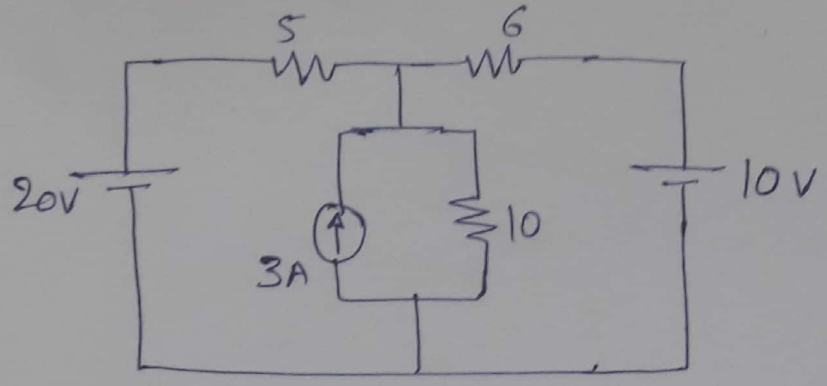
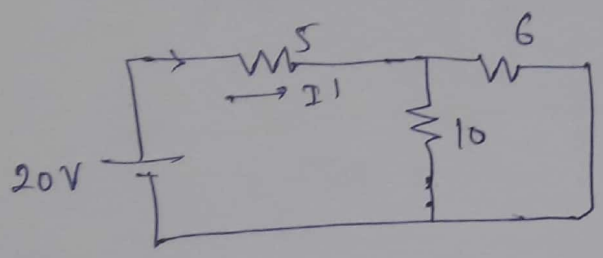
BEEE TEST-1 solution - Feb 2018

SEM-I [Date of Exam - 28.02.2018]

Q1. SPT. $I_{5\Omega} = ?$



Soln: i) Consider 20V source only:

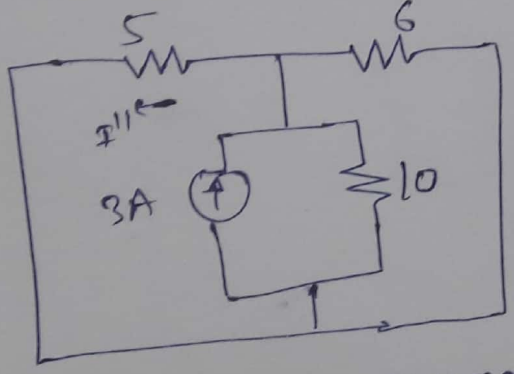


~~using CDR~~

$$I' = \frac{20}{5+(6\|10)} = \frac{20}{5+3.75}$$

$$I' = 2.286\ A\ (\rightarrow)$$ (02M)

ii) Consider 3A source only:

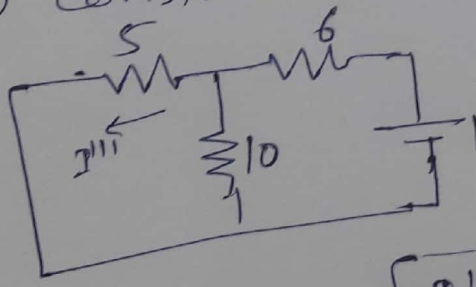


using CDR

$$I'' = \frac{3 \times (10\|6)}{5+3.75}$$

$$I'' = 1.286\ A\ (\leftarrow)$$ (02M)

iii) Consider 10V source only:



$$I_T = \frac{10}{6+(5\|10)} = \frac{10}{3.33+6}$$

$$\Rightarrow I_T = 1.0718\ A$$

using CDR:

