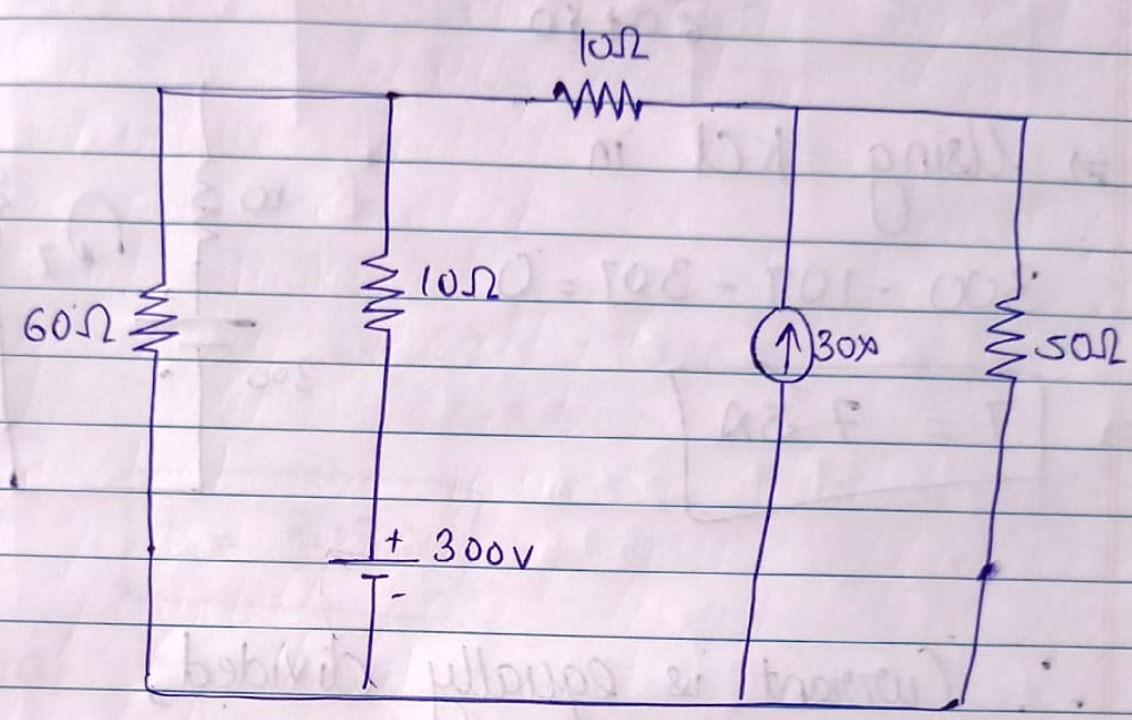
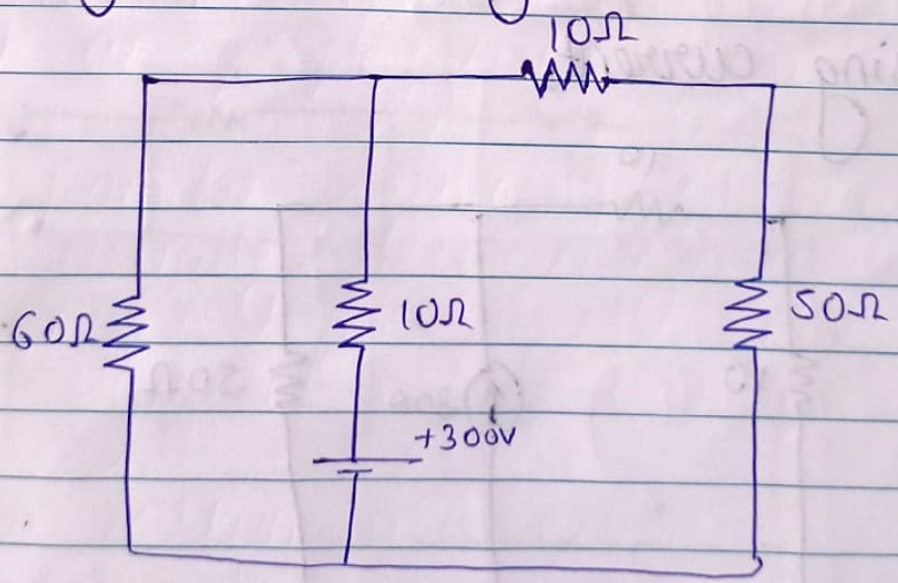
Name → Pratham Pali Roll no. → 21H018

