ST. FRANCIS INSTITUTE OF TECHNOLOGY

FIRST YEAR ENGINEERING

BASIC ELECTRICAL ENGINEERING QUESTION PAPER & SOLUTION

IAT I OCTOBER 2019

BEE FACULTIES

St. Francis Institute of Technology (Engg. College)
Internal Assessment Test-I
Academic Year: 2019-2020

Branch: ALL Division: ALL	Year: F.E Semester: I
Subject: Basic Electrical Engineering	Time: 10:30 am -11:30 am
Date: 1/10/2019	No. of Pages: 02
Marks: 20 Marks	

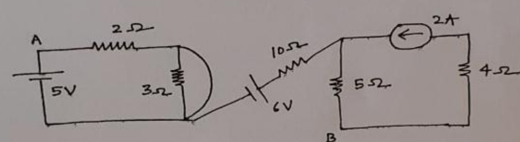
Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover of the Answer Book, which is provided for their use.

Note the following instructions.

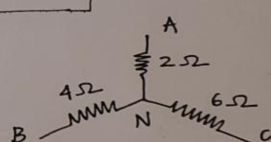
1. All questions are compulsory.
2. Draw neat diagrams wherever necessary.
3. Write everything in ink (no pencil) only.
4. Assume data, if missing, with justification.

Q.1. Attempt any five.

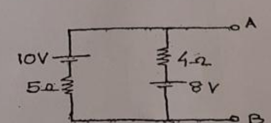
a. Find the potential difference V_{AB} of the given Network — 2M



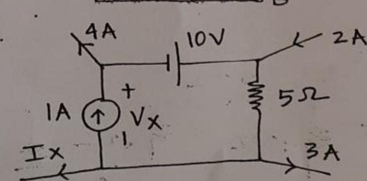
b. Convert given star network to delta network — 2M



c. Convert the given circuit into a current source in parallel with a single resistance between points A and B. — 2M



d. Find I_x and V_x in the circuit. — 2M

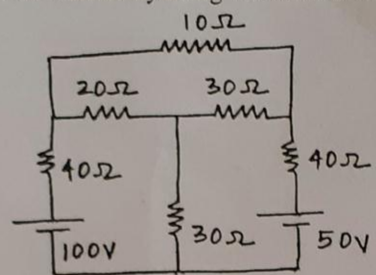


e. State Norton's Theorem and draw its equivalent circuit. Write expression for load current I_L. — 2M

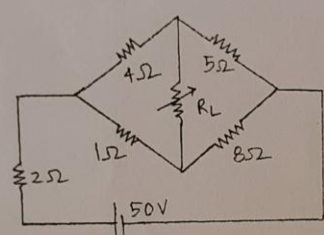
f. An AC, i (t) is given by i(t) = 100sin(200πt). Find peak value, frequency, time period and instantaneous value at t = 7ms. 2M

Q.2. Attempt any one.

a. Find the current through 10 Ω resistor by using Thevenin's Theorem. 5M

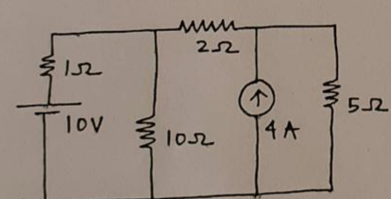


b. Find the value of resistance R_L for maximum power transfer and calculate maximum power. 5M

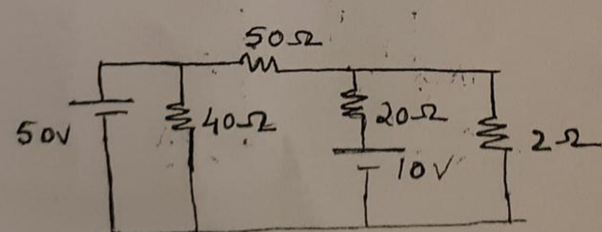


Q.3. Attempt any one.