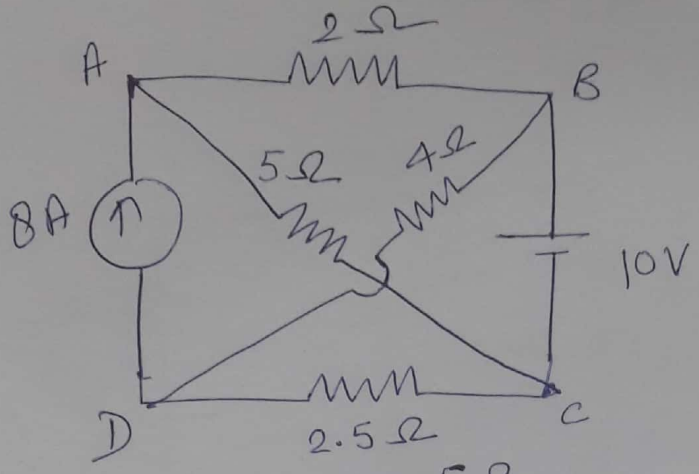
$$I''' = \frac{1.0718 \times 10}{10+5} = 0.714\ A\ (\leftarrow)$$ (02M)

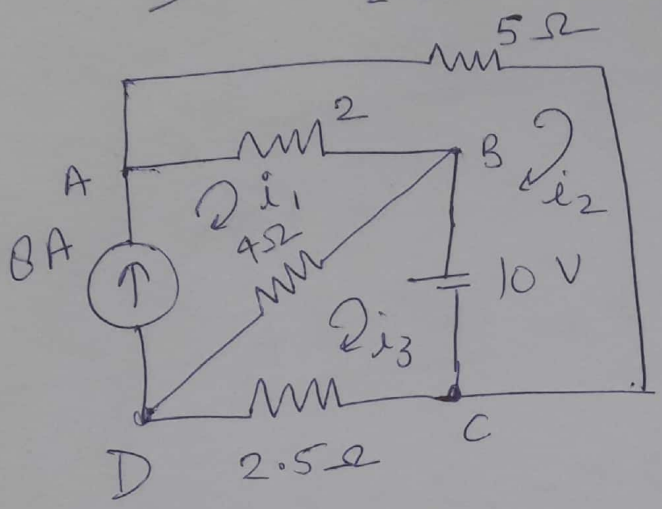
using SPT:

$$I_{5\Omega} = I' - I'' - I'''$$

$$= 2.286 - 1.286 - 0.7114 = 0.286\ A\ (\rightarrow)$$ (01M)

Q2





$i_1 = 8\,A$

Loop 1 ; $-2(8-i_2) - 4(8-i_3) = 0$

$2i_2 + 4i_3 = 48$ —— 2M

Loop 2 ; $-2(i_2-8) - 5i_2 + 10 = 0$

$-7i_2 = -26$

$i_2 = \frac{26}{7} = 3.714\,A$ —— 2M

Loop 3 ; $-4(i_3-8) - 10 - 2.5\,i_3 = 0$

$-6.5\,i_3 = -22$ —— 2M

$i_3 = 3.384\,A$

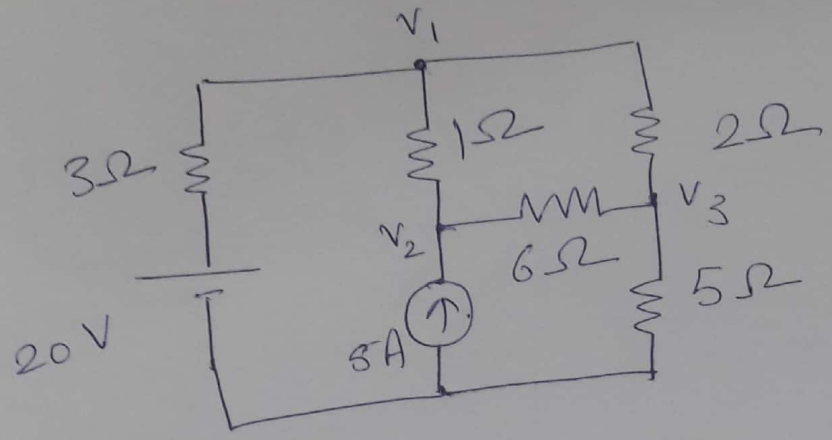
$I_{2\Omega} = i_1 - i_2 = 8 - 3.714 = 4.286\,A$

$I_{5\Omega} = i_2 = 3.714\,A$

$I_{4\Omega} = i_1 - i_3 = 8 - 3.384 = 4.615\,A$

$I_{2.5\Omega} = i_3 = 3.384\,A$ } 4M

Q2 (OR)



