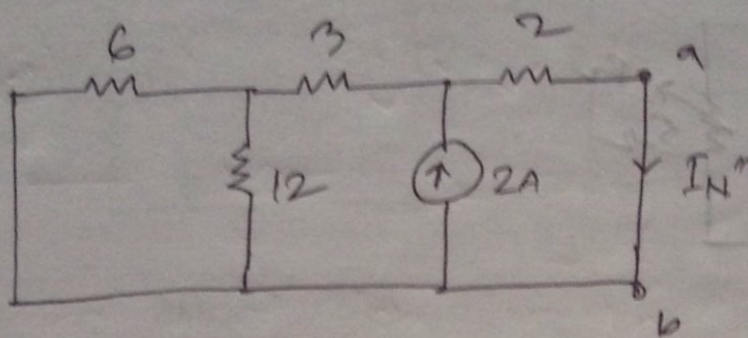
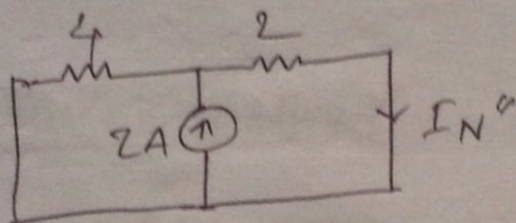


When 2A is active



$$(12 \parallel 6) + 3 = 4 \Omega$$

The circuit can be ~~be~~ reduced to -



$$\therefore \downarrow I_N'' = I_{2\Omega} = \frac{4 \times 2}{4 + 2} = 1.33 \text{ A} \quad \left( \frac{4}{3} \right)$$

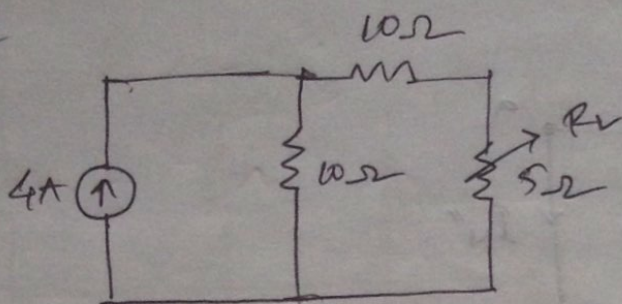
$$\therefore I_N = \downarrow I_N' + \downarrow I_N'' = 0.89 + 1.33 = 2.22 \text{ A} \quad \left( \frac{20}{9} \right)$$

$$\therefore V_{Th} = I_N R_{Th} = 2.22 \times 9 = 19.98 \text{ V} \approx 20 \text{ V}$$

