Circuit Elements and kirchoff's laws:-

1.1 Voltage:- A certain amount of energy (work) is required to overcome the force and move the charges through a specific distance.

$$V = \frac{W}{Q} \text{ (or) } v = \frac{dw}{dq}$$

Problem:- If 70 Joule of Energy is available for 30 Colum of charge what is voltage

$$V = \frac{W}{Q} = \frac{70}{30} = 2.33V$$

1.2:- Current:-

$$I = \frac{Q}{t} \text{ (or) } i = \frac{dq}{dt}$$

Problem:- '5' coloumb of charge flow Past a given point in a wire '2S' how many amperes of current flowing.

$$I = \frac{Q}{t} = \frac{5}{2} = 2.5A.$$

1.3:- Power & Energy:-

Power is the rate of change of energy. if certain amount of energy is used over a certain length of time

$$\text{Power } (P) = \frac{\text{Energy}}{\text{time}} = \frac{W}{t}; \; P = \frac{dw}{dt}$$

we can also write

$$P = \frac{dw}{dt} = \frac{dw}{dq} \times \frac{dq}{dt}$$

$$= v \times i = vi \text{ (W) watts.}$$

Problem:- what is the Power in watts if energy Equal to 50J. is used in 2.5S?

$$P = \frac{\text{Energy}}{\text{time}} = \frac{50}{2.5} = 20\,W.$$

1.5:- Resistance Parameter:- (R): The property of a material to restrict the flow of electron is called resistance, denoted by 'R'.

$$I = \frac{V}{R}; \; i = \frac{v}{R}$$

$$V = R \cdot \frac{dq}{dt} \quad (\because i = \frac{dq}{dt})$$

(or)

$$i = \frac{v}{R} = GV$$

Units:-
Resistance :- ohms (Ω)
Conductance :- mho ($\mho$)
Power observed by the resistor is

$$P = vi = (iR)\, i = i^2 R$$

Energy lost by resistance in time t is given by

$$W = \int_0^t P\,dt = Pt = i^2 Rt = \frac{v^2}{R} t.$$

Problems:- A 10 Ω resistor is connected across a 12V battery how much current flows through the resistor

$$V = IR$$
$$I = \frac{V}{R} = \frac{12}{10} = 1.2A.$$

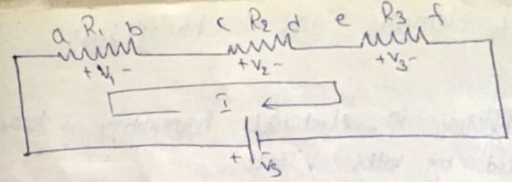
Inductance Parameter:- back side of the book
Problem:- The current in a 2H inductor varies at a rate of 2A/S. Find the voltage across the inductor and energy stored in magnetic field after 2S

$$v = L \cdot \frac{di}{dt} = 2 \times 4 = 8V$$
$$W = \frac{1}{2} L i^2 = \frac{1}{2} \times 2 \times (4)^2 = 16J.$$

Capacitance Parameter:- B.S.O.B
Problem:- A capacitor having a capacitance 2 μF is charged to a voltage of 1000V calculate stored energy in joules.

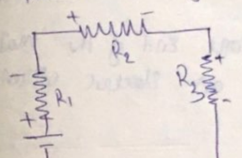
$$W = \frac{1}{2} CV^2 = \frac{1}{2} \times 2 \times 10^{-6} \times (1000)^2 = 1 \text{ joule}$$

Kirchhoffs Voltage law (KVL):- The algebraic sum of all branch voltages around ~~Problem: Ex text book~~ any closed path in a circuit is always zero at all instants of time



$$V_S = V_1 + V_2 + V_3.$$

Assume the reference current direction and to indicate the polarities for different elements.



By using ohms law voltage across each resistor as follows

$$V_{R_1} = IR_1 ;\ V_{R_2} = IR_2 ,\ V_{R_3} = IR_3$$

where V_{R_1}, V_{R_2} and V_{R_3} are the voltages across R_1, R_2 & R_3, respectivelly finally by applying kirchhoffs laws we can form the eq

$$V = V_{R_1} + V_{R_2} + V_{R_3}$$
$$V = IR_1 + IR_2 + IR_3$$

from the above eq the current delivered by source is given by.

$$I = \frac{V}{R_1 + R_2 + R_3}.$$

Problem:- In text book

Voltage division:- The voltage droped across any resistor in a series circuit is equal to the ratio of that resistance value to the total resistance, multiplied by the source voltage

$$V_m = \frac{V_S(R_m)}{R_1 + R_2 + \dots R_m}.$$

Circuit Elements and kirchhoff's laws.

Voltage:-

Potential difference in electrical terminology is known as voltage. denoted by volts 'V' (or) v

It is expressed in terms of energy (W) per unit charge (Q)

$$V = \frac{W}{Q} \; ; \text{(or)} \; V = \frac{dw}{dq}$$

Current:-

movement of electrons from one end of the material to the other end constitutes an electric current denoted by I (or) i

It is defined as rate of flow of electron in an conductivity measured by no:- of electrons that flow ~~Point~~ past a point in unit time.

$$I = \frac{Q}{t} \; \text{(or)} \; i = \frac{dq}{dt}$$

Resistance:- The property of material to restric the flow of electrons through the conductor is called as a Resistance. It is denoted 'R' (-mm-)

Units:- ~~[illegible]~~ ~~[illegible]~~ ohms (Ω)

A/c to ohms law $I = V/R$ (or) $i = \frac{v}{R}$

Power absorbed $V = IR$ (or) $v = iR$

~~Energy~~ in resistance ~~for~~ ~~time~~ ~~t~~ ~~sec~~ is

$$\therefore P = Vi = i(iR) = i^2R$$

By ~~[illegible]~~ ~~[illegible]~~ Energy lost in time 't' sec is

$$W = \int P.dt = \cancel{I^2R}\, Pt = i^2Rt = \frac{V}{R}t.$$

Power and Energy:-

Energy:- Energy is the capacity for doing work. and it is nothing but stored work. It may exists in many forms such as mechanical, chemical, electrical and so on. Energy measured in 'Joules' (J).

Power:- It is a rate of change of energy and denoted by either P (or) ~~P~~ P. If certain amount of energy is used over a certain length of time then

$$\text{Power (P)} = \frac{\text{Energy}}{\text{time}} = \frac{W}{t};$$

$$P = \frac{dw}{dt}$$

where dw is change in energy and dt is change in time

$$P = \frac{dw}{dt} = \frac{dw}{dq} \times \frac{dq}{dt}$$

$$= V \times i$$

$$P = Vi. \; W$$

~~[illegible]~~ time in seconds (s) Power in watts (W).

Inductance Parameters:-

A wire of certain length, when twisted in to a coil becomes a basic inductor. If the current is made to pass through an inductor ~~changes the~~ electro magnetic field is formed. A change in magnitude of current changes electro magnetic field & increase in current expands and decrease in current reduces the electro magnetic field. therefore change in current produces the change in electro magnetic field. which induces the voltage across the coil according to faraday's law ~~of~~ of electromagnetic induction.

$$v = L.\frac{di}{dt}$$

$$di = \frac{1}{L}.v.dt$$

Integrating on B.S

$$\int_0^t di = \int_0^t \frac{1}{L} \cdot v \cdot dt$$

$$i(t) - i(0) = \frac{1}{L}\int_0^t v \cdot dt$$

$$i(t) = \frac{1}{L}\int_0^t v \cdot dt + i(0)$$

$$i(t) = \frac{1}{L}\int_0^t v \cdot dt$$

The Power observed by inductor is

$$P = vi = Li\frac{di}{dt} \text{ watts}$$

The energy stored by inductor is

$$W = \int_0^t P \cdot dt$$

$$= \int_0^t Li\frac{di}{dt} = \frac{Li^2}{2}$$

Chapter :- 1:

1) voltage:-

Current (I) :- Measured in Ampere(A)

$$V = \frac{W}{Q} \quad (\text{or}) \quad v = \frac{dw}{dq}$$

'W' is Energy in Joules(J) charge(Q) in Coulombs (C)

1) Given 70J of energy = W

30 C of charge = Q

$$\therefore V = \frac{W}{Q} = \frac{70}{30} = 2.33V$$

2) Given current 3A energy W = 500J

Time (t) = 12 sec

$$V = \frac{W}{Q} \quad \text{where } Q = I \times t$$

$$Q = 3 \times 12 = 36C$$

$$V = \frac{500}{36} = 13.88C.$$

a) Given Q = 75C t = 1s find I.

wkt? $Q = It$

$$I = \frac{Q}{t} = \frac{75}{1} = 75 \text{ Amp}$$

b) Given Q = 10C ; t = 0.5s find I

$$Q = It \Rightarrow I = \frac{Q}{t} = \frac{10}{0.5} = 0.2 \text{ Amp}$$

c) Given Q = 5C int=2s find I

$$Q = It$$

$$\Rightarrow I = \frac{Q}{t} = \frac{5}{2} = 2.5 \text{ Amp}$$

(ii) Q = 10 C ; I = 5A find 't'.

$$Q = It \Rightarrow t = \frac{Q}{I} = \frac{10}{5} = 2 \text{ sec}$$

objective:- Given W = 100J ; Q = 25C

$$V = \frac{W}{Q} = \frac{100}{25} = 4V$$

Given W = 800J ; Q = 40C

$$V = \frac{800}{40} = 20V$$

Given Q = 10C t = 0.5 sec

$$Q = It \Rightarrow I = \frac{Q}{t} = \frac{10}{0.5} = 20A$$

1 Coulomb of charge is 6.25×10^{-19} electrons.

Power:- and Energy:- $P = \frac{W}{t}$; $P = \frac{dw}{dt}$

$$P = \frac{dw}{dq} \times \frac{dq}{dt}$$

$$P = V \times i$$

Given $P = \frac{\text{Energy}}{\text{Time}} = \frac{50J}{2.5} = 20W.$

Given $R = 5\Omega$ here R is resistor in ohms Ω

$V = 100V$

WKT $= P = I \times V$ ∴ $I = V/R$

$\Rightarrow P = \frac{V}{R} \times V$

$= \frac{100}{5} \times \cancel{100}^{20} = 2000W = 2kW$

1.3 (long)

Given $I = 2A$; $W = 1000J$; $t = 5sec$

find 'V' across resistor:-

WKT $P = \frac{W}{t} = \frac{1000}{5} = 200W$

$P = I \times V$ $\quad I = \frac{Q}{t}$

∴ $200 = 2 \times V$ $\quad Q = 2 \times 5 = 10C$

$V = 100$ Volts

$R = \cancel{I = V/R \Rightarrow 200 = \frac{100}{R}}$

$\cancel{R = \frac{100}{200} \times 0.5}$

Objective: (wrong)

$R = 5.5V$; $I = 3mA$; $\cancel{t = 0.5 sec}$

find 'P'.