KCL at node 1

$$\frac{V_1-20}{3}+\frac{V_1-V_2}{1}+\frac{V_1-V_3}{2}=0$$

$$\Rightarrow 1.83V_1 - V_2 - 0.5V_3 = 6.67 \quad \text{—— (1)} \quad \text{—— 2M}$$

KCL at node 2

$$\frac{V_2-V_1}{1}+\frac{V_2-V_3}{6}=5$$

$$-V_1 + 1.17V_2 - 0.17V_3 = 5 \quad \text{—— (2)}$$

—— 2M

KCL at node 3

$$\frac{V_3-V_2}{6}+\frac{V_3}{5}+\frac{V_3-V_2}{6}=0$$

$$-0.5V_1 - 0.17V_2 + 0.87V_3 = 0 \quad \text{—— (3)} \quad \text{—— 2M}$$

Solving (1), (2), (3) $\Rightarrow$

$V_1 = 23.82V$ —— 3M

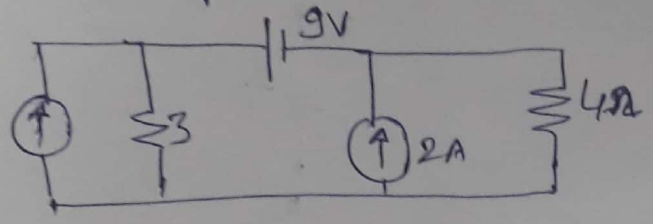
$V_2 = 27.4V$

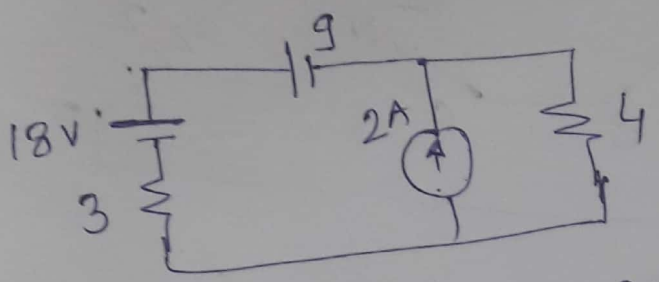
$V_3 = 19.04V$ —— 1M

$$I_{6\Omega} = \frac{V_2-V_3}{6} = \frac{27.4-19.04}{6} = 1.39A$$

Q3

Find current thro' 4Ω resist.