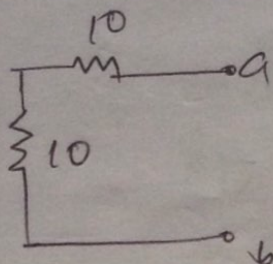


# Exercise

4.33

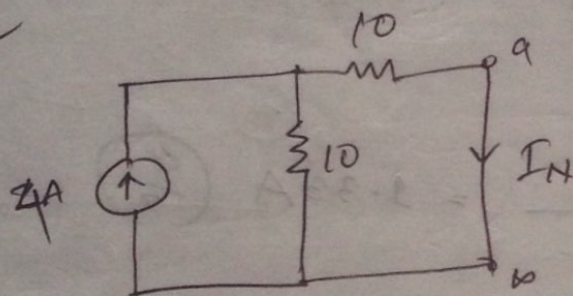


$R_{Th}$



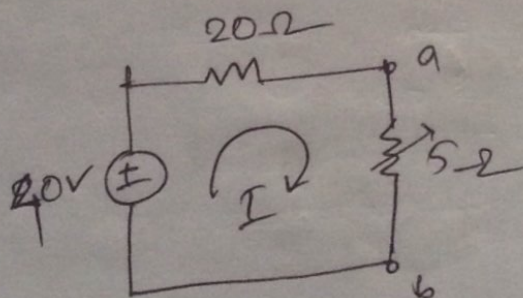
$$R_{Th} = 10 + 10 = 20\Omega$$

$V_{Th}$



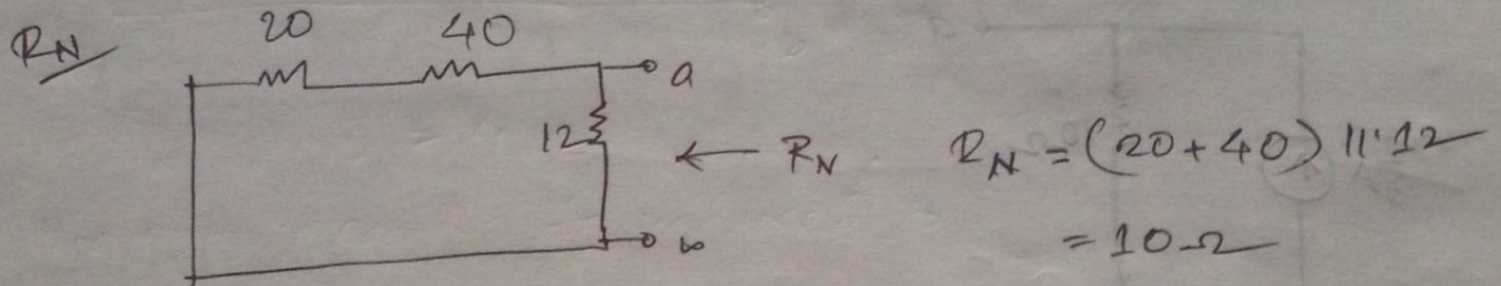
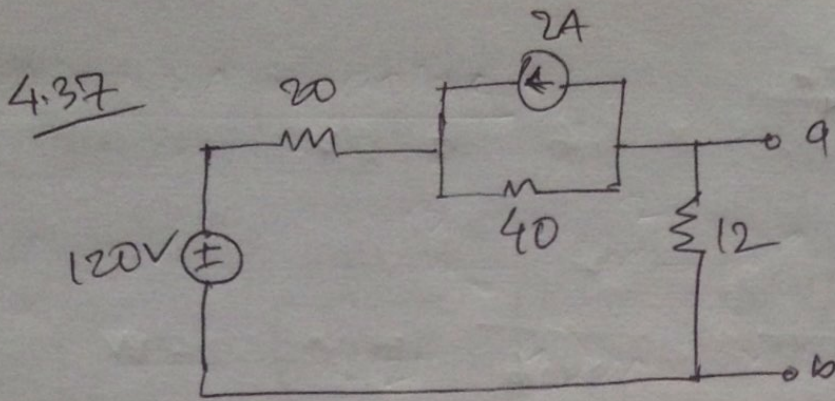
$$I_N = I_{10} = \frac{10}{10+10} \times 4 = 2A$$

$$\therefore V_{Th} = I_N R_{Th} = 2 \times 20 = 40V$$

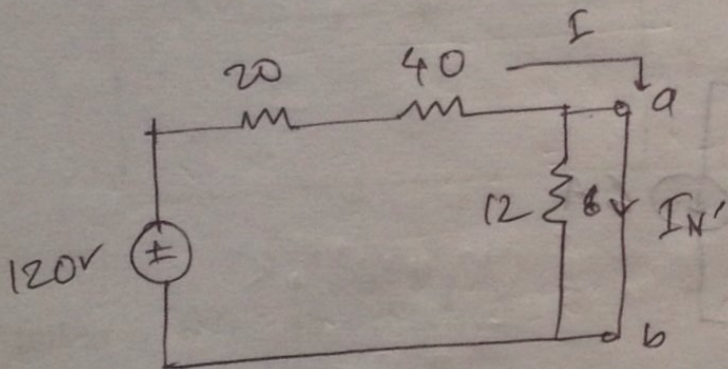


$$I_{5\Omega} = I = \frac{40}{20+5} = 1.6A$$





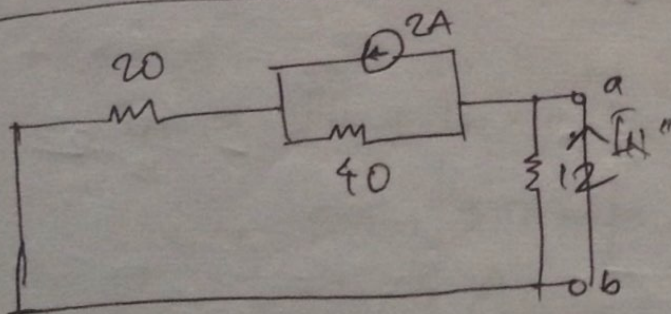
$I_N$  when 120V is active



Current won't flow through  $12 \Omega$

$$\downarrow I_N' = I = \frac{120}{20 + 40} = 2A$$

when 2A is active

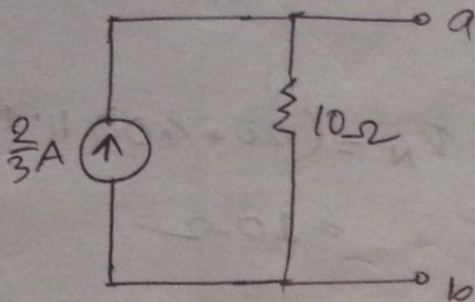


current won't flow through  $12 \Omega$ .