Sch no. → 211112254 BEEE-124

Q1)



Sol) Considering 300V battery



∴ 10Ω & 50Ω are in parallel,

$\Rightarrow R_{eq} = 10 + 50$

$= 60\Omega.$

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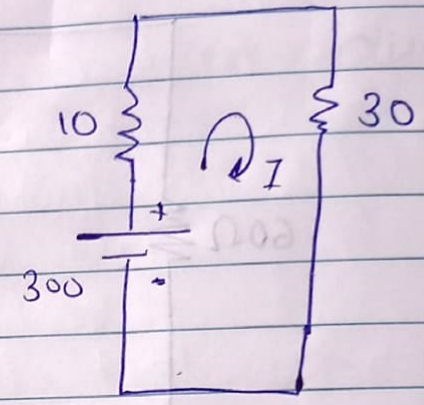
Now 60Ω, ~~10Ω~~, 60Ω are in parallel

$\Rightarrow R_{eq} = \frac{60 \times 60}{60+60} = 30\Omega$

$\Rightarrow$ Using KCL in



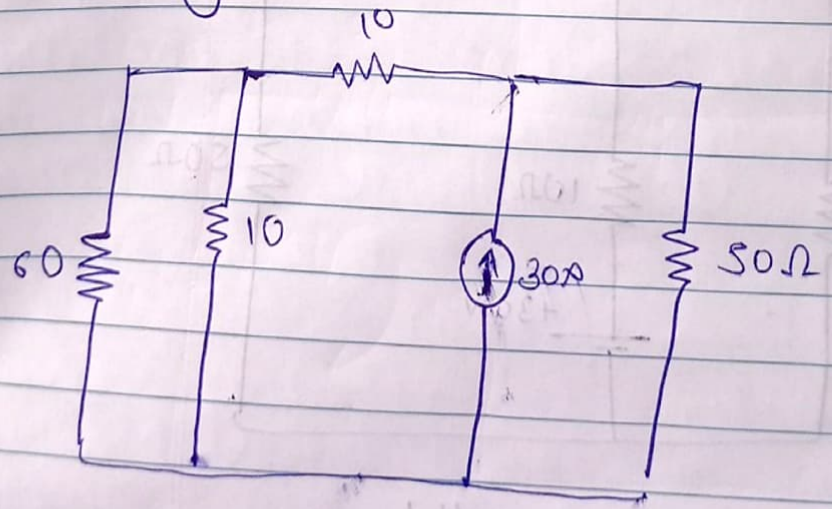
$300 - 10I - 30I = 0$

$\Rightarrow \boxed{I = 7.5A}$

$\therefore$ Current is equally divided,

$\therefore \boxed{I \text{ in } 50\Omega \text{ resistance is } \cancel{7.5A}\ 3.75}$

Considering current,



60 & 10 in parallel,

$R = \frac{60 \times 10}{60+10} = \frac{600}{70} = \frac{60}{7}\Omega$

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10Ω & $\frac{60}{7}\Omega$ in series,