$P = I \times V$ when $I = \frac{V}{R} \Rightarrow 3 = \frac{V}{5.5}$

$= 16.5 = V$

$\cancel{R = 16.5 \times 3}$

$\cancel{R = 49.5}$

units of conductance are mho ($\mho$)

Resistance:-

units are ohm's (Ω)

$V = IR$

$I = \frac{V}{R}$

Given $R = 10\Omega$; $V = 12$

$I = \frac{12}{10} = 1.2Am$

1.4) Given: $V = 120V$; $I = 0.8A$; $R = ?$

$I = \frac{V}{R} \Rightarrow 0.8 = \frac{120}{R}$

$R = \frac{120}{0.8} = 150\Omega$

Inductance Parameter:-

units of inductance is henry (H)

$v = L\frac{di}{dt}$

Given inductance $L = 2H$; $\frac{di}{dt} = 2A/s \times 2sec$

and Energy stored in magnetic field in 2 sec

Power absorbed by inductor is

$P = Vi = Li\frac{di}{dt}$

Energy stored by inductor is

$W = \int_0^t P.dt = \int_0^t Li \frac{di}{dt} dt = \frac{Li^2}{2}$,

work in Joules (J)

$V = 2 \times 2 \times 2 = 8V$

$W = \frac{1}{2}Li^2 = \frac{1}{2} \times 2 \times (4)^2 = 16J$

1.5: $L = ?$ Current in 0.3s increases 0 to 0.2.

$V = 15V$

$V = L.\frac{di}{dt}$ current in 1s $= \frac{0.2}{0.3} = 0.66A$.

Current changes at rate of 0.66A/s

$L = \frac{V}{\left(\frac{di}{dt}\right)} = \frac{15}{0.66} = 22.727H.$

1.7. Capacitance Parameter:-

unit are Farad's. (F)

$C = \frac{Q}{V}$ (or) $C = \frac{q}{v}$

$W = \frac{1}{2}CV^2$

$C = 2\mu F$ $\mu F = 10^{-6}$

$V = 1000$

$W = \frac{1}{2}CV^2 = \frac{1}{2} \times 2 \times 10^{-6} \times (1000)^2 = 1J.$

Energy Sources:-

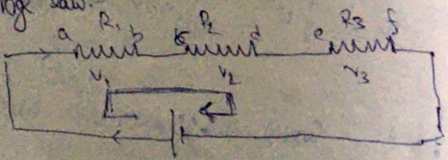
A/C to their terminal voltage current

electrical. Energy Sources

ideal voltage — ideal current Sources

independent — dependent Sources

Krichoff's law voltage law:



$V = IR_1 + IR_2 + IR_3$

$I = \frac{V}{R_1 + R_2 + R_3}$

By using ohm's law voltage across resistor

$V_{R1} = IR_1$; $V_{R2} = IR_2$; $V_{R3} = IR_3$

voltage division

draw duality of circuit in (imp ...)

chapter 1:-

1) voltage :- $V = \frac{W}{Q}$ (or) $V = \frac{\omega}{q}$

2) current:-

$I = \frac{Q}{t}$ (or) $i = \frac{dq}{dt}$

3) Power and Energy:-

$P = \frac{\text{Energy by it}}{\text{time}} = \frac{W}{t}$ (or) $P = \frac{dw}{dt}$

$P = \frac{dw}{dt} = \frac{dw}{dq} \times \frac{dq}{dt} = v \times i = vi$ W.

4)

ImpQ:- Chapter - 1:- Spectrum:-

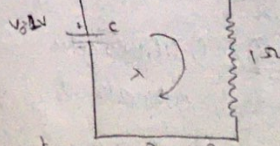
Sol

1) Given that:- A capacitor charged 1volt at $t = 0$

Resistor 1Ω is connected across terminals

The current in the form $i(t) = e^{-t}$ Amp. → (1)

At particular time current drops:- 0.37 Amp



$i(t) = e^{-t}$ Amp $R = 1\Omega$

the current eq is given by

$i(t) = i(0). e^{-t/RC}$ → (2)

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Comparing Eq ② with ① we get

$i(0) = 1$ & $RC = 1 \Rightarrow C = \frac{1}{R} = \frac{1}{1} = 1F$

(i) $i(t) = e^{-t}$

Given $i(t) = 0.37A$

wkt $i(t) = e^{-t}$ so

$e^{-t} = 0.37\,A$

Applying log on both sides

$$\log_e e^{-t} = \log_e 0.37$$

$$-t \cdot \log_e e = \log_e 0.37$$

$$-t(1) = \log_e 0.37$$

$$-t = -0.9942$$

$$t = 0.9942 \text{ sec}$$

$\therefore$ rate of change of voltage across capacitor is given by

$$\frac{dv(t)}{dt} = \frac{i(t)}{C} = \frac{0.37}{1} = 0.37 \text{ v/sec}$$

(2) charge on Capacitor.

$$Q = CV = C \times \frac{i(t)}{R} = 1 \times \frac{0.37}{1} = 0.37 \text{ Colombs} \quad (\because V = \frac{i}{R})$$

3) voltage across capacitor:-

$V_c(t) = e^{-t} = 0.37$ Coulombs.

4) Energy stored in a Capacitor.

$$W_c = \frac{1}{2} CV^2 = \frac{1}{2} \times 1 \times (0.37)^2$$

$$= \times 0.06845 \text{ Joules}$$

5) voltage across resistor as $t = 0.9942$ sec is

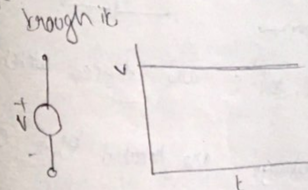
$$V_R = i(t) \times R = e^{-t} \times 1 = e^{-t} = 0.37\,V.$$

2) What are Active, Passive elements? Explain voltage current relation of Passive elements with Eg:-

A) <u>Active Elements</u>:- The elements which are capable of Providing Energy to the devices & networks which are connected across ~~term~~ them is called as active elements. Basically there are two kinds

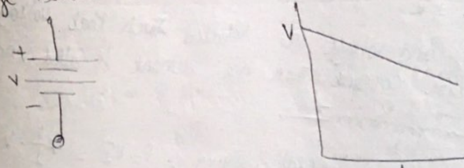
1) Independent voltage source
2) " Current "

1) An independent voltage source is a source in which the voltage across the terminals is independent of current passing through it



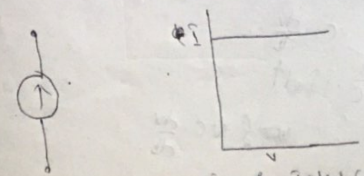
v-i characteristics of an ideal source D.C. voltage source. The

The voltage source is termed as a constant voltage and its represented voltage source if it has a



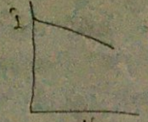
v-I characteristic of Practical voltage

2) An independent current source is a source which can deliver a constant current independent of the voltage across it's terminals.



v-I of Ideal current source

Practically the ... ideal behaviour.



V-I of Practical current

Passive elements:-

The Elements which can not deliver Power and can only receive the power as known as Passive Element.

There are 3 types of Passive elements

1) Resistor 2) Inductor 3) Capacitor.

* The Passive Elements R, L, C are defined which current and voltage related.

(i) If the current 'I' and voltage 'V' are related by a constant for a single Element, then element is 'R'.

$I \rightarrow$ + V − R

voltage $V = IR \Rightarrow I = \frac{V}{R}$; Power $\Rightarrow P = VI = I^2 R$

2) If the current and voltage are related such that voltage is the time derivative current. Then the element is called Inductor

$I \rightarrow$ + V − L

$V = L \cdot \frac{dI}{dt} \Rightarrow I = \frac{1}{L} \cdot \int V \cdot dt$; Power $\Rightarrow P = VI = \frac{1}{L} \cdot V$

3) If the voltage and current are related such that the current is such that current is the time derivative of voltage. Then it is called Capacitor

current $I = C \cdot \frac{dv}{dt}$

voltage $V = \frac{1}{C} \cdot \int I \, dt$

Power $P = VI = VC \cdot \frac{dv}{dt}$.

3n) A heater elements takes 8W of Power when connected to mains. The element is redrawn such that the length is doubled.

Case-1:- let P_1 = Power absorbed by resistor R_1

$$P_1 = 8W = \frac{V^2}{R_1}$$

l_1 = length of heating element

A_1 = Area of cross section of heating element

$$\rho = \frac{l_1}{A_1}$$

V_1 = volume of heating element

$$V_1 = l_1 \times A_1$$

Case 2:-

When length is doubled the area will be halved

$$l_2 = 2l$$

$$A_2 = \frac{A_1}{2}$$

$$R_2 = \rho \cdot \frac{l_2}{A_2}$$

$$R_2 = \rho \cdot \frac{2l}{\frac{A_1}{2}} = \rho \frac{4 l_1}{A_1} = 4 \cdot R_1$$

$$R_2 = 4R_1$$

Power observed by new element

$$P_2 = \frac{V^2}{R_2} = \frac{V^2}{4R_1}$$

Voltage applied.

$$P_2 = \left(\frac{V^2}{R_1}\right) \times \frac{1}{4} = 8W \cdot \frac{1}{4} = 2W.$$

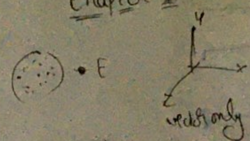
(Series)

22/3/07

Net Work Theory:-

Chapter-I:-

1) field Theory:-



now a days
Field Theory is expired

vectors only

Ik

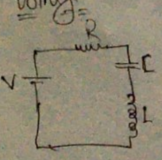
Circuit Theory:-
$F < 1MHz$

1MHz 1000 kHz

10.001

(10.001-10) it will not be expired because it may be used in small circuits.

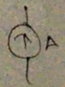
1) Voltage:-



Voltage –

Current –
here current is constant

2) Current:-



here Voltage is constant.