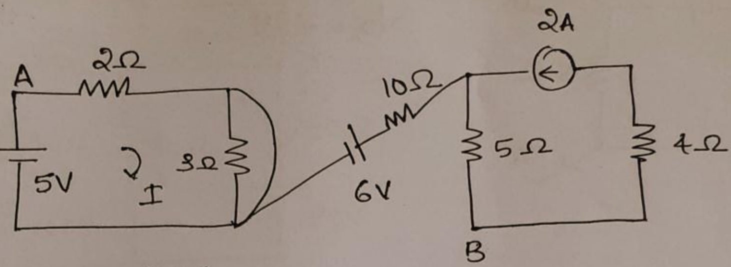
a. Find the value of the current flowing through the 10 Ω resistance using Superposition Theorem. 5M



b. Find the current through 2 Ω resistance using Nodal Analysis. 5M



1. a)



$I = 2.5A.$

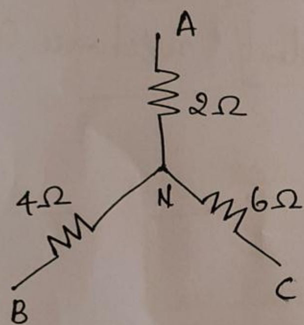
$V_A - 2\times 2.5 + 6 - 2\times 5 - V_B = 0.$

$V_A - 5 + 6 - 10 - V_B = 0$

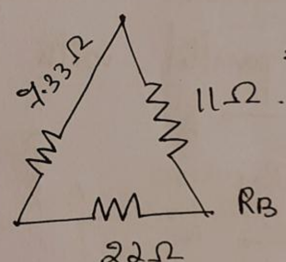
$V_A - V_B - 9 = 0$

$\underline{\underline{V_{AB} = 9V}}$

b)



$\Rightarrow$



$$R_A = \frac{R_1R_2 + R_2R_3 + R_1R_3}{R_1}$$

$$= \frac{8+24+12}{2} = \underline{\underline{22\Omega}}$$

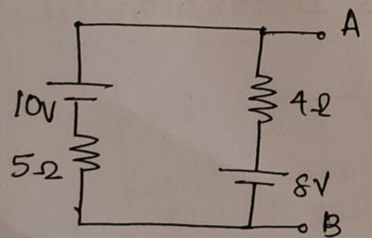
$$R_B = \frac{R_1R_2 + R_2R_3 + R_1R_3}{R_2}$$

$$= \frac{8+24+12}{4} = \underline{\underline{11\Omega.}}$$

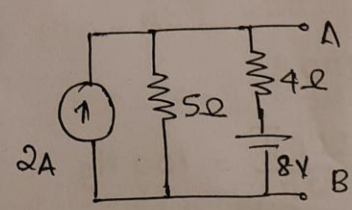
$$R_C = \frac{R_1R_2 + R_2R_3 + R_1R_3}{R_3} = \frac{8+24+12}{6}$$

$$= \underline{\underline{7.33\Omega}}$$

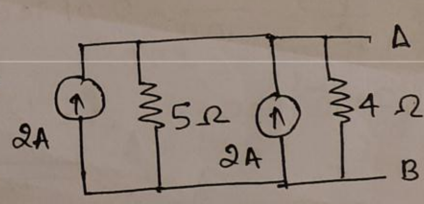
c)



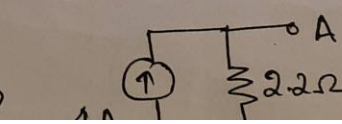
$\Rightarrow$



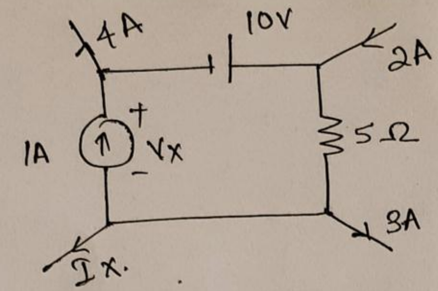
$\Rightarrow$



$\Rightarrow$



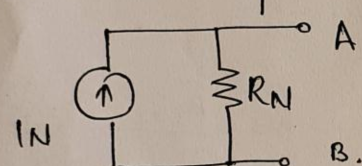
d.



$I_x = -5A$

$V_x = -15V$

e. It is the converse of thevenin's theorem. Norton's theorem states that any complex network between terminals A and B can be replaced with an equivalent current source (IN) which is connected in parallel with equivalent resistance (RN).



equivalent circuit.