$$\Rightarrow R = \frac{70+60}{7} = \frac{130}{7} = 18.59\Omega$$

So I in 50Ω is

$$I = \frac{18.59 \times 30}{68.59}$$

$$\boxed{I = 8.13A}$$

∴ Total current,

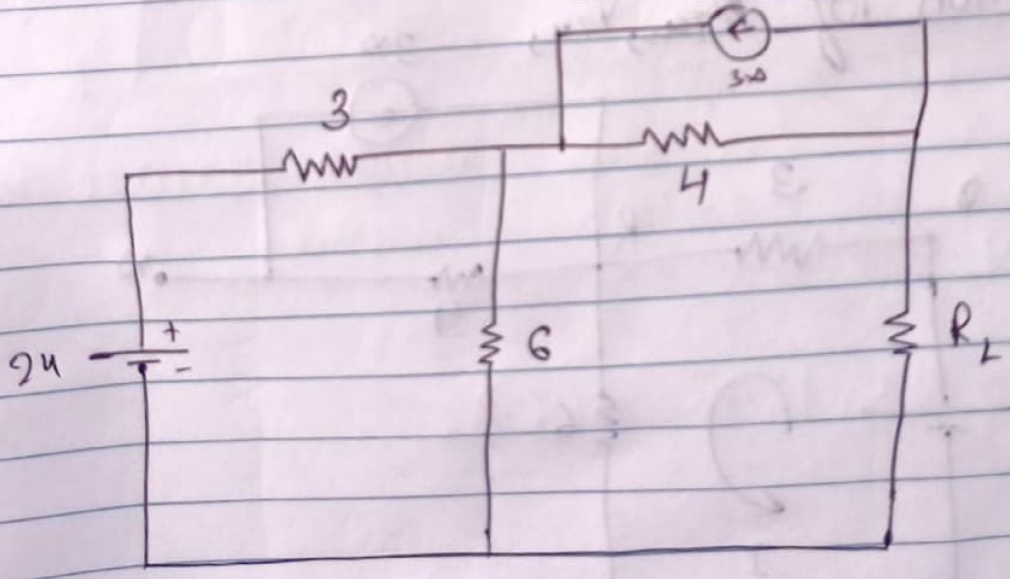
~~$I = 7.5 + 8.13$~~

~~$I = 15.63A$~~

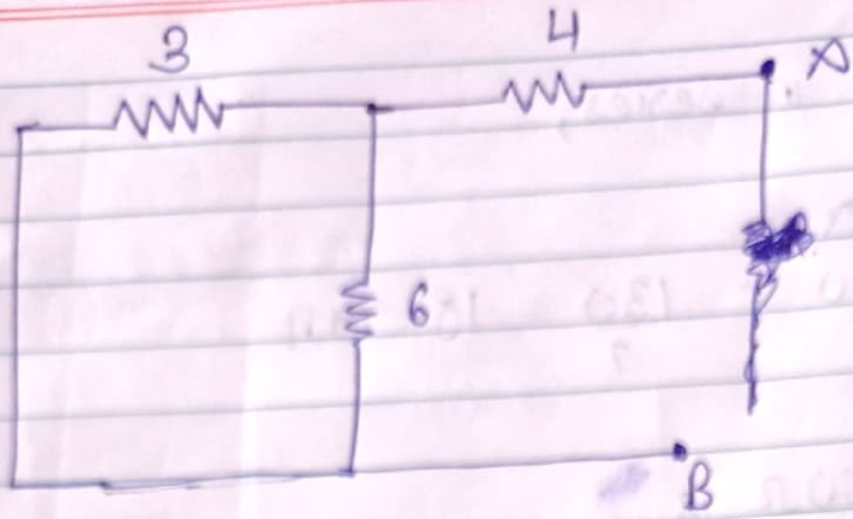
$I = 8.13 + 3.75$

$= 11.18A$

(b)