Resistor:- R

Capacitor C

Inductor

$5\times C/S$
$5\times 6\times 10^{18}$ c/s
voltage current 30×10^{18} c/s

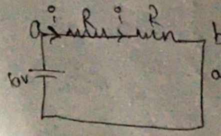
Resistor:- R
i + V −

$V \propto i$
$\boxed{V = Ri}$ Ohms law

$\boxed{i = V/R}$

Power $P = Vi$
$P = Ri \times i = i^2R$
(or)
$P = \frac{V^2}{R}$

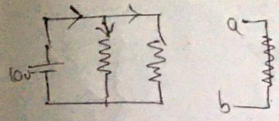
Series:-



a — R_1 — R_2 — b

a — R — b
$R = R_1 + R_2$

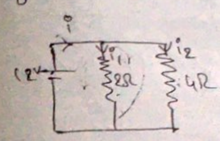
Parallel:-



$R = \frac{R_1R_2}{R_1+R_2}$

27/03/07

Current division :- opposite resistance
voltage " :- That "



$\frac{0.1}{6}\times 4$

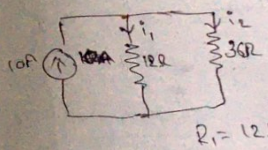
$\frac{12}{6}\times 2$

$i = \frac{V}{R} = \frac{12}{2} = 6A$; $i = \frac{12}{4} = 3A$

$i_1 = \frac{\cancel{V}}{R_1+R_2}$

$i = i_1 + i_2$
$= 6 + 3 = 9A$

$\frac{R_1R_2}{R_1+R_2} =$



Current division :-

$i = \frac{\text{Total current}}{\text{Sum of resistance}} \times$ opposite resistance

i_1 $\frac{10A}{12+36}\times i_2$ at 'i_1' current

$\frac{10A}{12+36}\times i_1$ at 'i_2' current

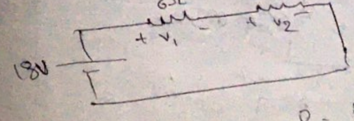
$R_1 = 12Ω$; $R_2 = 36Ω$

$R = \frac{12\times 36}{12+36} = \frac{432}{48} = 9.$

$i_1 = \frac{10}{48}\times 36 = \frac{360}{48} = 7.5A$

$i_2 = \frac{10}{48}\times 12 = 2.5A$

Voltage divider:-



$V = \frac{\text{Total voltage}}{\text{Sum of resistance}} \times$ that resistance

$V = \frac{18V}{6+3}\times 6$ at 'V_1'

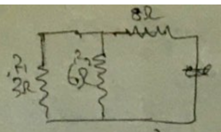
$V = \frac{18V}{6+3}\times 3$ at 'V_2'

$\frac{18}{9}\times 6$
$= 12V$

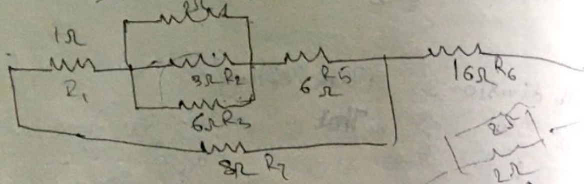
$\frac{18}{9}\times 3 = 6V$

Series:- $R = R_1 + R_2$
$= 6 + 3 = 9Ω$

$I_1 = \frac{18}{9} = 2A$; $I_2 = \frac{18}{3} = 6A$ $I = 8A$

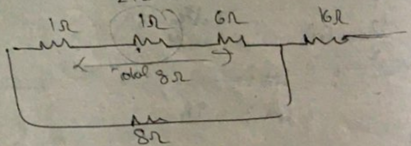


$\frac{18}{9}$

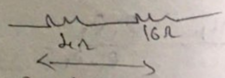


$R_2 \parallel R_3 = \frac{18}{9} = 2\Omega$

$(R_2 R_3) \parallel R_4 \quad \frac{2\times 2}{2+2} = 1$

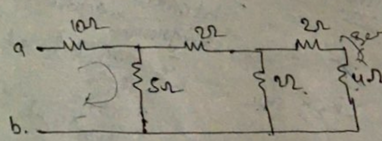


$\frac{8\times 8}{8+8} = \frac{64}{16} = 4\Omega$



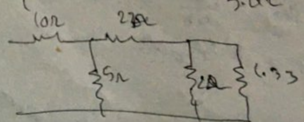
$R = 20\Omega$

Q.)

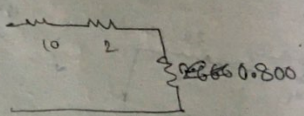


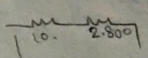
$\frac{10}{7} = 1.42$ $\quad \frac{1.42\times 4}{5.42} = \frac{5.7142}{5.42}$

1.0542



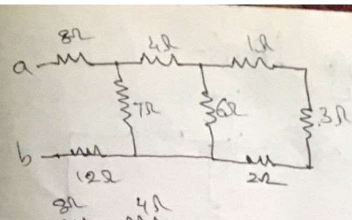
2.666



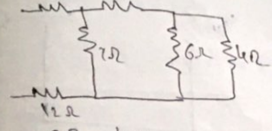


12.800.

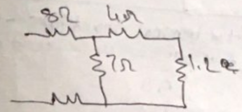
2)

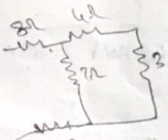


$\frac{42}{13}$



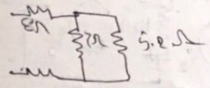
$\frac{6\times 4}{4+6} = \frac{24}{10} = 2.4\Omega$

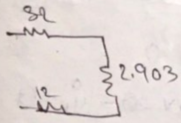


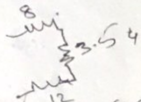


$I = \frac{V}{R}$

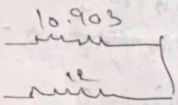
$\frac{30}{6} = 5A$





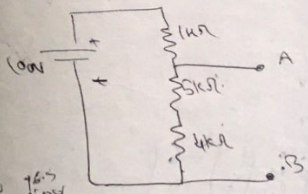


23.549



22.903.

A voltage division:-

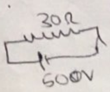


$\frac{100}{9+1} \times 9 = 90V$

$I = \frac{V}{R} = \frac{500}{30} = 16.6$

practice

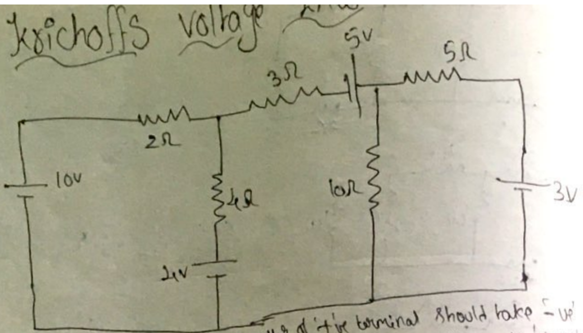
2) Total Power:-



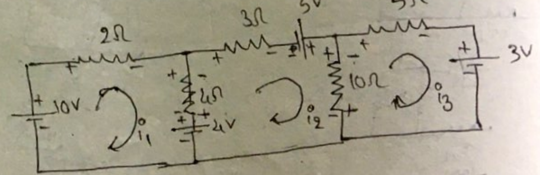
$P = \frac{V}{R} = \frac{500}{30} = 16.6$

P) Krichoffs voltage

1)



When the current is entering into resistor of '+ve' terminal should take '-ve'
" " " " '-ve' " " '+ve'



$10v - 2i_1 - 4i_1 + 4i_2 - 4v = 0$

$-3i_2 + 5v - 10i_2 + 10i_3 + 4v - 4i_1 = 0$

$-5i_3 - 3v - 10i_3 + 10i_2 = 0$

$6v - 6i_1 + 4i_2 = 0$

$-13i_2 + 9v + 10i_3$

$-15i_3 - 3v + 10i_2 = 0$

$-6i_1 + 4i_2 = -6v$

$-13i_2 + 10i_3 = -9v$

$10i_2 - 15i_3 = 3v$

$$\begin{bmatrix} -6 & 4 & 0 \\ 0 & -13 & 10 \\ 0 & 10 & -15 \end{bmatrix} \begin{pmatrix} i_1 \\ i_2 \\ i_3 \end{pmatrix} = \begin{pmatrix} -6 \\ -9 \\ 3 \end{pmatrix}$$

$$\Delta = \begin{vmatrix} -6 & 4 & 0 \\ 0 & -13 & 10 \\ 0 & 10 & -15 \end{vmatrix} =$$

$10v - 2i_1 - 4i_1 - 4v + 4i_2 = 0$

$4v - 4i_2 + 4i_1 - 3i_2 + 5v - 10i_2 + 10i_3 = 0$

$-10i_3 + 10i_2 - 5i_3 - 3v = 0$

$-6i_1 + 6v + 4i_2 = 0$

$9v - 17i_2 + 4i_1 + 10i_3 = 0$

$-10i_3 + 5i_2 - 3v = 0$

$\Rightarrow -6i_1 + 4i_2 = -6v$

$4i_1 - 17i_2 + 10i_3 = -9v$

$5i_2 - 10i_3 = 3v$

$$\begin{bmatrix} -6 & 4 & 0 \\ 4 & -17 & 10 \\ 0 & 10 & -15 \end{bmatrix} \begin{pmatrix} i_1 \\ i_2 \\ i_3 \end{pmatrix} = \begin{pmatrix} -6 \\ -9 \\ 3 \end{pmatrix}$$

$$\Delta = \begin{vmatrix} -6 & 4 & 0 \\ 4 & -17 & 10 \\ 0 & 10 & -15 \end{vmatrix} = -560$$

$$\Delta_1 = \begin{vmatrix} -6 & 4 & 0 \\ -9 & -17 & 10 \\ 3 & 5 & -10 \end{vmatrix} = -960$$

$$\Delta_2 = \begin{vmatrix} -6 & -6 & 0 \\ 4 & -9 & 10 \\ 0 & 3 & -10 \end{vmatrix} = -600$$

$$\Delta_3 = \begin{vmatrix} -6 & 4 & -6 \\ 4 & -17 & -9 \\ 0 & 5 & 3 \end{vmatrix} = -132$$

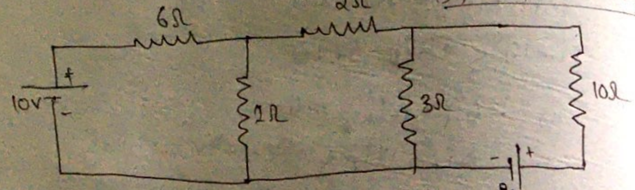
$i_1 = \dfrac{\Delta_1}{\Delta} = \dfrac{-960}{-560} = 1.714$

$i_2 = \dfrac{\Delta_2}{\Delta} = \dfrac{-600}{-560} = 1.0714$

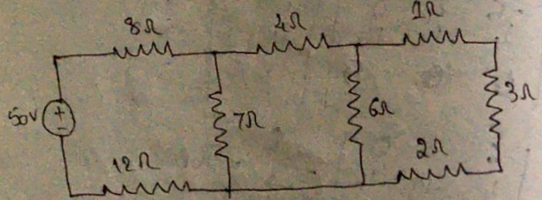
$i_3 = \dfrac{\Delta_3}{\Delta} = \dfrac{-132}{-560} = 0.235$

By using Mesh Analysis

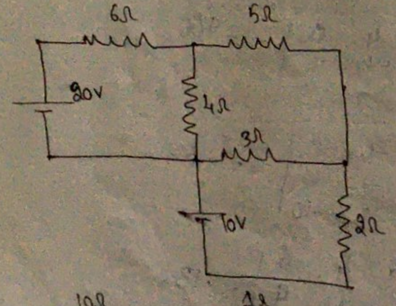
P) 2)



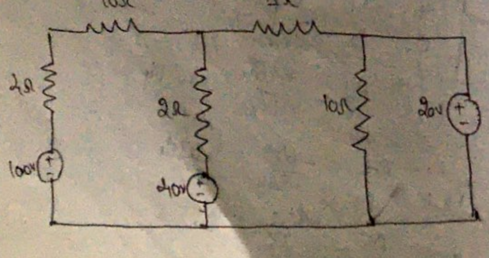
P) 3)



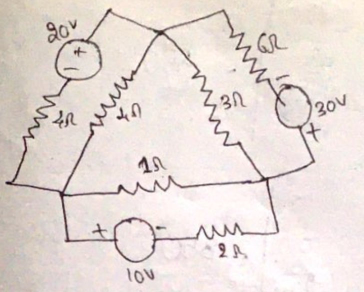
P) 4)



5) P)



P) 6)