$i(t) = 100 \sin 200\pi t.$ $\quad i(t) = I_m \sin \omega t.$

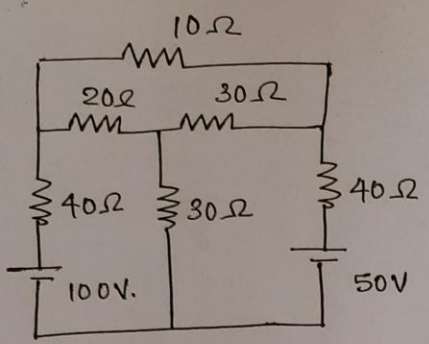
1) $I_m = 100A$

2) $f = \frac{200\pi}{2\pi} = 100 \, Hz.$

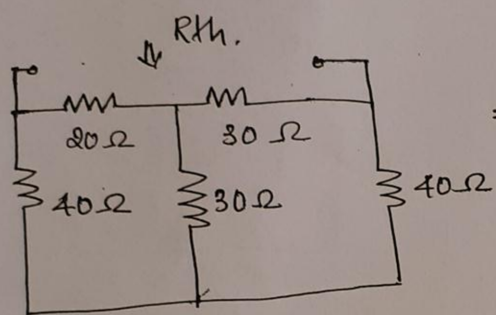
3) $T = \frac{1}{f} = \frac{1}{100} = 0.01 \, sec$

4) $t = 7 \times 10^{-3} \, sec$ $\quad i = -95.1 \, A$

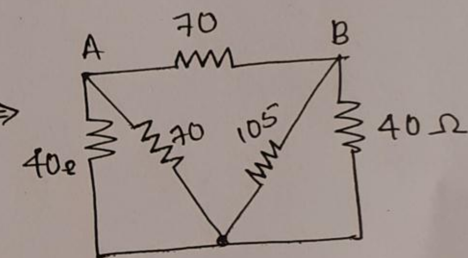
2.a.

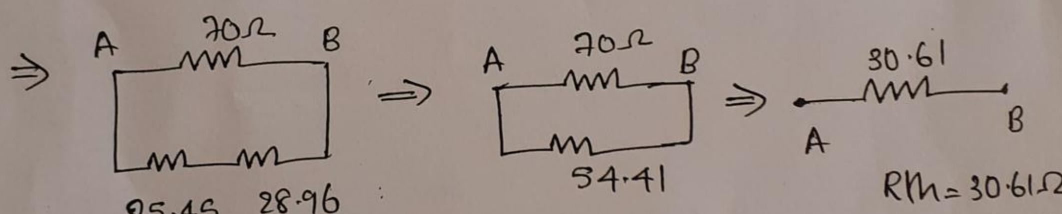


Calculation of Rth



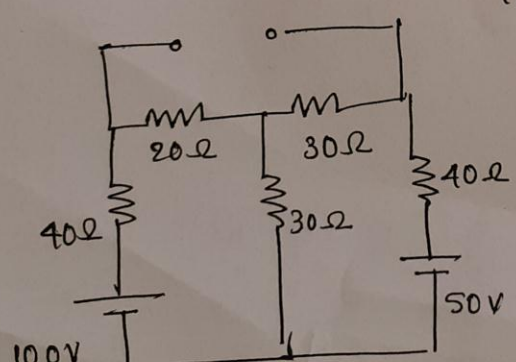
⇒





$R_{th} = 30.61\Omega$

Calculation of Vth



$$100 - 40I_1 - 20I_1 - 30(I_1 - I_2) = 0$$

$$100 - 90I_1 + 30I_2 = 0 \quad — ①$$

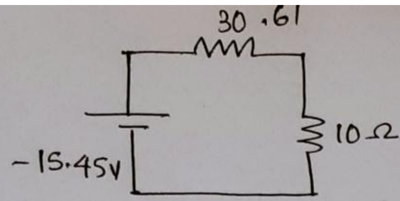
$$-30(I_2 - I_1) - 30I_2 - 40I_2 - 50 = 0$$

$$-100I_2 + 30I_1 = 50 \quad — ②$$

$$I_1 = 1.05\,A$$

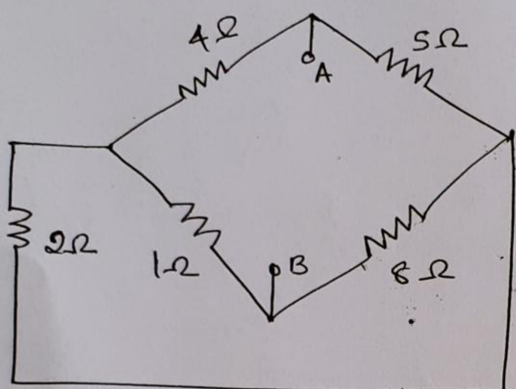
$$I_2 = -0.115\,A.$$

$$V_{th} = V_{AB} = -20I_1 + 30I_2 = -15.45V$$

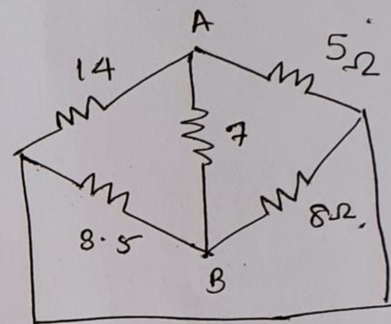


$$I_{10\Omega} = \frac{-15.45}{30.61+10} = \underline{\underline{0.380\,A}}$$

2b.) <u>Rth</u>.



