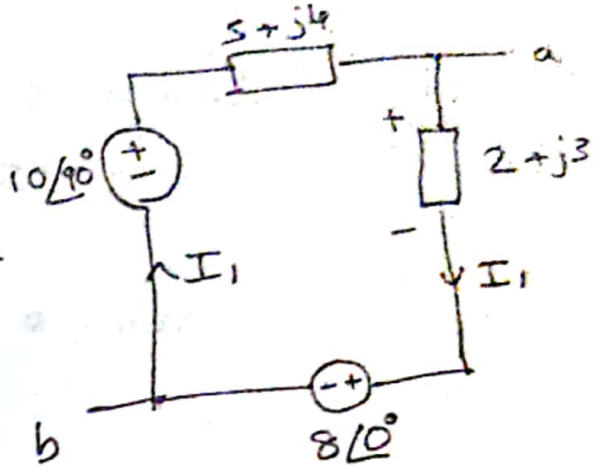


(4)

∴ Applying KVL

$$+10\angle 90^\circ - 8\,I_1(5+j4) - I_1(2+j3) - 8\angle 0^\circ = 0$$

$$\Rightarrow 10\angle 90^\circ - 8 = I_1(7+j7)$$

$$\Rightarrow I_1 = 1.29\angle 83.66^\circ \text{ A}$$

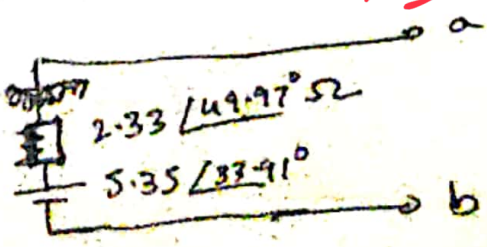
$$\therefore V_{ab} = (2+j3)I_1 + 8\angle 0^\circ$$

$$= 3.6\angle 56.31^\circ \times 1.29\angle 83.66^\circ + 8\angle 0^\circ$$

$$V_{ab} = \frac{16.02}{5.35}\angle 33.91^\circ - 25.83^\circ$$

$$\boxed{V_{ab} = 5.35\angle 33.91^\circ} = V_{th}$$

∴



Thevenin equivalent

3. $X = 100$ kVA

$\Rightarrow$ Power rating $= 150 + X$

$= 250$ kVA

~~rated current~~ : $I_{HV} = \frac{250 \times 1000}{11000}$

$I_{HV} = 22.72$ A

$P = \sqrt{3} V_L I_L$

$V_L = (11000)$ V (Delta)

(1) $\therefore \quad 250 \times 1000 = \sqrt{3} \times 11000 \times I_L$

$I_{HV\,rated} = 13.14$ A

$\therefore P_{CL} = 3 \frac{I_{HV\,rated}^2}{3} R_{eq_2} \times 3$ (as $I_P = \frac{I_L}{\sqrt{3}}$)

3 resistances

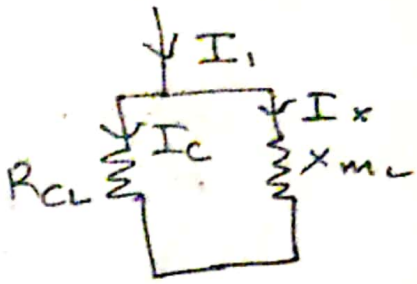
$\Rightarrow R_{eq_2} = \frac{2.1 \times 1000}{13.14^2 \times 3} \times 3$

$R_{eq_2} = 12.16\ \Omega$ (2)

$Z_{eq_2} = \frac{350}{13.14} = 26.64\ \Omega$ (1/2)

$\therefore X_{eq_2} = \sqrt{Z_{eq_2}^2 - R_{eq_2}^2} = 23.70\ \Omega$ (1/2)