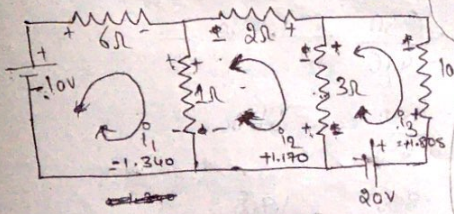


$P = vi$

$= v^2/R$

$= i^2 R$

P) 2Ans)



$P_{3\Omega} = (1.170)^2 \cdot 3 + (1.803)^2 \cdot 3$

$= (\ )$

$P_{10V} = 10 \times 1.340 = 13.4$ (delivered)

$P_{6\Omega} = (1.340)^2 \times 6 =$

$P_{1\Omega} = i_1^2 R + i_2^2 R$

$= (1.340)^2 \times 1 + (1.17)^2 \cdot 1$

$P_{20V} = 20 \times 1.808 = ($ delivered$)$

$10 - 6i_1 - i_1 + i_2 = 0$ Ac +ve

$-i_2 + i_1 - 2i_2 - 3i_2 + 3i_3 = 0$ Ac −ve

$-20 - 3i_3 + 3i_2 - 10i_3 = 0$

$-7i_1 + i_2 = 10$

$i_1 - 6i_2 + 3i_3 = 0$

$3i_2 - 13i_3 = 20$

$$\begin{bmatrix} -7 & 1 & 0 \\ 1 & -6 & 3 \\ 0 & 3 & -13 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ 20 \end{bmatrix}$$

$$\Delta = \begin{vmatrix} -7 & 1 & 0 \\ 1 & -6 & 3 \\ 0 & 3 & -13 \end{vmatrix} = -470$$

$$\Delta_1 = \begin{vmatrix} 10 & 1 & 0 \\ 0 & -6 & 3 \\ 20 & 3 & -13 \end{vmatrix} = -630$$

$$\Delta_2 = \begin{vmatrix} -7 & 10 & 0 \\ 1 & 0 & 3 \\ 0 & 20 & -13 \end{vmatrix} = 550$$

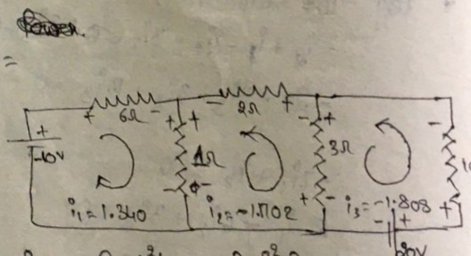
$$\Delta_3 = \begin{vmatrix} -7 & 1 & 10 \\ 1 & -6 & 0 \\ 0 & 3 & 20 \end{vmatrix} = 850$$

$$i_1 = \frac{\Delta_1}{\Delta} = \frac{-630}{-470} = 1.340$$

$$i_2 = \frac{\Delta_2}{\Delta} = \frac{550}{-470} = -1.1702$$

$$i_3 = \frac{\Delta_3}{\Delta} = \frac{850}{-470} = -1.808$$

Power: $P_{10V} =$



$P = vi$; $P = v^2/R$; $P = i^2 R$

$P_{10V} = (1.340) \times (10) = 13.40$

$P_{6\Omega} = 10 \times (1.340) = 13.40$

$P_{1\Omega} = i_1^2 R + i_2^2 R$

$= (1.340)^2 (1) + (-1.1702)^2 \times 1$

$= 3.16496\Omega$

$P_{20} = (-1.808) \times 20$

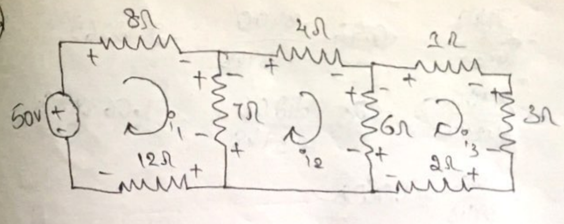
$= -36.16$

$P_{2\Omega} = 10 \times -1.1702 = -11.702$

$P_{3\Omega} = i_2^2 R + i_3^2 R$

$= (-1.1702)^2 \times 3 + (-1.808)^2 \times 3 = 11.175$

2)



$50 - 8i_1 - 7i_1 + 7i_2 - 12i_1 = 0$

$-7i_2 + 7i_1 - 4i_2 - 6i_2 + 6i_3 = 0$

$-6i_3 + 6i_2 - i_3 - 3i_3 - 2i_3 = 0$

$-27i_1 + 7i_2 = -50$

$7i_1 - 17i_2 + 6i_3 = 0$

$6i_2 - 12i_3 = 0$

$$\Delta = \begin{bmatrix} -27 & 7 & 0 \\ 7 & -17 & 6 \\ 0 & 6 & -12 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 50 \\ 0 \\ 0 \end{bmatrix}$$

$$\Delta = \begin{vmatrix} -27 & 7 & 0 \\ 7 & -17 & 6 \\ 0 & 6 & -12 \end{vmatrix} = -3948$$

$$\Delta_1 = \begin{vmatrix} 50 & 7 & 0 \\ 0 & -17 & 6 \\ 0 & 6 & -12 \end{vmatrix} = 8400$$

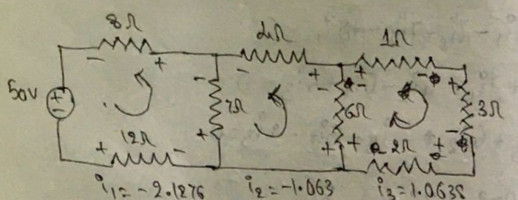
$$\Delta_2 = \begin{vmatrix} -27 & 50 & 0 \\ 7 & 0 & 6 \\ 0 & 0 & -12 \end{vmatrix} = 4200$$

$$\Delta_3 = \begin{vmatrix} -27 & 0 & 50 \\ 7 & 6 & 0 \\ 0 & -12 & 0 \end{vmatrix} - 4800$$

$i_1 = \frac{\Delta_1}{\Delta} = \frac{8400}{-3948} = -2.12765$

$i_2 = \frac{\Delta_2}{\Delta} = \frac{4200}{-3948} = -1.063829$

$i_3 = \frac{\Delta_3}{\Delta} = \frac{-4200}{-3948} = 1.0638$



$(++) \to (+)$
$(+-) \to (+)$
$(--) \to (+)$

$P_{50v} = (-2.127) \times 50 = -17.016$

$P_{8\Omega} = (-2.127)^2 \times 8 = -36.193$

$P = iv$

$P = i^2R$

$P_{7\Omega} = (-2.1276)^2 \times 7 + (-1.063)^2 \times 7$

$= -23.776$

$P_{12} = (-2.1287)^2 \times 12 = -54.289$

$P_4 = (-1.063)^2 \times 4 = -4.519$

$P_6 = (-1.063)^2 \times 6 + (1.0638)^2 \times 6$

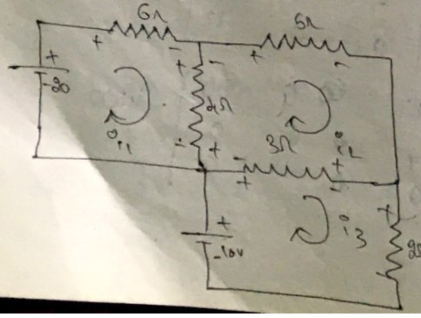
$= 0.0102$

$P_1 = 1 \times 1.0638 = 1.0638$

$P_3 = 3 \times 1.063 = 3.189$

$P_2 = 2 \times 1.063 = 2.126..$

2)



$20 - 6i_1 - 4i_1 + 4i_2 = 0$

$-4i_2 + 4i_1 - 5i_2 - 3i_2 + 3i_3 = 0$

$10 - 3i_3 + 3i_2 - 2i_3 = 0$

$-10i_1 + 4i_2 = -20$

$4i_1 - 12i_2 + 3i_3 = 0$

$3i_2 - 5i_3 = -10$

$$\begin{bmatrix} -10 & 4 & 0 \\ 4 & -12 & 3 \\ 0 & 3 & -5 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} -20 \\ 0 \\ -10 \end{bmatrix}$$

$$\Delta = \begin{vmatrix} -10 & 4 & 0 \\ 4 & -12 & 3 \\ 0 & 3 & -5 \end{vmatrix} = -430$$

$$\Delta_1 = \begin{vmatrix} -20 & 4 & 0 \\ 0 & -12 & 3 \\ -10 & 3 & -5 \end{vmatrix} = -1140$$

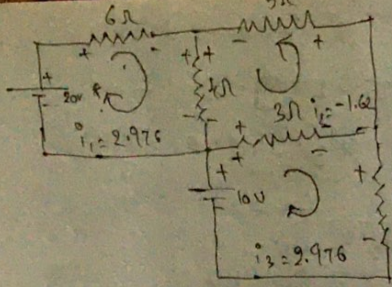
$$\Delta_2 = \begin{vmatrix} -10 & -20 & 0 \\ 4 & 0 & 3 \\ 0 & -10 & 5 \end{vmatrix} = 700$$

$$\Delta_3 = \begin{vmatrix} -10 & 4 & 20 \\ 4 & -12 & 0 \\ 0 & 3 & -10 \end{vmatrix} = -1280$$

$i_1 = \frac{\Delta_1}{\Delta} = \frac{-1140}{-430} = 2.976$

$i_2 = \frac{\Delta_2}{\Delta} = \frac{700}{-430} = -1.62$

$i_3 = \frac{\Delta_3}{\Delta} = \frac{-1280}{-430} = 2.976$



$P_{20} = 2.976 \times 20 = 59.52$

$P_6 = (2.976)^2 \times 6 = 53.13$

$P_4 = (2.976)^2 \times 4 + (-1.62)^2 \times 4$

$= 35.42 - 10.4976 = 24.922$

$P_5 = (-1.62)^2 \times 5$

$= -13.122$

$P_3 = (-1.62)^2 \times 3 + (2.976)^2 \times 3$

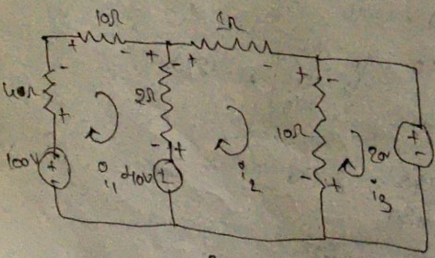
$= 18.696$

$P_2 = (2.976)^2 \times 2 = 17.713$

$P_{10} = 2.976 \times 10 = 29.76$

v = iR
v/i
R = V/i
P = vi

n)