Calculation of R_{TH},

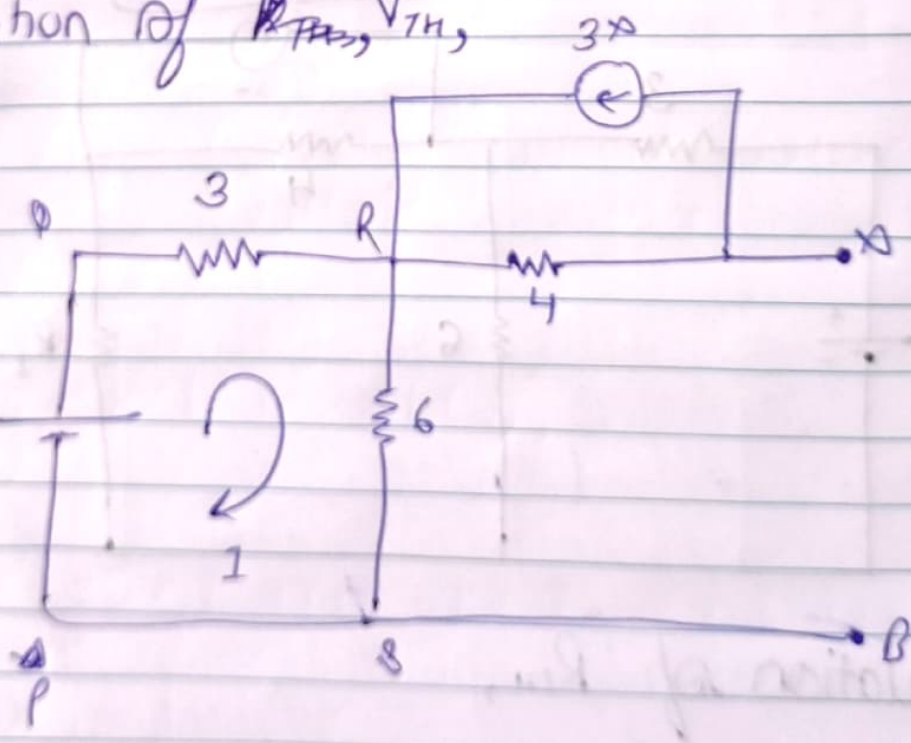


~~3 || 6~~ = ~~2~~

$$R_{eq} = 4 + \frac{3 \times 6}{3+6}$$

$$R_{TH} = 6\,\Omega$$

Calculation of ~~R_{TH}~~, V_{TH},



Apply KCL in ~~P~~ R S,

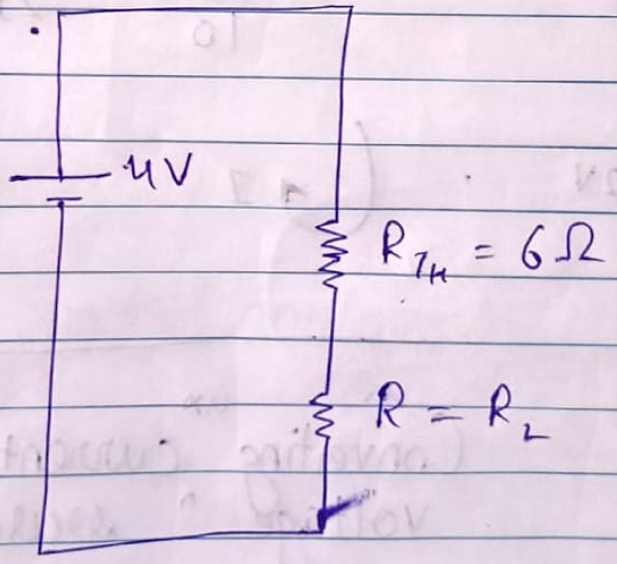
$+24 - 3I - 6I = 0$

$\Rightarrow I = \frac{24}{9} = 2.67A$

$\therefore V_A - 12 - 6 \times 2.67 = V_B$

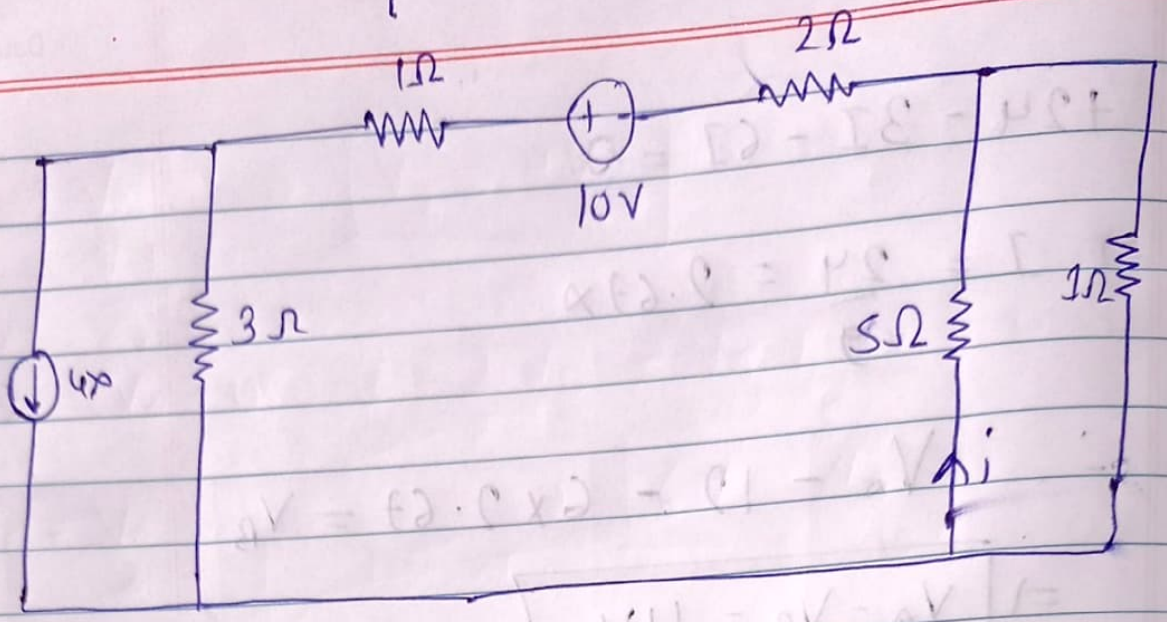
$\Rightarrow \boxed{V_A - V_B = 4V}$