$$P_{oc} = 3 \times \frac{400^2}{R_{CL}}$$



$$\Rightarrow R_{CL} = 3 \times \frac{400 \times 400}{1500}$$

$$R_{CL} = 320\ \Omega$$

$$\Rightarrow I_c = \frac{400}{320} = 1.25\ A$$

$$\text{Now, } I_x = \sqrt{I_1^2 - I_c^2}$$

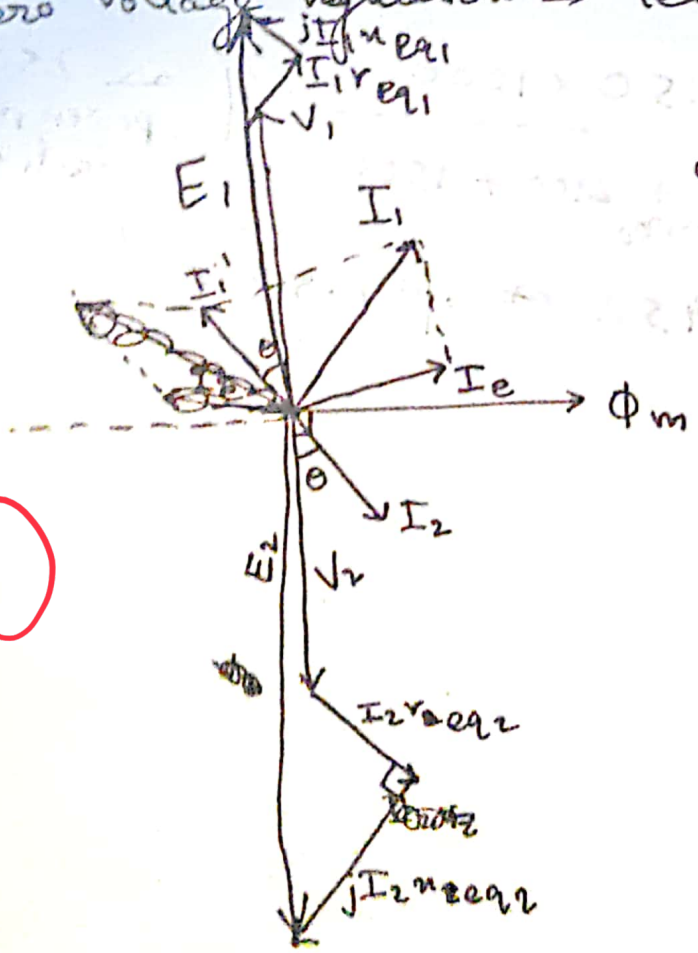
$$= \sqrt{9^2 - 1.25^2} = 8.91\ A$$

$$\eta = \frac{3 \times 250 \times 1000}{3 \times 250 \times 1000 + 2100 + 1500}$$

(as 250 kVA = power rating of each transformer)

$$\eta = 0.9952 = 99.52\ \%$$

4. Zero Voltage regulation ⇒ leading pf



where, $\bar{I}_1 = \bar{I}_1' + \bar{I}_e$

$\bar{E}_2 = \bar{V}_2 + \bar{I}_2(r_{eq_2} + jx_{eq_2})$

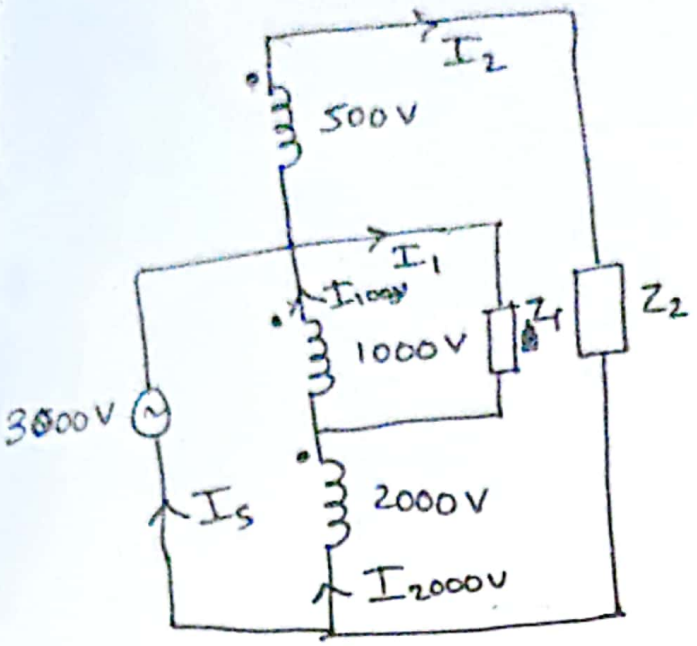
and

$\bar{E}_1 = \bar{V}_1 + \bar{I}_1(r_{eq_1} + jx_{eq_1})$

and $\tan\theta = \dfrac{r_{eq_2}}{x_{eq_2}}$

where r_{eq_2} and x_{eq_2} are leakage components referred to secondary.

5] $X = 100$ kVA



$$P_{Z_1} = 130 + X$$
$$= \frac{\cancel{110}}{230} \text{ kVA}$$

$$P_{Z_2} = 1000 + X$$
$$= 1100 \text{ kVA}$$

$$\therefore I_1 = \frac{P_{Z_1}}{1000V} = \frac{230 \times 10^3}{10^3} = \underline{\underline{230 \text{ A}}}$$

3½

$$I_2 = \frac{P_{Z_2}}{\cancel{1100}\ 3500V} = \frac{\cancel{1100} \times \cancel{10^3}^{220}\ 10}{\cancel{350}\ 7\ \cancel{\emptyset}} = \underline{\underline{314.29 \text{ A}}}$$