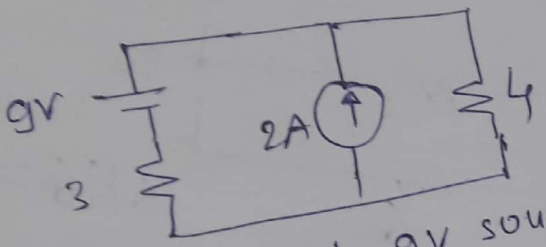




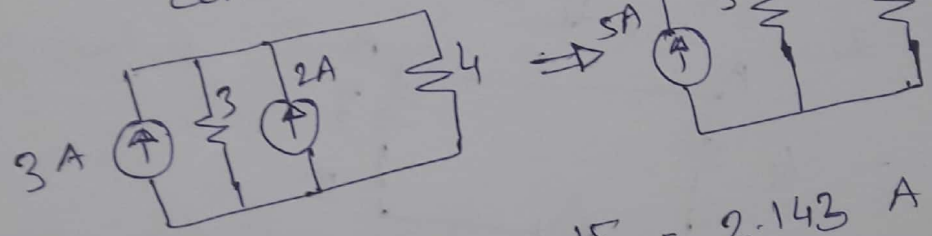
02M

Combining 9V & 18V

01M



convert 9V source into C.S



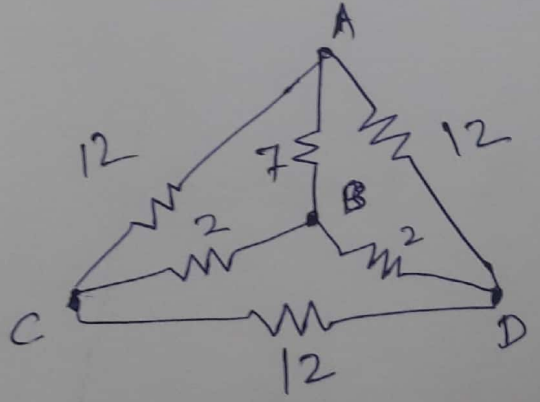
02M

01M

$$I_{4\Omega} = \frac{5 \times 3}{7} = \frac{15}{7} = 2.143 \text{ A}$$

OR

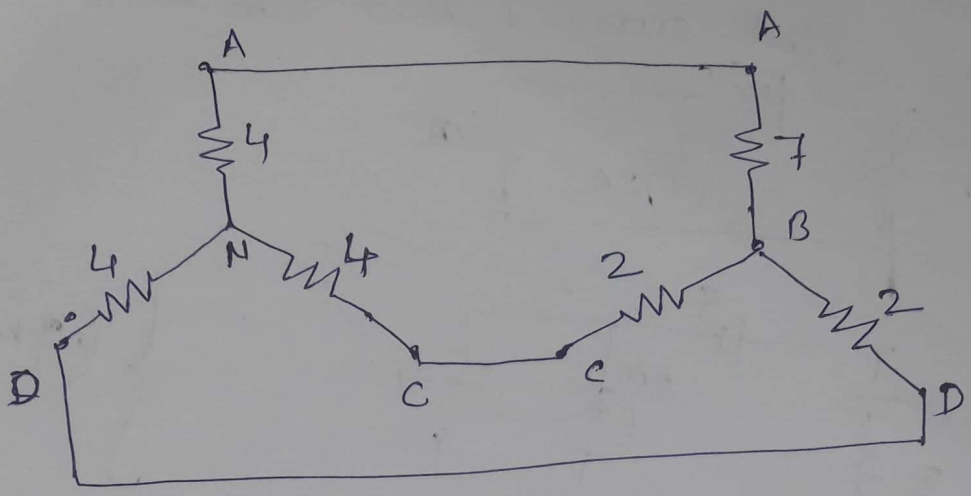
Q3

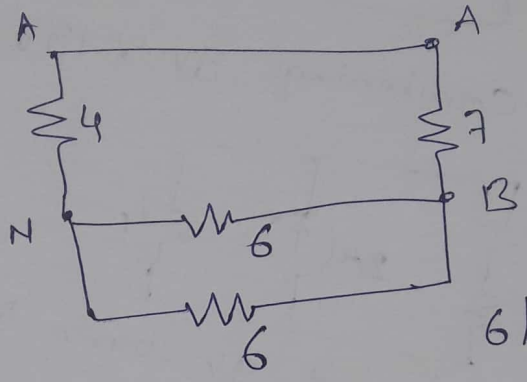


$R_{AB} = ?$

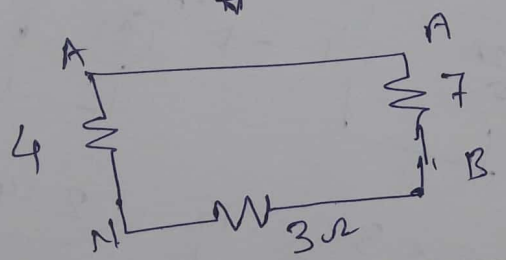
Converting outer Delta ACD into star.

P.T.O.





$6||6 = 3\Omega$



$R_{AB} = 7||7 = 3.5\Omega$

Pack 5

Sol 4:- Given $v = 325 \sin 314t$

$v = V_m \sin \omega t$

$V_m = 325$ volt

RMS value $V_{(RMS)} = \frac{V_m}{\sqrt{2}} = \frac{325}{1.414} = 230\ V$

$\omega = 314$

$2\pi f = 314$

$\Rightarrow f = 50\ Hz$

Now $i = 14.14 \sin(314t - 60^\circ)$

comparing $i = I_m \sin(\omega t - \phi)$

$\Rightarrow I_m = 14.14$

RMS value $I_{(RMS)} = I_m/\sqrt{2} = \frac{14.14}{1.414}$

$= 10$ Amp.