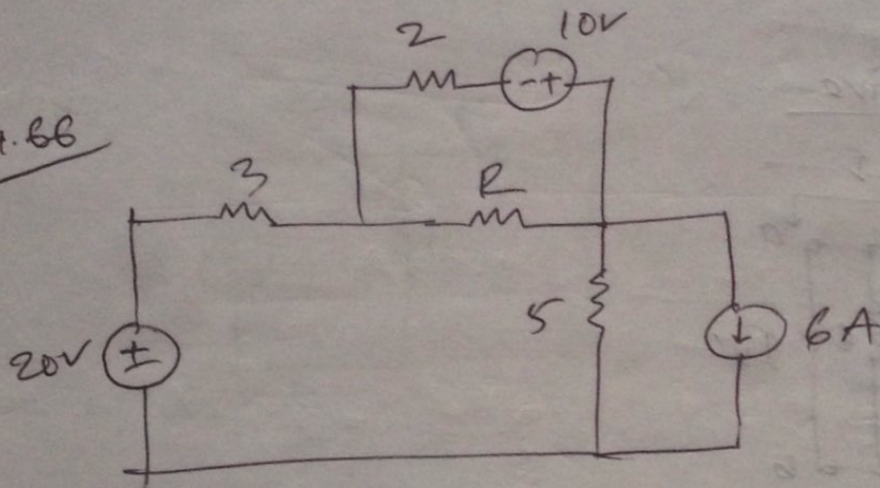
$$\uparrow I_N'' = I_{20\Omega} = \frac{40 \times 2}{40 + 20} = \frac{4}{3} A$$



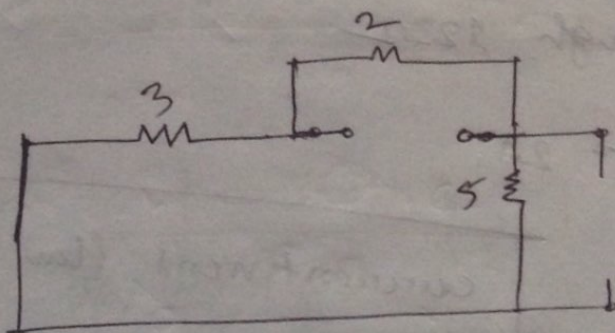
$$\begin{aligned}
 \therefore \downarrow I_N &= \downarrow I_{N'} - \uparrow I_{N''} \\
 &= 2 - \frac{4}{3} \\
 &= \frac{2}{3} \text{ A}
 \end{aligned}$$



4.66



$R_{Th}$

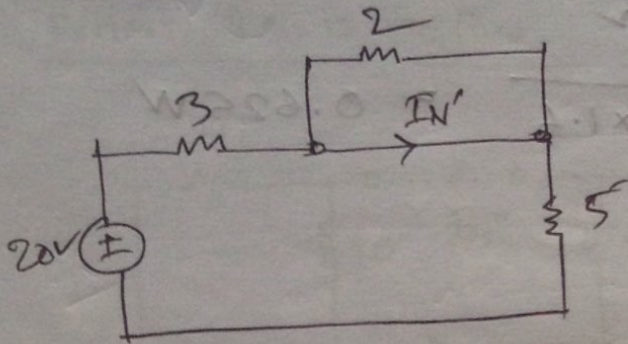


$$\begin{aligned}
 R_{Th} &= (5+3) \parallel 2 \\
 &= 1.6 \Omega
 \end{aligned}$$