$100 - 40i_1 - 10i_1 - 2i_1 + 2i_2 - 40 + 40 = 0$

$40 - 2i_2 + 2i_1 - i_2 - 10i_2 + 10i_3 = 0$

$-20 - 10i_3 + 10i_2 = 0$

$-16i_1 + 2i_2 = -100$

$-13i_2 + 2i_1 + 10i_3 = -40$

$10i_2 - 10i_3 = 20$

$$\begin{bmatrix} -16 & 2 & 0 \\ 2 & -13 & 10 \\ 0 & 10 & -10 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} -100 \\ -40 \\ 20 \end{bmatrix}$$

$$\Delta = \begin{vmatrix} -16 & 2 & 0 \\ 2 & -13 & 10 \\ 0 & 10 & -10 \end{vmatrix} = -440$$

$$\Delta_1 = \begin{vmatrix} -100 & 2 & 0 \\ -40 & -13 & 10 \\ 20 & 10 & -10 \end{vmatrix} = -3400$$

$$\Delta_2 = \begin{vmatrix} -16 & -100 & 0 \\ 2 & -40 & 10 \\ 0 & 20 & -10 \end{vmatrix} = -5200$$

$$\Delta_3 = \begin{vmatrix} -16 & 2 & -100 \\ 2 & -13 & -40 \\ 0 & 10 & 20 \end{vmatrix} = -4320$$

$i_1 = \frac{\Delta_1}{\Delta} = \frac{-3400}{-440} = 7.7272$

$i_2 = \frac{\Delta_2}{\Delta} = \frac{-5200}{-440} = 11.818$

$i_3 = \frac{\Delta_3}{\Delta} = \frac{-4320}{-440} = 9.818$

Power :-

Scanned with CamScanner

$P_{100v} = 100 \times 7.727$

$= 772.7$

$P_{4\Omega} = (7.727)^2 \times 4 = 238.8$

$P_{100\Omega} = (7.727)^2 \times 100 = 5970.6$

$P_{2\Omega} = (7.727)^2 \times 2 + (11.818)^2 \times 2$

$= 119.41 + 279.33$

$= 398.74$

$P_{40v} = i_1 \times v + i_2 \times v$

$= 7.727 \times 40 + 11.818 \times 40$

$= 309.08 + 472.72$

$= 781.8$

$P_{1\Omega} = 139.66 \times 1$

$= 139.66$

$P_{10} = 139.66 \times 10 + 96.393 \times 10$

$1396.6 + 963.93$

$= 2360.53$

$P_{20} = 9.818 \times 20$

$= 196.36$

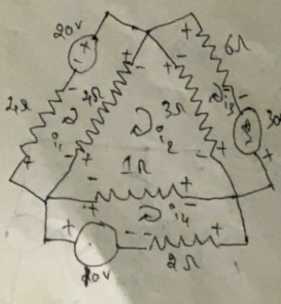
$P = vi$; $P = v^2/R$; $P = i^2 R$

$i_1^2 = 59.706$

$i_2^2 = 139.66$

$i_3 = 96.393$

p)



$-4i_1 + 20 - 4i_1 + 4i_2 = 0$

$-4i_2 + 4i_1 - 3i_2 + 3i_3 - i_2 + i_4 = 0$

$-3i_3 + 3i_2 - 6i_3 + 30 = 0$

$-i_4 + i_3 - 2i_4 + 10 = 0$

$-8i_1 + 4i_2 = -20$

$4i_1 - 8i_2 + 3i_3 + i_4 = 0$

$-9i_3 + 3i_2 = -30$

$-3i_4 + i_3 = -10$

$$\begin{bmatrix} -8 & 4 & 0 & 0 \\ 4 & -8 & 3 & 1 \\ 0 & 3 & -9 & 0 \\ 0 & 0 & 1 & -3 \end{bmatrix} = \begin{bmatrix} i_1 \\ i_2 \\ i_3 \\ i_4 \end{bmatrix} = \begin{bmatrix} -20 \\ 0 \\ -30 \\ -10 \end{bmatrix}$$

$$\Delta = \begin{vmatrix} -8 & 4 & 0 & 0 \\ 4 & -8 & 3 & 1 \\ 0 & 3 & -9 & 0 \\ 0 & 0 & 1 & -3 \end{vmatrix}$$

$|\Delta| = -8|A| - 4|B| + 0 + 0 = 0$

Consider

$$A = \begin{bmatrix} -8 & 3 & 1 \\ 3 & -9 & 0 \\ 0 & 1 & -3 \end{bmatrix} \Rightarrow |A| = \begin{vmatrix} -8 & 3 & 1 \\ 3 & -9 & 0 \\ 0 & 1 & -3 \end{vmatrix}$$

$-8 \times |A| = -186 \times -8$

$= 1488.$

$$B = \begin{bmatrix} 4 & 3 & 0 \\ 0 & -9 & 1 \\ 0 & 1 & 0 \end{bmatrix} = |B| = -4$$

$4 \times |B| = 4 \times -4 = -16$

now:- $|\Delta| = 1488 - (-16)$

$= 1488 + 16 = 1504$

$$\Delta_1 = \begin{vmatrix} -20 & 4 & 0 & 0 \\ 0 & -8 & 3 & 1 \\ -30 & 3 & -9 & 0 \\ -10 & 0 & 1 & -3 \end{vmatrix}$$

now :- $|\Delta_1| = -20\times|A| - 4\times|B|$

now :- $A = \begin{bmatrix} -8 & 3 & 1 \\ 3 & -9 & 0 \\ 0 & 1 & -3 \end{bmatrix} \Rightarrow |A| = 1488$

$\therefore \; -20\times|A| = -20\times 1488$
$= -29760.$

now :- $B = \begin{bmatrix} 0 & 3 & 1 \\ -30 & -9 & 0 \\ -10 & 1 & -3 \end{bmatrix} \Rightarrow |B| = -390$

$\therefore \; -4\times|B| = -390\times -4$
$= 1560$

$|\Delta_1| = -29760 + 1560 = -28200$

$\Delta_2 = \begin{vmatrix} -8 & -20 & 0 & 0 \\ 4 & 0 & 3 & 1 \\ 0 & -30 & -9 & 0 \\ 0 & -10 & 1 & 3 \end{vmatrix}$

$|\Delta_2| = -8\times|A| - (-20)\times|B|$

$A = \begin{bmatrix} 0 & 3 & 1 \\ -30 & -9 & 0 \\ -10 & 1 & 3 \end{bmatrix} \Rightarrow |A| = -390$

$\Rightarrow -8\times|A| = -390\times -8$
$= 3120$

$B = \begin{bmatrix} 4 & 3 & 1 \\ 0 & -9 & 0 \\ 0 & 1 & 3 \end{bmatrix} \Rightarrow |B| = -16$

$-20\times -16 = 320$

now $|\Delta_2| = 3120 - 320 = 2800$

$\Delta_3 = \begin{vmatrix} -8 & 4 & -20 & 0 \\ 4 & -8 & 0 & 1 \\ 0 & 3 & -30 & 0 \\ 0 & 0 & -10 & 3 \end{vmatrix}$ + - + -

$|\Delta_3| = -8\times|A| - 4\times|B| - 20\times|C|.$

$A = \begin{bmatrix} -8 & 0 & 1 \\ 3 & -30 & 0 \\ 0 & -10 & 3 \end{bmatrix} \Rightarrow |A| = 690$

$-8\times|A| = -8\times 690 = -5520$

$B = \begin{bmatrix} 4 & 0 & 1 \\ 0 & -30 & 0 \\ 0 & -10 & 3 \end{bmatrix} \Rightarrow \cancel{-360}\; |B| = -360$

$4\times|B| = 4\times -360 = -1440$

$C = \begin{bmatrix} 4 & -8 & 1 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix} = 36$

$20\times|C| = 20\times 36 = 720$

$|\Delta_3| = -5520 + 1440 - 720$
$= -3360$

$\Delta_4 = \begin{bmatrix} -8 & 4 & 0 & -20 \\ 4 & -8 & 3 & 0 \\ 0 & 3 & -9 & -30 \\ 0 & 0 & 1 & -10 \end{bmatrix}$

$|\Delta_4| = -8\times|A| - 4\times|B| - 20\times|D|$

$A = \begin{bmatrix} -8 & 3 & 0 \\ 3 & -9 & -30 \\ 0 & 1 & -10 \end{bmatrix} \Rightarrow |A| = -870$

$-8\times|A| = -8\times -870 = 6960$

$B = \begin{bmatrix} 4 & 3 & 0 \\ 0 & -9 & -30 \\ 0 & 1 & -10 \end{bmatrix}$

$\Rightarrow |B| = 480$

$-4\times|B| = -4\times 480 = -1920$

$$D = \begin{bmatrix} 4 & -8 & 3 \\ 0 & 3 & -9 \\ 0 & 0 & 1 \end{bmatrix} \Rightarrow |D| = 12$$

$$= -20 \times 12 = -240$$

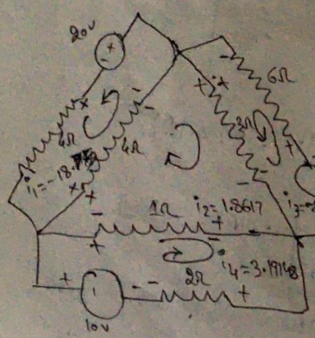
$$|\Delta_4| = +6960 - 1920 - 240$$
$$4800$$

$$\therefore i_1 = \frac{\Delta_1}{\Delta} = \frac{-28200}{1504} = -18.75$$

$$i_2 = \frac{\Delta_2}{\Delta} = \frac{2800}{1504} = 1.8617$$

$$i_3 = \frac{\Delta_3}{\Delta} = \frac{-3360}{1504} = -2.234$$

$$i_4 = \frac{\Delta_4}{\Delta} = \frac{4800}{1504} = 3.19148$$



$$\therefore P_{4\Omega} = i_1^2 \times 4 = (-18.75)^2 \times 4$$
$$= 1406.25$$

$$P_{20v} = (-18.75) \times 20 = -375$$

$$P_{4\Omega} = i_1^2 \times R + i_2^2 \times R$$
$$= (-18.75)^2 \times 4 + (1.8617)^2 \times 4$$
$$= -351.562 \times 4 + (3.465 \times 4)$$
$$= 1406.248 + 13.863 = -1392.385$$

$i_1^2 = -351.562$
$i_2^2 = 3.465$
$i_3^2 = -4.99075$
$i_4^2 = 10.1856$

$$P_3 = i_2^2 \times 3 + i_3^2 \times 3 \qquad i_3^2 =$$

$$= (3.465 \times 3) + (-4.99075 \times 3)$$
$$= 10.395 - 14.972$$
$$= -4.577$$

$$P_1 = i_2^2 \times 1 + i_4^2 \times 1$$
$$= 13.650$$

$$P_{6\Omega} = i_3^2 \times 6 = -29.94$$

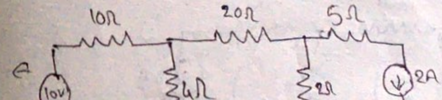
$$P_{30} = i_3 \times 30 = -66.9$$

$$P_2 = i_4^2 \times 2 = 20.37$$

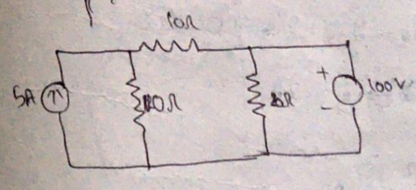
$$P_{10} = i_4 \times 10 = 31.914.$$

Mesh Anylasis:-

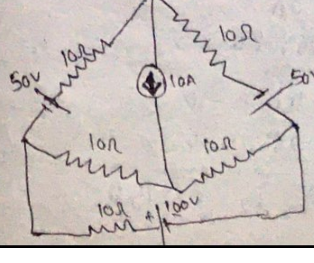
P).