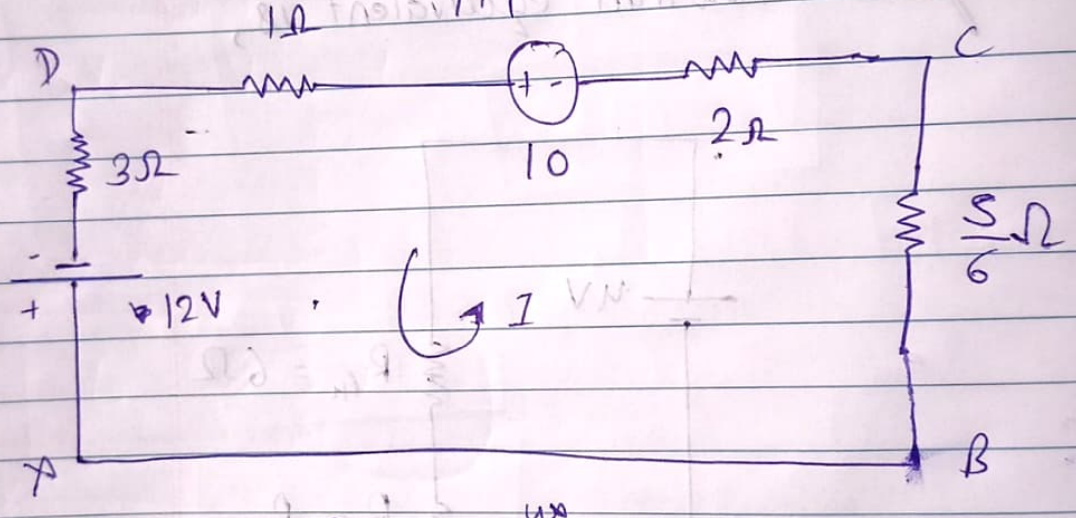
Therefore thevinin equivalent is,



$V_x = ?$

Q2 a)





$V = IR$
$= 4 \times 3$
$= 12V$

Converting 4A current source into voltage source

Applying KCL in ABCD,

$$-\frac{5}{6} \times I - 2 \times I + 10 - 1 \times I - 3 \times I + 12 = 0$$

$$\Rightarrow \left(-\frac{5}{6} - 2 - 1 - 3\right) I + 22 = 0$$

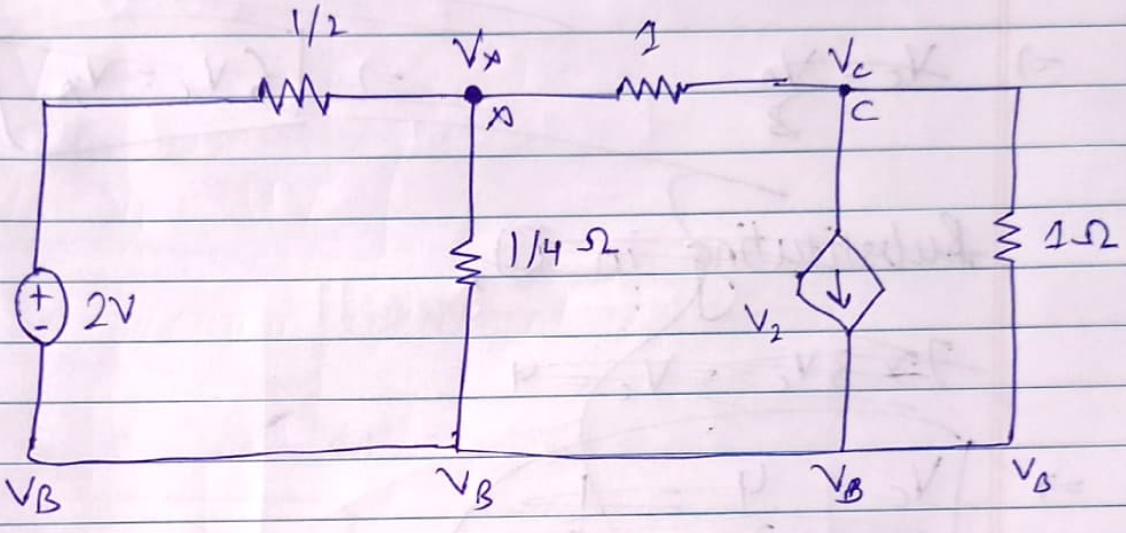
$$\Rightarrow \boxed{I = \frac{22}{6.83} = 3.22A}$$