$I_N$

When 20V is active

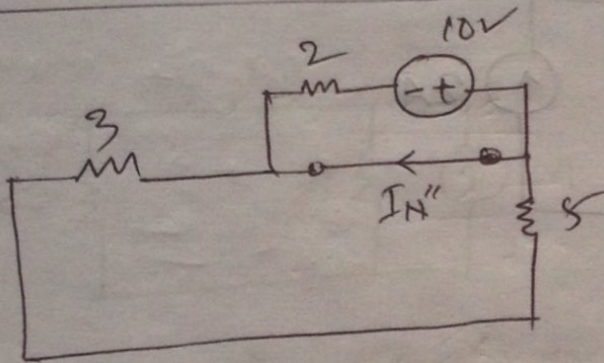


Current won't flow through

2-2

$$\therefore \vec{I}_{N'} = I = \frac{20}{3+5} = 2.5A$$

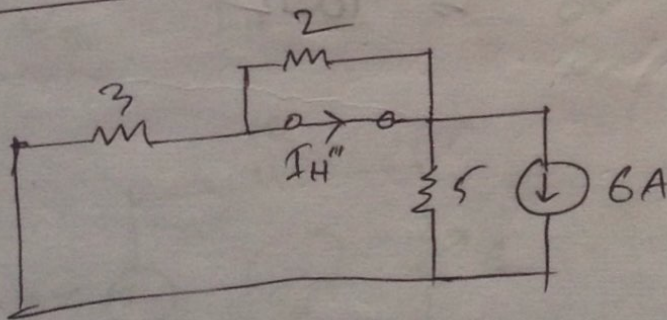
When 10V is active



Current won't flow through  
5-2 and 3-2.

$$\therefore \vec{I}_{N''} = \frac{10}{2} = 5A$$

When 6A is active



Current won't flow  
through 2-2.

$$\therefore \vec{I}_{N'''} = I_{3\Omega} = \frac{5 \times 6}{3+5} = 3.75A$$

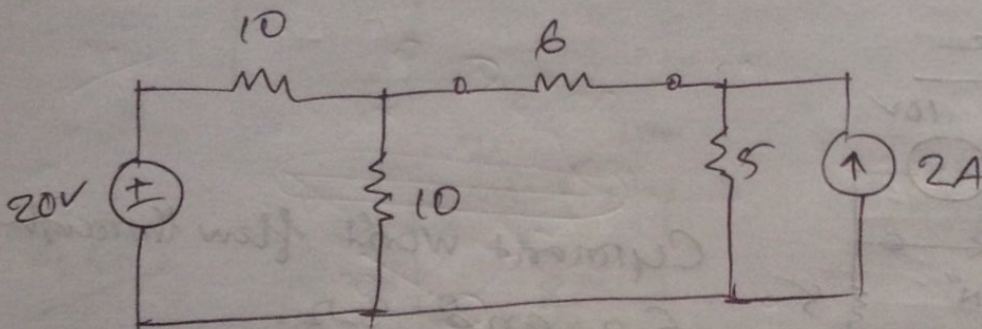
$$\begin{aligned} \therefore I_N &= \vec{I}_{N'} + \vec{I}_{N'''} - \vec{I}_{N''} \\ &= 2.5 + 3.75 - 5 \\ \therefore \vec{I}_N &= 1.25A \end{aligned}$$



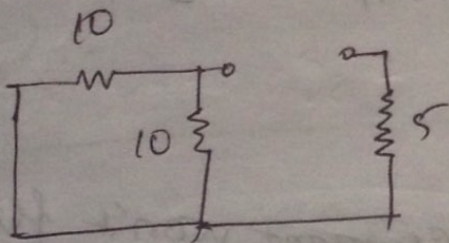
$$\therefore V_{Th} = I_H R_{Th} = 1.25 \times 1.6 = 2V$$