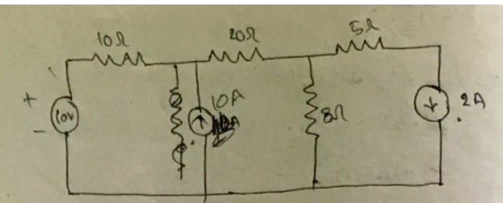
P)



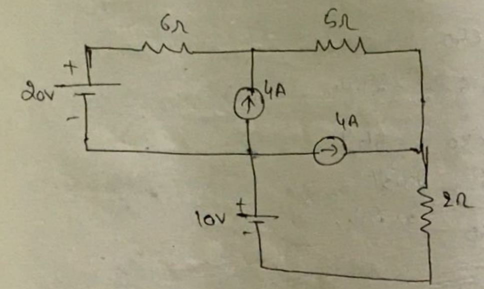
P) Super Mesh:-



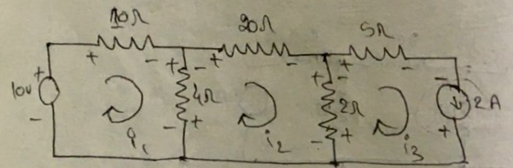
P)



P)



1)



$10 - 10i_1 - 4i_1 + 4i_2 = 0 \rightarrow (1)$

$-4i_2 + 4i_1 - 20i_2 - 2i_2 + 2i_3 = 0 \rightarrow (2)$

$i_3 = 2A$

$-14i_1 + 4i_2 = -10$

$-26i_2 + 4i_1 + 2i_3 = 0$

$i_3 = 2A$

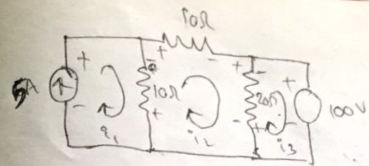
$\Rightarrow +4i_1 - 26i_2 + 4 = 0$

$\Rightarrow -14i_1 + 4i_2 = -10$

$4i_1 - 26i_2 = -4$

$i_1 = 0.793A \quad i_2 = 0.275A$

2)



$i_1 = 5A$

$-10i_2 + 10i_1 - 10i_2 - 20i_2 + 20i_3 = 0$

$-20i_3 + 20i_2 - 100 = 0$

$\Rightarrow -40i_2 + 10i_1 + 20i_3 = 0 \Rightarrow -40i_2 + 50 + 20i_3 = 0$

$-20i_3 + 20i_2 = 100 \qquad \Rightarrow -40i_2 + 20i_3 = -50$

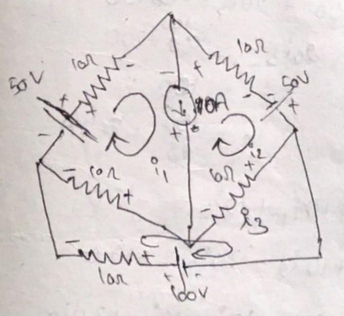
$\Rightarrow -40i_2 + 20i_3 = -50$

$20i_2 - 20i_3 = 100$

$i_2 = -2.5A \quad i_3 = -7.5A$

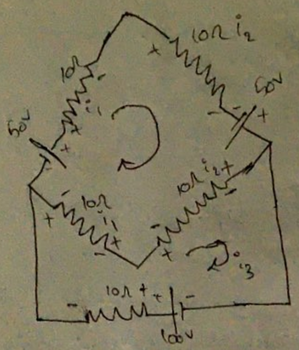
$i_1 = 5A \; ; \; i_2 = -2.5A \; ; \; i_3 = -7.5A$

Super mesh:-



$50 - 10i_1 - 10i_1 + 10i_3 = 0 \quad (i_1 - i_2) = 10$

$-20i_1 + 10i_3 = 50$



$i_1 - i_2 = 10A \to (1)$

$50+50-10i_1-10i_2-10i_2+10i_3-10i_1+10i_3=0 \to (1)$

$-10i_3+10i_1-10i_3+10i_2+100-10i_3=0 \to (2)$

$-20i_1-20i_2+20i_3 = \cancel{-50}\ -100$

$-20(i_1-i_2)+20i_3=-100$

$-20\times10+20i_3=-100$

$-200+20i_3=-100$

$20i_3=-100+200$

$20i_3=100$

$i_3=\frac{100}{20}=5A$

$-30i_3+10i_1+10i_2=-100$

$10i_1+10i_2-30i_3=-100$

$100=-10i_1-10i_2+30i_3$

$100=-10(i_1+i_2)+30i_3$

$100=-10(i_1+i_2)+30\times5$

$100=-10(i_1+i_2)+150$

$-50=-10(i_1+i_2)$

$i_1+i_2=\frac{50}{10}=5$

$i_1+i_2=5 \to (b)$

Solving $i_1-i_2=10$

$i_1+i_2=5$

$-2i_2=5$

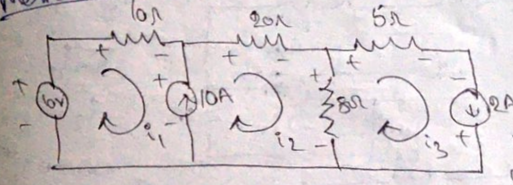
$i_2=-\frac{5}{2}=2.5$

$i_2=-2.5$

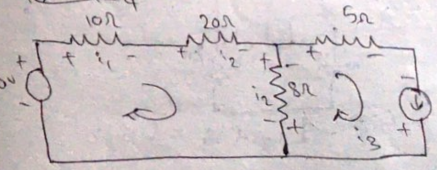
$i_1=7.5$; $i_2=-2.5$

$i_1=7.5A$; $i_2=-2.5A$; $i_3=5A$

Mesh analysis:-



here in last loop the (2A) current is moving so that the loop contains only (2A) i.e. $i_3=2A$



$-i_1+i_2=10A \to (a)$

$10-10i_1-20i_2-8i_2+8i_3=0$

$i_3=2A$

$10-10i_1-28i_2+8i_3=0$

$-10i_1-28i_2+8\times2=-10$

$-10i_1-28i_2+16=-10$

$-10i_1-28i_2=-26$

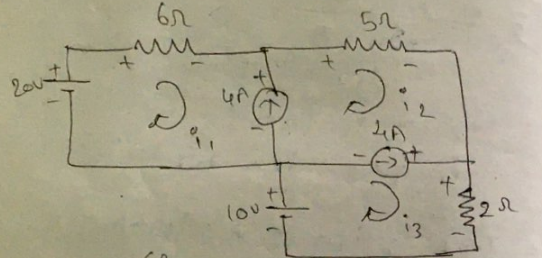
$-(10i_1+28i_2)=-26$

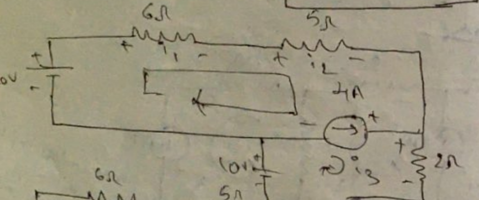
$10i_1 + 28i_2 = 26$

$-i_1 + i_2 = 10$

$i_1 = -6.68 \; ; \; i_2 = 3.315$

P)





$i_2 - i_1 = 4A$

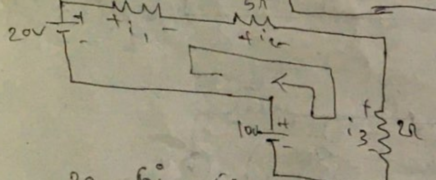
$\Rightarrow i_2 = 4 - i_1$

$-i_2 + i_3 = 4A$

Substitute $i_2 = 4 - i_1$ in above eq

$-4 + i_1 + i_3 = 4$

$i_1 + i_3 = 16 \rightarrow (A)$



$20 - 6i_1 - 5i_2 - 2i_3 + 10 = 0$

$-6i_1 - 5i_2 - 2i_3 + 30 = 0$

$30 = 6i_1 + 5i_2 + 2i_3$

$30 = 6i_1 + 20 - 5i_1 + 2i_3$

$10 = i_1 + 2i_3 \rightarrow (B)$

Solving (A) and (B)

$i_1 + 2i_3 = 16$

$i_1 + 2i_3 = 10$

$i_1 = 22 \; ; \; i_3 = -6$

$i_1 = 22A \; ; \; i_3 = -6A$

now Substitute in $i_2 = 4 - i_1$

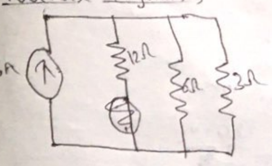
$i_2 = 4 - 22$

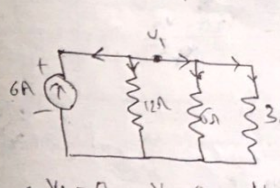
$i_2 = -18A$

P) Nodal Anayalasis

Current - Register

Nodal Analysis :-





$-6 + \frac{V_1 - 0}{12} + \frac{V_1 - 0}{6} + \frac{V_1 - 0}{3} = 0$

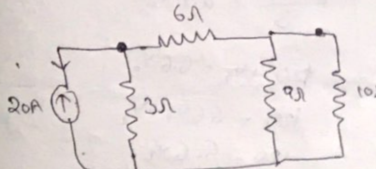
$\frac{V_1}{12} + \frac{V_1}{6} + \frac{V_1}{3} = 6$

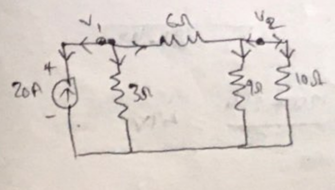
$\frac{V_1 + 2V_1 + 4V_1}{24} = 6$

$\frac{7V_1}{12} = 6$

$V_1 = \frac{72}{7} = 10.28$

P)





$$-20 + \frac{V_1}{3} + \frac{V_1 - V_2}{6} = 0$$

$$\frac{V_1}{3} + \frac{V_1 - V_2}{6} = 20$$

$$\frac{2V_1 + V_1 - V_2}{6} = 20$$

$$\frac{3V_1 - V_2}{6} = 20$$

$$3V_1 - V_2 = 120$$

$$3V_1 = 120 + V_2$$

$$V_1 = \frac{120 + V_2}{3}$$

$$\frac{V_2 - V_1}{6} + \frac{V_2}{9} + \frac{V_2}{10} = 0$$

$$\frac{15V_2 - 15V_1 + 10V_2 + 9V_2}{90} = 0$$

$$\frac{34V_2 - 15V_1}{90} = 0$$

$$34V_2 - 15V_1 = 0$$

$$-15V_1 = -34V_2$$

$$V_1 = \frac{34V_2}{15}$$

$$V_1 = 2.2V_2$$

$$\frac{120 + V_2}{3} = 2.2V_2$$

$$120 + V_2 = 6.6V_2$$

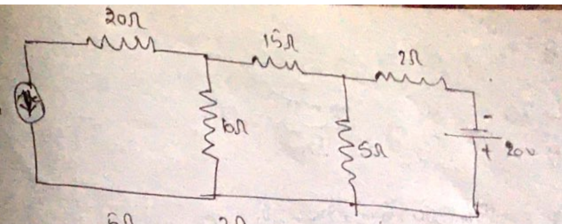
$$120 = 6.6V_2 - V_2$$

$$120 = 5.6V_2$$

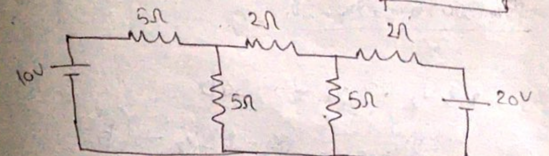
$$V_2 = 21.42$$

$$V_1 = \frac{120 + 21.4}{3} = 47V$$

p)



p)