Now, assuming efficiency of ~~out~~ autotransformer ≈ 1

$$\Rightarrow P_{input} = P_{output}$$

$$\Rightarrow 3000 \times I_S = P_{Z_1} + P_{Z_2}$$

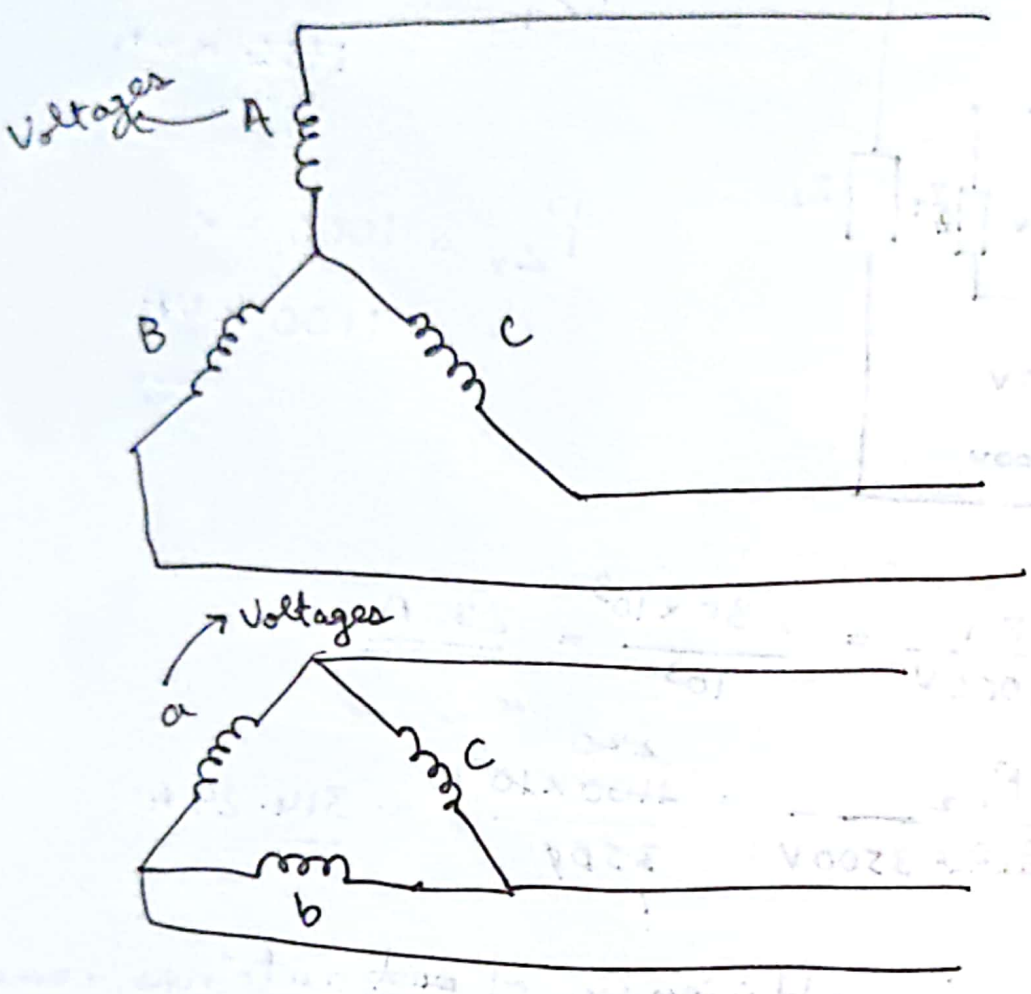
$$\Rightarrow 3000 \times I_S = 1330 \times \cancel{10^3}$$

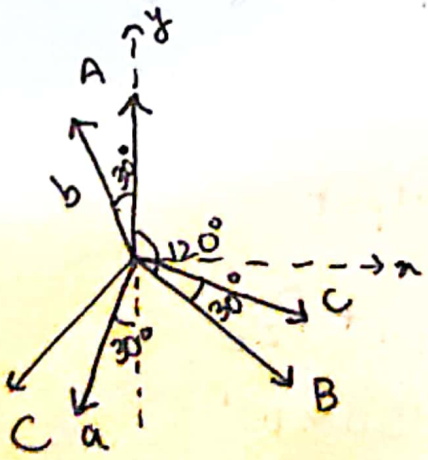
$$I_S = \underline{\underline{443.33 \text{ A}}}$$

$$\therefore I_{1000V} = I_2 + I_1 - I_S = 100.96 \text{ A}$$

$$I_{2000V} = I_S - I_2 = 129.04 \text{ A}$$

6. $\phi = 7 \Rightarrow Y d_7$??





Phasor diagram

∴ a leads A by 150°

b " B "

C " " "