⇒



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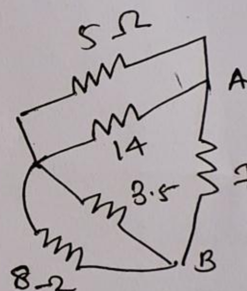

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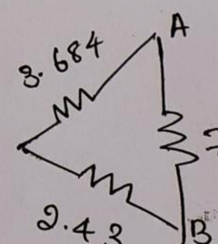
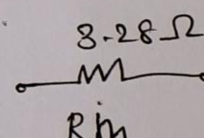


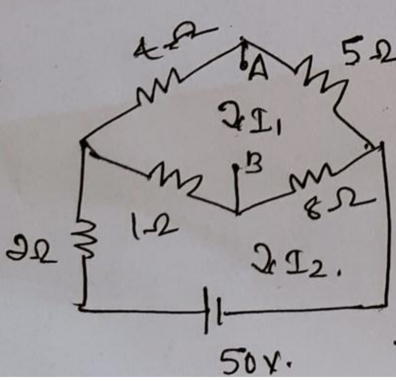
⇒

$7 \| 6.114$



$$R_L = R_{th} = \underline{\underline{3.28\,\Omega}}$$

<u>Vth</u>.



$-4I_1 - 5I_1 - 8(I_1 - I_2) - (I_1 - I_2) =$

$-9I_1 - 8I_1 + 8I_2 - I_1 + I_2 = 0$

$-18I_1 + \overset{9}{10}I_2 = 0$ —— ①.

$-(I_2 - I_1) - 8(I_2 - I_1) + 50 - 2I_2 = 0$

$-I_2 + I_1 - 8I_2 + 8I_1 + 50 - 2I_2 = 0.$

$-11I_2+9I_1+50=0$ $\qquad I_1 = \cancel{4.629\,A}$ 3.84 A

$9I_1-11I_2=-50$ — (2) $\qquad I_2 = \cancel{8.33\,A}$. 7.69 A.

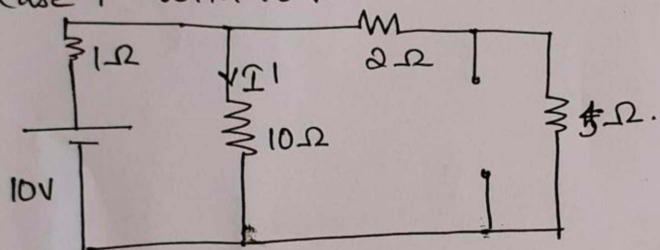
Vth $\quad V_A - 5\times \overset{3.84}{\cancel{4.629}} \overset{-}{\cancel{+}}\, 8\times(\overset{-7.69+3.84}{\cancel{8.33-4.629}}) - V_B = 0$.

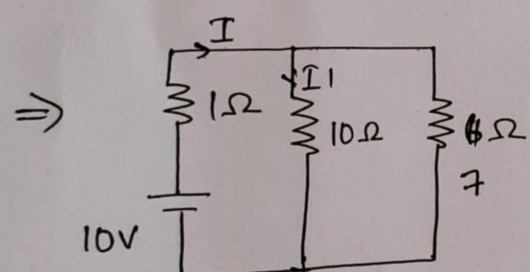
$$V_{AB} = 5\times \overset{3.84}{\cancel{4.629}} \overset{-}{\cancel{+}} 8\,(\overset{7.69-3.84}{\cancel{8.33-4.629}})$$

$$= \cancel{52.753\,V}.\ 11.6\,V$$

$$P_{max} = \frac{V_{th}^2}{4R_{th}} = \frac{\overset{11.6^2}{\cancel{52.753^2}}}{4\times 8.28} = \underline{\underline{\cancel{212.10\,W}}}\ 10.25\,W.$$

a. Case 1 with 10V.





$$R_{eq} = 1 + \frac{10\times \overset{7}{\cancel{6}}}{10+\cancel{6}_7} = \cancel{1+\frac{60}{16}}$$

$$R_{eq} = \underline{\underline{\cancel{4.75}\,\Omega}}.\quad \underline{\underline{5.11\,\Omega}}$$