$\therefore V_x = IR$

$= 3.22 \times 1$

$\boxed{V_x = 3.22V}$

b)



Sol) Let V_B be at 0

$\therefore$ Applying nodal analysis at A,

$$\frac{V_A - 2 - 0}{1/2} + \frac{V_A - 0}{1/4} + \frac{V_A - V_C}{1} = 0$$

$$\Rightarrow 2V_A - 4 + 4V_A + V_A - V_C = 0$$

$$\Rightarrow \boxed{7V_A - V_C = 4} \quad -(1)$$

Applying nodal analysis at C

$$\frac{V_C - V_A}{1} + V_2 + \frac{V_C - 0}{1} = 0$$

$$\Rightarrow 2V_C - V_A + V_2 = 0$$

$V_2 = V_A$

$2V_C - V_A + V_2 = 0$

$\Rightarrow \boxed{V_C = 0}$

$\therefore V_A = \frac{4}{7}$

$\therefore \boxed{V_1 = 2V}$

$V_2 = V_A - V_B$

$\boxed{V_2 = \frac{4}{7}V}$

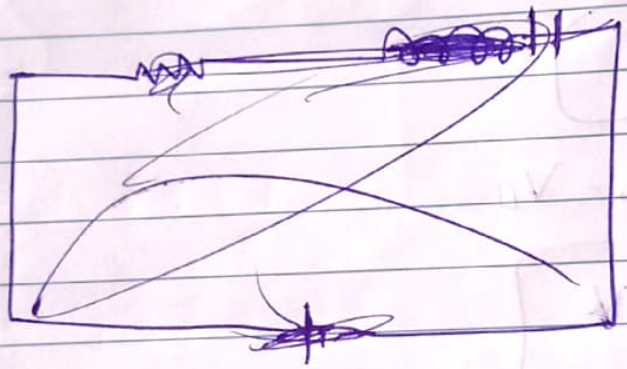
$V_3 = V_C - V_B$

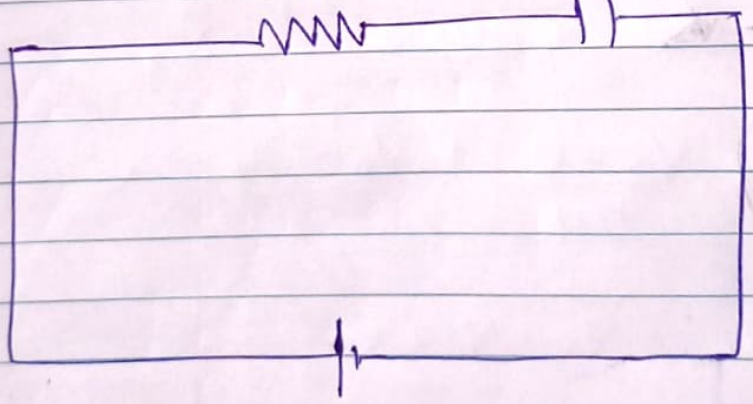
$\boxed{V_3 = 0}$

Q3 a) Z_1 ⇒

For Z_1, $\cos\phi = \frac{1}{2}$ Lagging

$P = 100W$ $\phi = 60°$





$P = V_1 I_1 \cos\phi$

$\Rightarrow 100 = 230 \times I \times \frac{1}{2}$

$\Rightarrow \boxed{I = \frac{20}{23} A}$

$\therefore V = IZ$

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$\Rightarrow Z = \frac{V}{I}$

$= \frac{230}{20} \times 23$

$= 264.5$

$Z_1 = 264.5$

$Z_1 = 264.5 \angle -60°$

For Z_2, $\cos\phi = \frac{3}{5}$, $P = 60$

$P = VI\cos\phi$

$\Rightarrow 60 = \frac{230}{5} \times I \times \frac{6}{10}$

$\Rightarrow I = \frac{10}{23}$

$Z_2 = \frac{230}{10} \times 23 =$

$Z_2 = 529\Omega$

$Z_2 = 529 \angle 53.13°$

$Z_{eff} = Z_1 + Z_2$

$= 264.5\left(-\frac{1}{2} + j\frac{\sqrt{3}}{2}\right) + 529\left(\frac{3}{5} + j\frac{4}{5}\right)$