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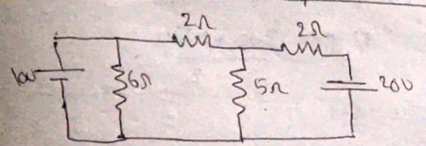

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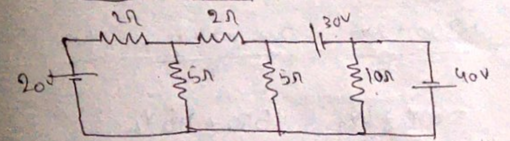

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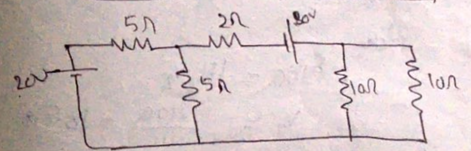

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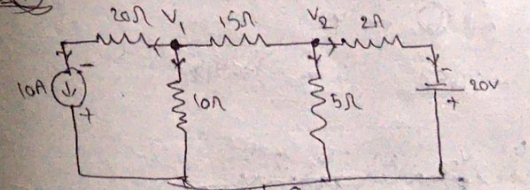


At Node 'V_1'

$$10 + \frac{V_1}{10} + \frac{V_1 - V_2}{15} = 0$$

$$10 + \frac{3V_1 + 2V_1 - 2V_2}{30} = 0$$

$$300 + 5V_1 - 2V_2 = 0$$

$$5V_1 - 2V_2 = -300 \rightarrow (a)$$

$$5V_1 = -300 + 2V_2$$

$$V_1 = \frac{-300 + 2V_2}{5}$$

At node 'V_2' :-

$$\frac{V_2+20}{2}+\frac{V_2}{5}+\frac{V_2-V_1}{15}=0$$

$$\frac{15V_2+300+6V_2+2V_2-2V_1}{30}=0$$

$5 \mid 5, 2, 15$
$\quad 1, 2, 3$

$$23V_2-2V_1=-300$$

$$-2V_1=-300-23V_2 \rightarrow (b)$$

$$V_1 = \frac{300+23V_2}{2}$$

Evaluating 'V_1' we get

$$\frac{-300+2V_2}{5}=\frac{300+23V_2}{2}$$

$$-600+4V_2=1500+115V_2$$

$$-2100=111V_2$$

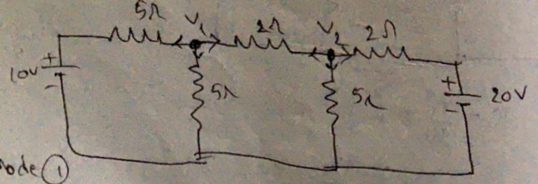
$$V_2=\frac{-2100}{111}=18.918$$

$$V_1=\frac{-300+23\times18.918}{2}=367.567$$

Solving (a) and (b) we get

$V_1=-67.56$; $V_2=18.918$

p)



node (1)

$$\frac{V_1-10}{5}+\frac{V_1}{5}+\frac{V_1-V_2}{2}=0$$

$5, 5, 2$
$1, 1, 1$

$$\frac{2V_1-20+2V_1+5V_1-5V_2}{10}=0$$

$$9V_1-20-5V_2=0$$

$$9V_1-5V_2=20 \rightarrow (a)$$

node (2)

$$\frac{V_2-20}{2}+\frac{V_2}{5}+\frac{V_2-V_1}{2}=0$$

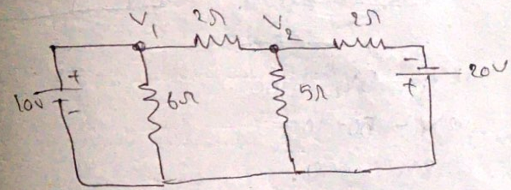
$$\frac{5V_2-100+2V_2+5V_2-5V_1}{10}=0$$

$$12V_2-5V_1=100 \rightarrow (b)$$

Solving (a) and (b)

$V_1=8.91$; $V_2=12.04$

p)



node (1) :- $V_1=-10V$

node (2) :-

$$\frac{V_2+20}{2}+\frac{V_2}{5}+\frac{V_2-V_1}{2}=0$$

$$\frac{5V_2+100+2V_2+5V_2-5V_1}{10}=0$$

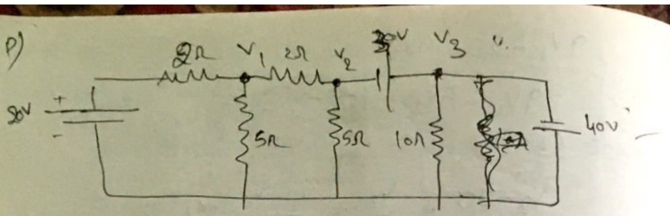
$$12V_2-5V_1=-100$$

$$12V_2=-150$$

$$12V_2=-150$$

$$V_2=-12.5$$

P)

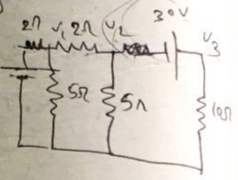


$$\frac{V_1-20}{2}+\frac{V_1}{5}+\frac{V_1-V_2}{2}=0$$

$V_3 = 40$

$$\frac{5V_1-100+2V_1+5V_1-5V_2}{10}=0$$

$V_3 - V_2 = 30V$



$V_3 = 40$
$V_3 - V_2 = 30V$
$40 - V_2 = 30V$
$V_2 = 10V$

~~$12V_1 - 5V_2 = 100$~~

~~$12V_1 = 250$~~

~~$V_1 = 20.833$~~

$12V_1 - 5V_2 = 100$

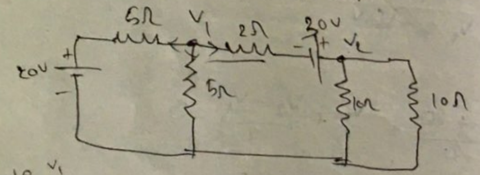
$12V_1 - 50 = 100$

$12V_1 = 150$

$V_1 = 12.5$

$V_3 - V_2 = 30V$

P)



node V_1

$$\frac{V_1-20}{5}+\frac{V_1}{5}+\frac{V_1+30-V_2}{2}=0$$

$$\frac{2V_1-40+2V_1+5V_1+150-5V_2}{10}=0$$

$9V_1 - 5V_2 = -110$

~~$V_1 = -12.22$~~

$9V_1 - 5V_2 = -110$

node V_2 :-

$$\frac{V_2}{10}+\frac{V_2}{10}+\frac{V_2-30-V_1}{2}$$

~~$2V_2 - 300 = 0$~~

~~$2V_2 = 300$~~

~~$V_2 = 150$~~

~~$9V_1 - 750 = -110$~~

~~$9V_1 = -860$~~

~~$V_1 = -95.5$~~

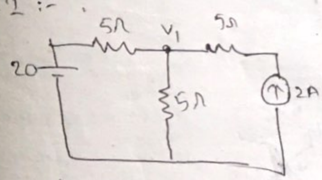
$$\frac{2V_2+5V_2-150-5V_1}{10}=0$$

$7V_2 - 5V_1 = 150$

$V_1 = -0.5$

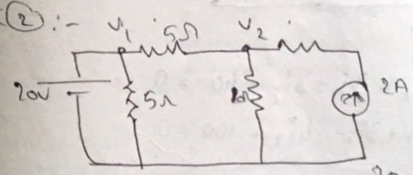
$V_2 = 21.05$

1) Case '1' :-



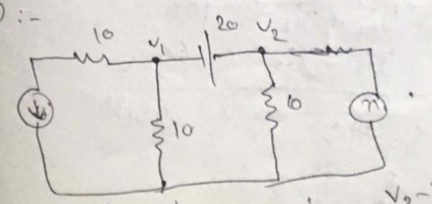
$$\frac{V-20}{5}+\frac{V}{5}-2A=0$$

Case (2) :-



$V_1 = 10$; $\frac{V_2-20}{5}+\frac{V_2}{10}-2=0$

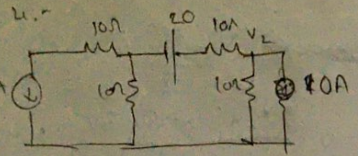
Case (3) :-



$20+\frac{V_1}{10}+\frac{V_2}{10}-20=0$; $V_2 - V_1 = 20$

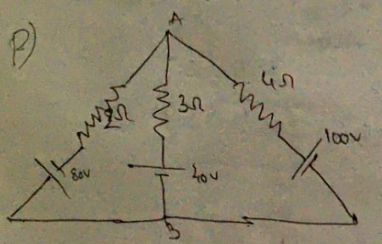
$V_1 + V_2 = 0$

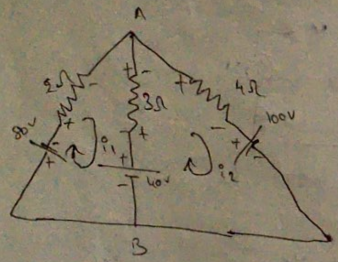
Case ii:-



$$\frac{V_1 + 20 - V_2}{10} -$$

P)





$$-80 - 2i_1 - 3i_1 + 3i_2 - 40 = 0$$

$$40 - 3i_2 + 3i_1 - 4i_2 - 100 = 0$$

$$-120 - 5i_1 + 3i_2 = 0$$

$$3i_1 - 7i_2 - 60 = 0$$

$$-5i_1 + 3i_2 = 120$$

$$3i_1 - 7i_2 = 60.$$

$i_1 = -39.2$; $i_2 = -25.38$

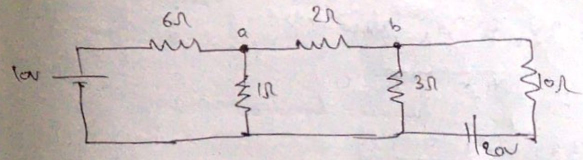
$P_4 = i_2^2 \times 4 =$

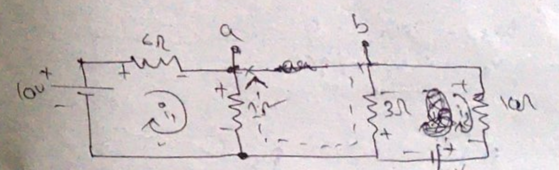
P)

P) Thevines:-

voltage - short

current - open.