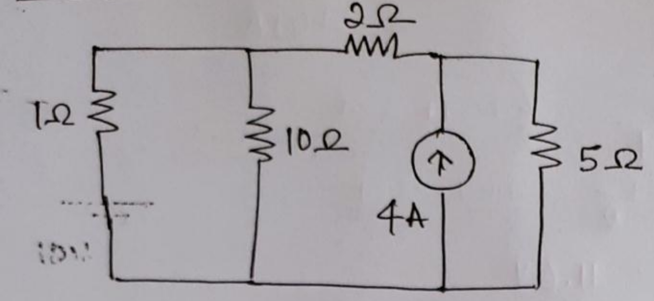
$$\cancel{I = \frac{10}{4.75} = 2.10\,A}.$$

$$\cancel{I' = 2.10\times\frac{6}{10+6}} = \underline{\underline{\cancel{0.7875\,A}}}$$

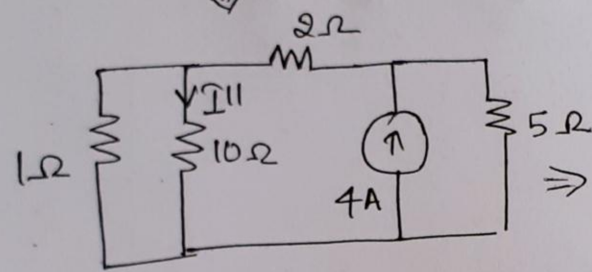
$$I = \frac{10}{5.11} = 1.956\,A$$

$$I' = 1.956\times\frac{7}{17} = \underline{\underline{0.8054\,A\ (\downarrow)}}$$

Case 2 with 4 A



⇓



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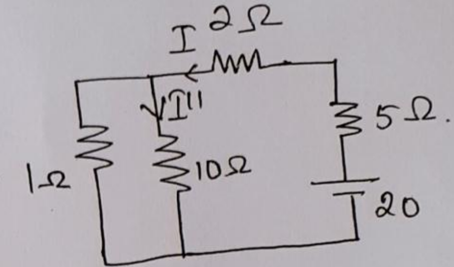


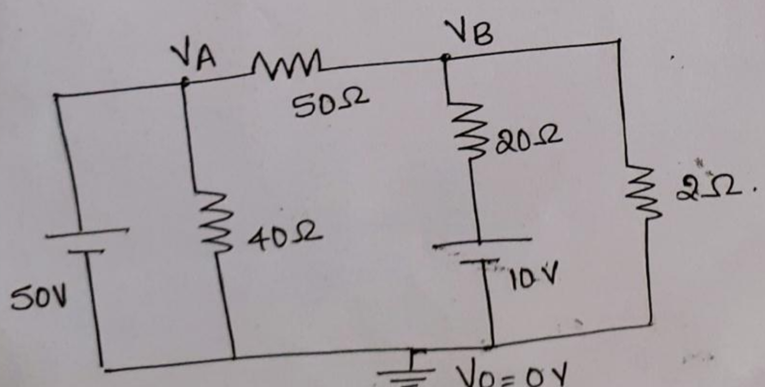
$$R_{eq} = 7 + \frac{10 \times 1}{10+1} = 7.9\Omega$$

$$I = \frac{20}{7.9} = 2.53A.$$

$$I'' = I \times \frac{1}{1+10} = 2.53 \times \frac{1}{11} = \underline{\underline{0.23\,A\,(\downarrow)}}$$

$$I_{10\Omega} = I'_1 + I'' = 0.805\,(\downarrow) + 0.23\,A\,(\downarrow) = \underline{\underline{1.035\,A\,\downarrow}}$$

2 b).



At node A

$$V_A = 50V \text{ ——— } (1)$$

At node B.

$$\frac{V_B - V_A}{50} + \frac{V_B - 0}{2} + \frac{V_B - 10}{20} = 0.$$

$$\frac{V_B - 50}{50} + \frac{V_B}{2} + \frac{V_B - 10}{20} = 0$$

$$V_B\left(\frac{1}{50} + \frac{1}{2} + \frac{1}{20}\right) - 1 - \frac{1}{2} = 0.$$

$$0.57 V_B - \frac{3}{2} = 0.$$

$$V_B = \frac{1.5}{0.57} = \underline{\underline{2.63V}}.$$

$$I_{2\Omega} = \frac{V_B - 0}{2} = \frac{2.63}{2} = \underline{\underline{1.315A}}.$$