$$P_{max} = \frac{V_{Th}^2}{4R_{Th}} = \frac{2^2}{4 \times 1.6} = 0.625W$$

4.43



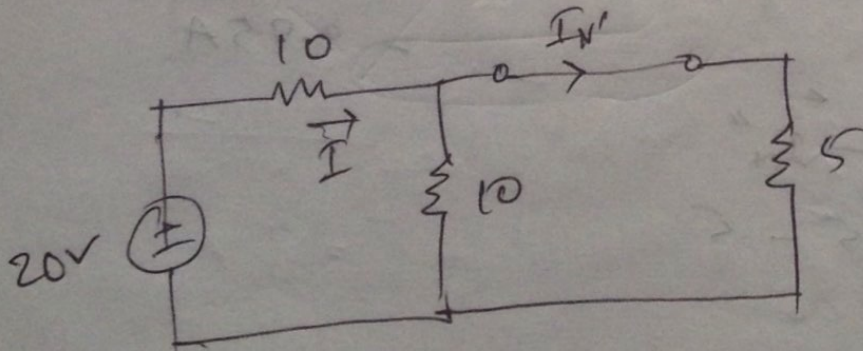
$R_{Th}$



$$R_{Th} = (10 \parallel 10) + 5 = 10 \Omega$$

$V_{Th}$

When 20V is active



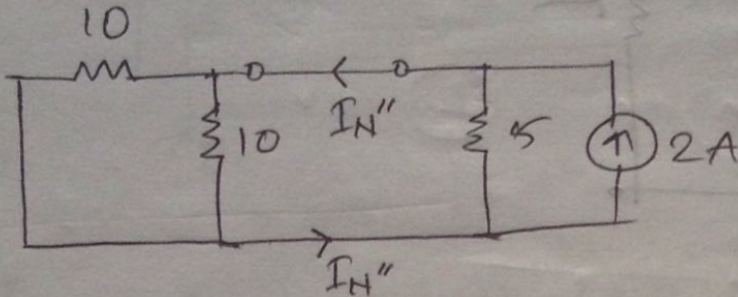
$$R_{eq} = (10 \parallel 5) + 10 = \frac{40}{3} \Omega$$