Power factor Angle $\phi = 60^\circ$

Power factor, $\cos\phi = \cos 60^\circ$

$= 0.5$ lagging

Power consumed $P = VI\cos\phi$

$= 230 \times 10 \times 0.5$ ——— 3M

$= 1150$ watts

Impedance $Z = \frac{V}{I} = \frac{230\angle 0^\circ}{10\angle -60^\circ}$

$= 23\angle 60^\circ\ \Omega$

In complex form $Z = 23(\cos 60^\circ + j \sin 60^\circ$

$= 23 \times 0.5 + j\,23 \times 0.866$

$= 11.5 + j\,19.918\ \Omega$

$Z = R + jX_L$

$\Rightarrow R = 11.5\ \Omega$

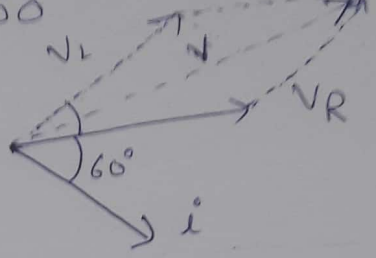
$X_L = 20.99\ \Omega$ (19.918)

$\omega L = 20.99$ (19.918) Ω

$2\pi f L = 20.99$ (19.918) Ω

$\Rightarrow L = \dfrac{19.918}{2 \times 3.14 \times 50} = 63.433$ mH $= 78.21$ mH — 4M

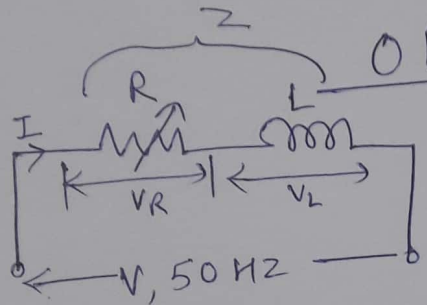
Phasor



— 3M

Sol:-

OR



Given $L = 100$ mH

$X_L = \omega L = 2\pi f L = 2 \times 3.14 \times 50 \times 100 \times 10^{-3}$

$= 31.4\ \Omega$

condition is $V_L = \dfrac{1}{2} V$ — 2M

$V_L = I X_L$

$V = IZ = I\sqrt{R^2 + X_L^2}$

$V_L = \dfrac{V}{2}$

$I X_L = \dfrac{I}{2}\sqrt{R^2 + X_L^2}$

$\Rightarrow \sqrt{R^2 + X_L^2} = 2X_L = 2 \times 31.4\ \Omega$

$= 62.8\ \Omega$

$$R^2 + X_L^2 = (62.8)^2$$

$$R^2 = (62.8)^2 - (31.4)^2$$

$$R^2 = 3943.8 - 985.9$$

$$\Rightarrow R = 54.4\ \Omega$$

} 8M

Q5:

$$V(t) = \begin{cases} \frac{30}{T}t & ; \quad 0 < t < T/3 \\ 10\,V & ; \quad \frac{T}{3} < t < \frac{2T}{3} \\ -\frac{30t}{T} + 30 & ; \quad \frac{2T}{3} < t < T \end{cases}$$ } 01M

(i) $V_{avg} = \frac{1}{T}\int_0^T V(t)\,dt$

$$V_{avg} = \frac{1}{T}\left[\int_0^{T/3} \frac{30t}{T}\,dt + \int_{T/3}^{2T/3} 10\,dt + \int_{2T/3}^{T} \left(\frac{-30t}{T} + 30\right) dt\right]$$ } 02M

By solving:

$$V_{avg} = 6.33\ V$$ } 01M

(ii) $V_{rms} = \sqrt{\frac{1}{T}\int_0^T V(t)^2\,dt}$ } 01M

$$= \sqrt{\frac{1}{T}\left[\int_0^{T/3} \frac{30t}{T}\,dt + \int_{T/3}^{2T/3} 10^2\,dt + \int_{2T/3}^{T} \left(\frac{-30}{T} + 30\right) dt\right]}$$ } 03M

By solving:-

$$\Rightarrow V_{rms} = 7.45\ V$$ } 01M

(a) Form factor = $\frac{\text{RMS value}}{\text{Average value}}$

(b) Peak/Crest factor = $\frac{\text{peak value}}{\text{RMS value}}$ } 02.

Q6.

(Mrs Savita Raut)
EXTC

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BTRx