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$= 449.65 + 200.31 - 203.14j - 194.1j$

$Z = \sqrt{202,185.1225 + 41265.85}$

$= 489$

$P = \frac{V^2}{Z} = \frac{230 \times 230 \times 0.918}{489.76}$

$R_{eq} = R_1 + R_2$

$= 132 + 318$

$= 450\Omega$

$X_C = 229 - 414$

$= -195.\Omega$

$Z = \sqrt{R^2 + X^2}$

$= \sqrt{450 \times 450 + 195 \times 195}$

$Z = 490$

(i) Total power absorbed

$= I^2R$

$= 0.472 \times 450$

$=$

$= 99\,W$

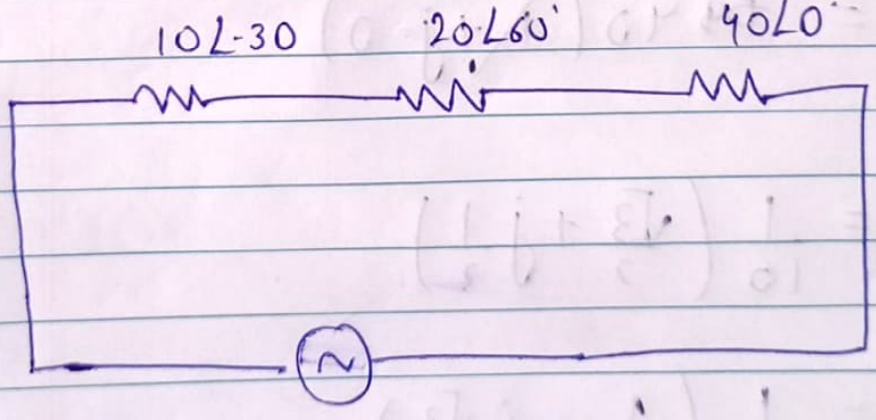
$\cos\phi = \frac{R}{Z} = \frac{450}{490} =$ 0.92 lead

(iii) $X_{net_{(C)}} = X_{net_{(L)}}$

∴ Reactance of required series pure inductive coil is 195 Ω

$Z = 195\,\Omega$

Q4) (b)



$Z_1 = 10\angle -30$

$= 10(\cos -30° + j\sin(-30°))$

$=$

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$Z_1 = 10\angle -30^\circ$ $\quad Z_2 = 20\angle 60^\circ$

$Y_1 = \frac{1}{10}\angle 30^\circ$ $\quad Y_2 = \frac{1}{20}\angle -60^\circ$

$Z_3 = 40\angle 0^\circ$

$Y_3 = \frac{1}{40}\angle 0^\circ$

$Z_1 = 10\left(\frac{\sqrt{3}}{2} - j\frac{1}{2}\right)$

$Z_2 = 20\left(\frac{1}{2} + j\frac{\sqrt{3}}{2}\right)$

$Z_3 = 40(1 + j\cdot 0)$

$Y_1 = \frac{1}{10}\left(\frac{\sqrt{3}}{2} + j\frac{1}{2}\right)$

$Y_2 = \frac{1}{20}\left(\frac{1}{2} - j\frac{\sqrt{3}}{2}\right)$

$Y_3 = \frac{1}{40}(1 + j\cdot 0)$

$Y_{net} = 0.0865 + 0.025 + 0.025 + j(0.05 - 0.0432)$

$= 0.1365 + j(-0.0067)$

$Y_{net} = 0.168$ Simen

(ii) $Z_{net} = (8.66 + 10 + 40) + j(-5 + 17.32)$

$= 58.66 + 12.32j$

$Z_{net} = 59.93$

(iii) Power consumed

$= \frac{V^2}{121} \cos\phi$

$= \frac{(230)^2}{59.93} \times 0.9788$

Power factor, $\cos\phi = \frac{58.66}{59.93}$

$= 0.9788$ lead

Power consumed

$= \frac{230 \times 230}{59.93} \times 0.9788$

$= 863.98$ W