$$\therefore I = \frac{20}{\frac{40}{3}} = 1.5A$$

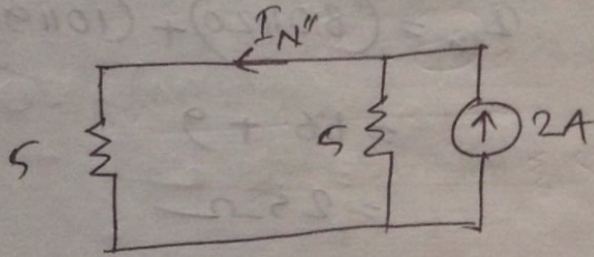


$$\therefore \vec{I_H'} = I_{5-2} = \frac{10 \times 1.5}{10+5} = 1A$$

When 2A is active



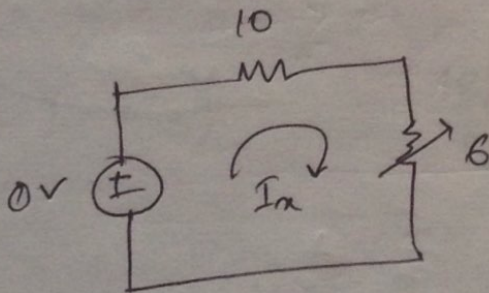
$$10 \parallel 10 = 5\Omega$$



$$I_H'' = \frac{5 \times 2}{5+5} = 1A$$

$$\therefore I_H = \vec{I_H'} - \vec{I_H''} = 1 - 1 = 0A$$

$$\therefore V_{th} = I_H R_{th} = 0V$$

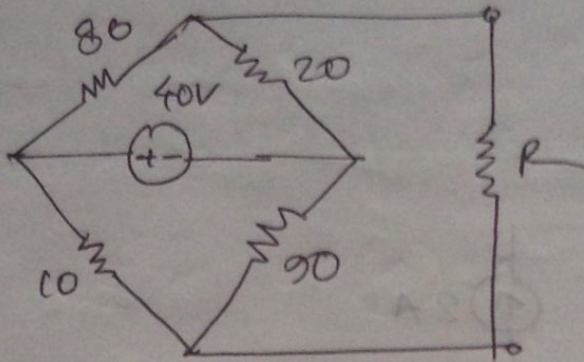


$$I_x = \frac{0}{10+6} = 0A$$

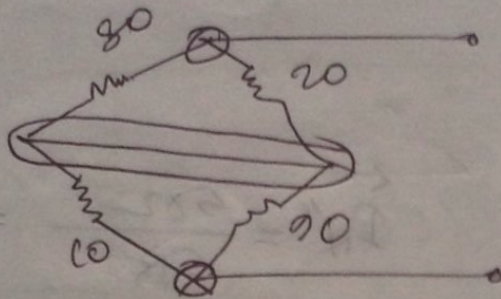


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3b



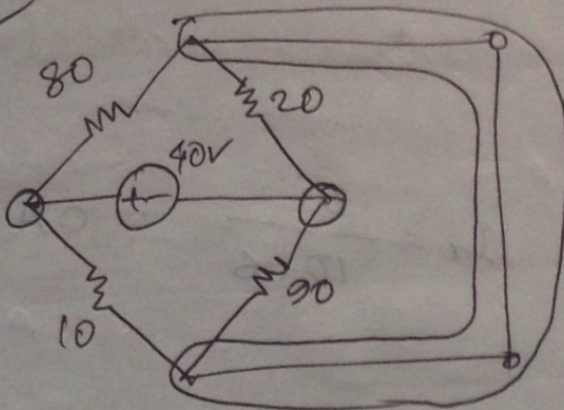
$R_{th}$



$$\begin{aligned} R_{th} &= (80 \parallel 20) + (10 \parallel 90) \\ &= 16 + 9 \\ &= 25 \Omega \end{aligned}$$

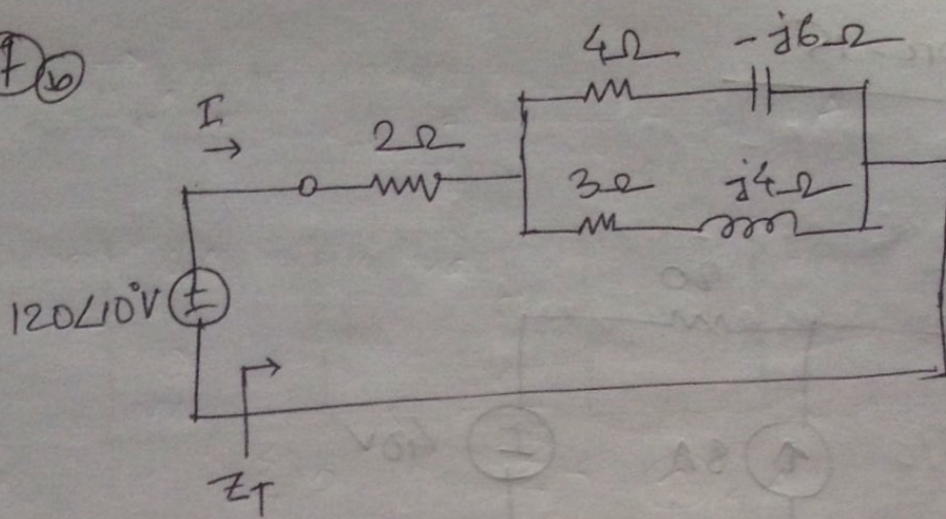
$R$  must be  $25 \Omega$  for maximum power.

$V_{th}$





7b



$$Z_T = 2 + \{ (4 - j6) \parallel (3 + j4) \}$$

$$= 2 + \frac{(4 - j6)(3 + j4)}{4 - j6 + 3 + j4}$$

$$= 2 + \frac{36 - 2j}{7 - j2}$$

$$= 2 + 4.83 + j1.09$$

$$\therefore Z_T = 6.83 + j1.09$$

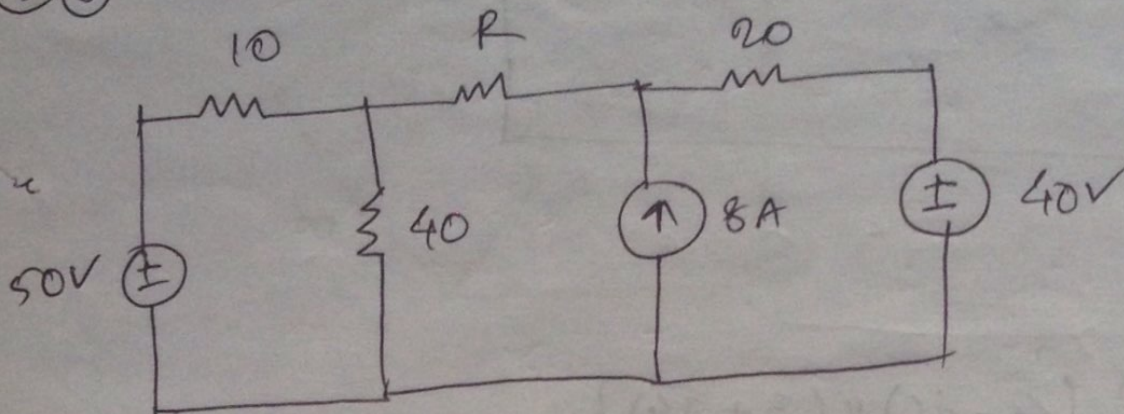
$$= 6.92 \angle 9.1^\circ$$

$$\therefore I = \frac{V}{Z_T} = \frac{120 \angle 10^\circ}{6.92 \angle 9.1^\circ} = 17.35 \angle 0.9^\circ \quad (\text{Ans})$$

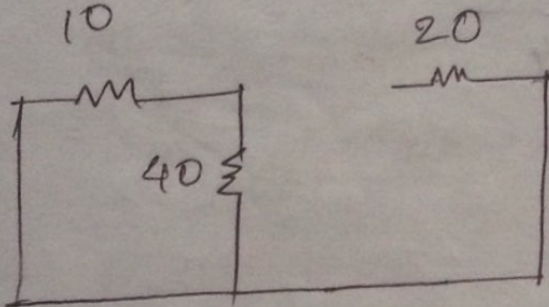


6pr-15

36



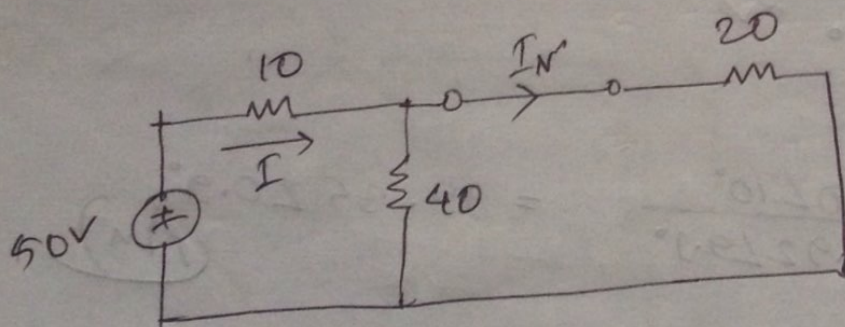
$R_{th}$



$$R_{th} = (10 \parallel 40) + 20$$
$$= 28 \Omega$$

$V_{th}$

When 50V is active



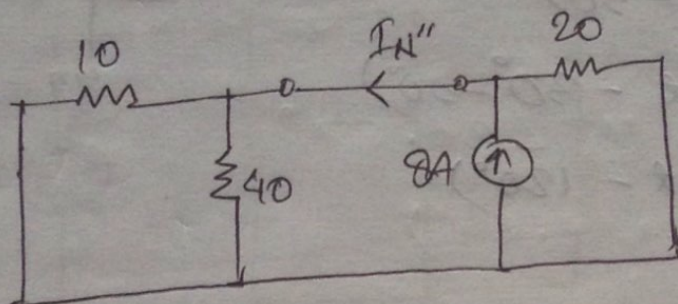
$$R_{eq} = (20 \parallel 40) + 10$$
$$= \frac{70}{3}$$

$$\therefore I = \frac{50}{\frac{70}{3}} = \frac{15}{7} \text{ A}$$

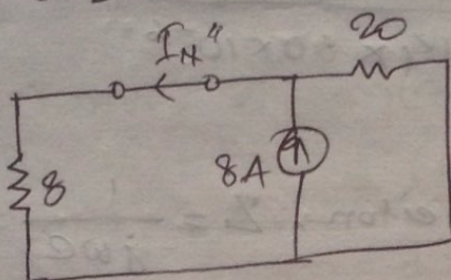
$$\therefore I_{N'} = I_{20\Omega} = \frac{40 \times \frac{15}{7}}{40 + 20} = \frac{10}{7} \text{ A}$$



When 8A is active

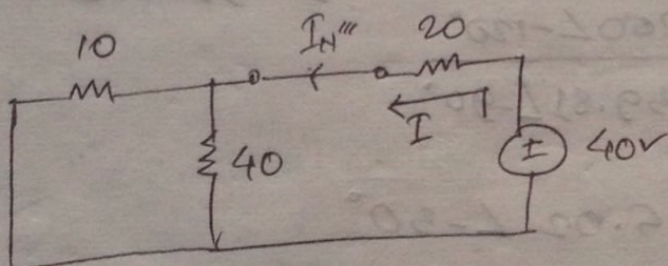


$$10 \parallel 40 = 8 \Omega$$



$$\therefore I_N'' = \frac{20 \times 8}{20 + 8} = \frac{40}{7} A$$

When 40V is active



$$R_{eq} = (10 \parallel 40) + 20 = 28 \Omega$$

$$\therefore I = \frac{40}{28} = \frac{10}{7} A$$

$$\therefore I_N''' = I = \frac{10}{7} A$$

$$\begin{aligned} \therefore I_N &= I_N'' + I_N''' - I_N' \\ &= \frac{10}{7} + \frac{40}{7} - \frac{10}{7} \end{aligned}$$

$$\therefore I_N = \frac{40}{7} A$$

$$\begin{aligned} \therefore V_{Th} &= I_N \times R_{Th} \\ &= \frac{40}{7} \times 28 \\ &= 160V \end{aligned}$$

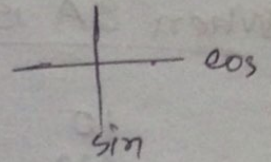
$$P_{max} = \frac{V_{Th}^2}{4R_{Th}} = \frac{228.57V}{}$$

Ans.



7) a)

$$\begin{aligned} V &= 200 \sin(314t - 30^\circ) \\ &= 200 \cos(314t - 30^\circ - 90^\circ) \\ &= 200 \cos(314t - 120^\circ) \end{aligned}$$



$$\omega = 314 \text{ rad/s}$$

$$\text{Reactance} = \frac{1}{\omega C} = \frac{1}{314 \times 80 \times 10^{-6}} = 39.81 \Omega$$

$$\text{Impedance of } 80 \mu\text{F Capacitor, } Z = \frac{1}{j\omega C}$$

$$\begin{aligned} &= -j39.81 \Omega \\ &= 39.81 \angle -90^\circ \end{aligned}$$

$$\therefore I = \frac{V}{Z} = \frac{200 \angle -120^\circ}{39.81 \angle -90^\circ}$$

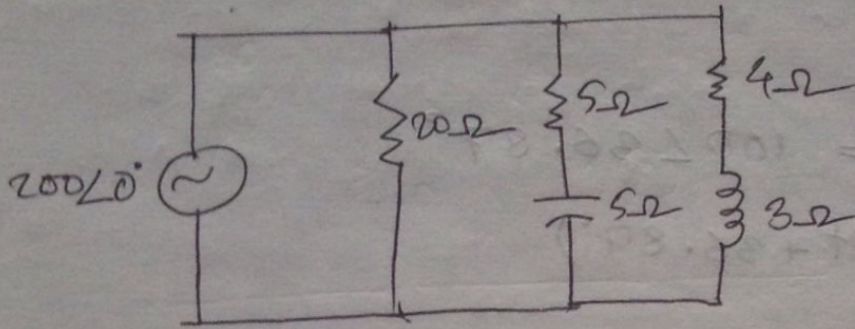
$$= 5.02 \angle -30^\circ$$

$$= 5.02 \cos(314t - 30^\circ)$$

(Ans)



6



~~Ques 47~~

$$\begin{aligned} \text{Total Impedance, } Z_T &= \{(4+3) \parallel (5+5)\} \parallel 20 \\ &= (7 \parallel 10) \parallel 20 \\ &= \frac{140}{41} \Omega = \frac{140}{41} \angle 0^\circ \end{aligned}$$

$$\text{Total Admittance, } Y = \frac{1}{Z_T} = \frac{41}{140} S$$

$$\therefore \text{Total current} = \frac{200\angle 0^\circ}{\frac{140}{41} \angle 0^\circ} = 58.57 \angle 0^\circ$$

Power supplied by source,

$$P = \frac{V^2}{Z_T} = \frac{(200\angle 0^\circ)^2}{\frac{140}{41} \angle 0^\circ} = 11.71 \text{ kW} \quad (\text{Ans})$$



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⑦②

$$V = 80 + j60^\circ = 100 \angle 36.87^\circ$$

$$= 100 \cos(\omega t + 36.87^\circ)$$

$$I = -4 + j10^\circ = 2\sqrt{29} \angle 111.80^\circ$$

$$= 2\sqrt{29} \cos(\omega t + 111.80^\circ)$$

$$\text{Impedance, } Z_T = \frac{V}{I} = 9.28 \angle -74.93^\circ$$

$$P = \frac{V^2}{Z_T} = 1077 \angle 148.67^\circ \text{ W}$$