$10 - 6i_1 - i_1 = 0$

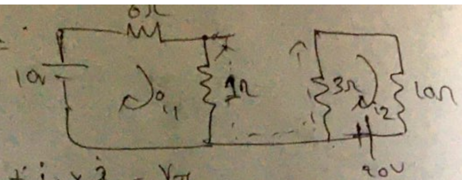
$7i_1 = 10 \Rightarrow i_1 = \frac{10}{7} = 1.428$

$-3i_2 - 10i_2 - 20 = 0$

$-13i_2 = 20$

$i_2 = \frac{20}{13} = -1.539$

V_{th} =

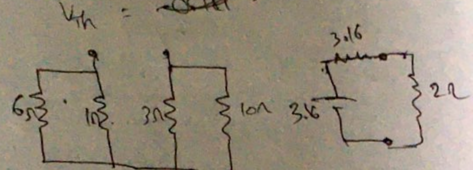


$i_1 \times 1 + i_2 \times 3 = V_{Th}$

$1.428 - 1.539 \times 3 = V_{th}$

$V_{th} = 3.189$

R_{Th} :-



$R_{Th} = \frac{6}{7} + \frac{30}{13} = 0.857 + 2.30$

$= 3.164$

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

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

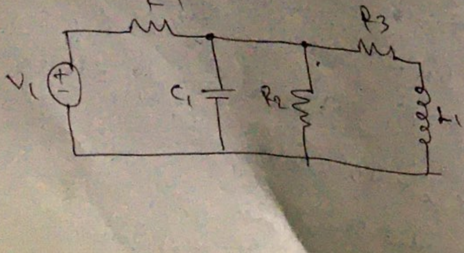
$3V_1 + 2V_1 + 3V_1 - 3V_2 = 0$

$8V_1 - 3V_2 = 0$

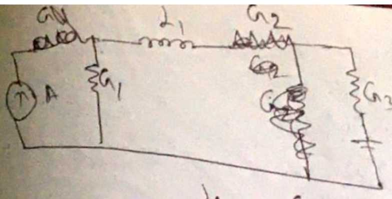
$3V_2 - V_1 = 20$

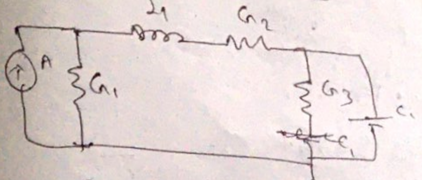
$8V_1 - 3V_2 = 0$

$-V_1 + 3V_2 = 20$

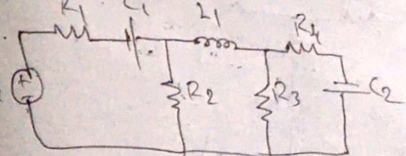


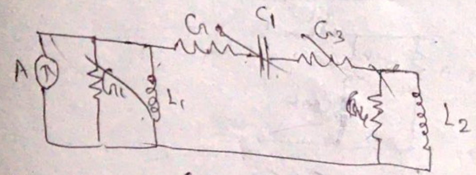
Duality

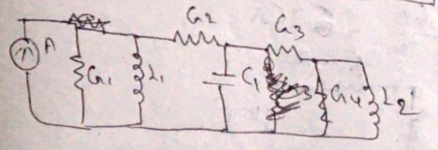




2)

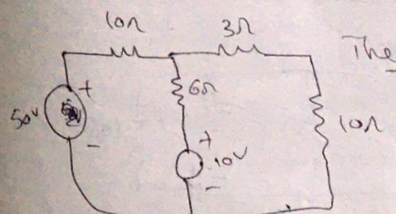


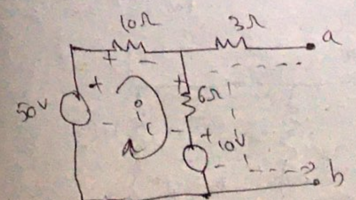




1)

Thevines





$50 - 10i_1 - 6i_1 - 10 = 0$

$-16i_1 = -40$

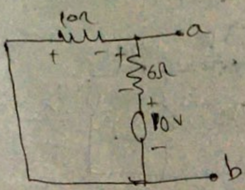
$16i_1 = 40$

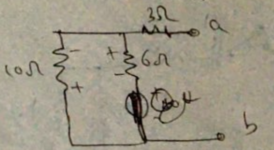
$i_1 = 2.5$

$V_{th} = 6 \times 2.5 + 10$

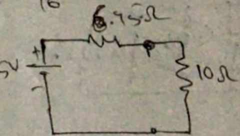
$V_{th} = 15 + 10 = 25V$

$R_{th} =$





$3 + \frac{60}{16} = 6.75\Omega$



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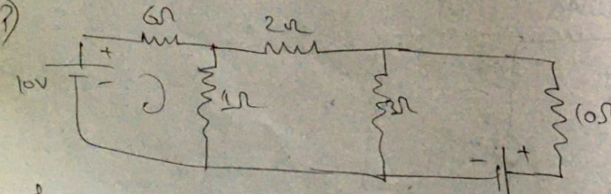
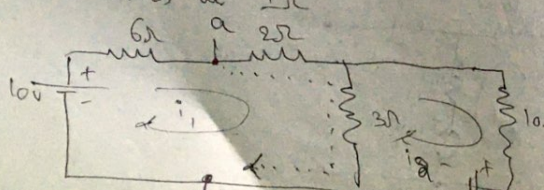
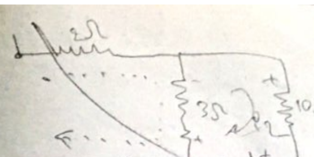


find thevines at 1Ω





$10 - 6i_1 - 2i_1 - 3i_1 + 3i_2 = 0$

$10 = 11i_1 + 3i_2 \rightarrow (a)$

$i_1 = \frac{10}{11} = 0.91A$

$-3i_1 - 20 - 3i_2 - 10i_2 = 0$

$3i_1 - 13i_2 = 20 \rightarrow (b)$

$\frac{20}{13} = 1.53$

$13)20(1.5385$

$\frac{20}{13}$

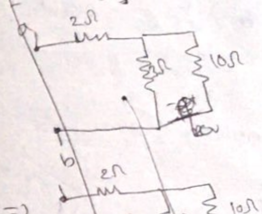
$V_{th} = 3 \times 1.53$

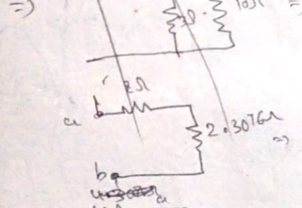
$= 4.59V$

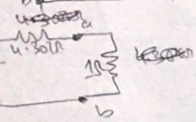
$i_1 = 0.46$

$i_2 = 1.64$

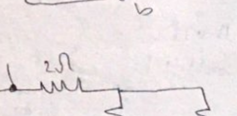
$R_{th} =$

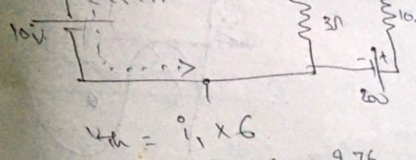






$\Rightarrow 4.3076\Omega$

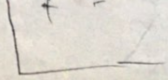




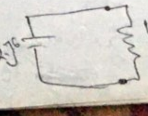
$V_{th} = i_1 \times 6$

$= 0.46 \times 6 = 2.76$

$R_{th} =$



$R_{th} = 6$



Chapter:- 4

$V_{av} = \frac{1}{T}\int_0^T v(t)\,dt$

1) Calculate frequency.

a) 0.2 S :- $f = \frac{1}{T} = \frac{1}{0.2} = 5Hz$

b) 50ms :- $f = \frac{1}{50} = 0.02$ KHz.

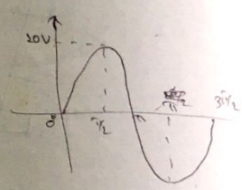
c) ~~500 us~~

2) $T = \frac{1}{f} = \frac{T}{~~60Hz~~} = \frac{1}{60} \Rightarrow f = \frac{1}{60} = 0.0165$

$T = \frac{1}{1\,KHz} = 1ms$

$T = \frac{1}{200\,KHz} = -0.005ms$

3) Given rms value = 20V



$v(t) = 20 \sin\omega t$

$= 20 \sin 33$

$= 20 \times 0.5446$

$= 10.89$ V

$v(t) = 20 \sin 110°$

$= 18.79V$

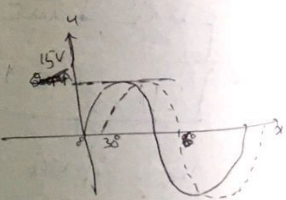
$v(t) = 20 \sin 148° = 11.471$

$v(t) = 20 \sin 325° = -11.471$

4) .

5) $V(t) = 15 \times \sin 30 V$

$= 7.5$



$V(t) = 15 \times \sin 90 V$

15

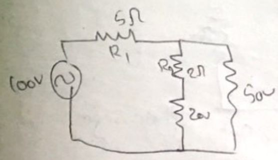
$V(t) = 15 \times \sin 45$

$= 10.60V$

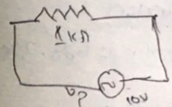
$v(t) = 15 \sin 180° = 0V$

$v(t) = 15 \sin 300° = -12.990V$

6)



7)



$V = IR$

$I = \frac{V}{R}$

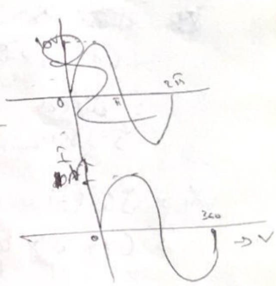
The function give to circuit is

$V(t) = V_p \sin\omega t = 10 \sin\omega t$

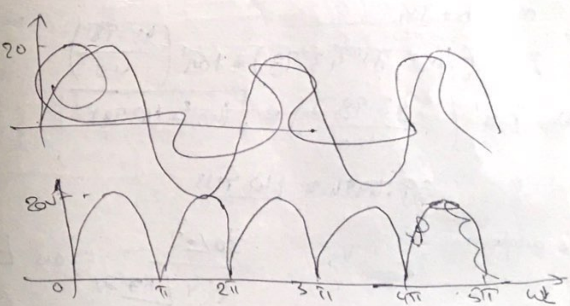
current trough risistor is $i(t) = \frac{V(t)}{R} = \frac{10}{}$

$V_{rms} = \sqrt{\frac{1}{T}\int_0^T V(t)^2 \cdot dt}$

$I = \frac{V_P}{R_r} = \frac{10}{1} = 10A$



14)



$V_{av} = \frac{1}{\pi}\int_0^{4\pi} 20 \sin\omega t \; d(\omega t)$

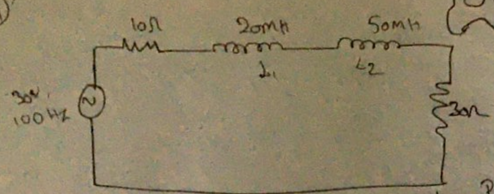
$= \frac{20}{\pi}\left(-\cos\omega t\right)_0^{4\pi}$

$= 6.366 \times \left(-\cos 0 - \cos 60\right)$

$= 3.183$

1)

5 - Chapter



find impedance, line current, and phase angle

$V_m = 30$; $f = 100Hz$ $\omega = 2\pi f$

$R = 10\Omega$; $\omega = 2 \times \pi \times 100$

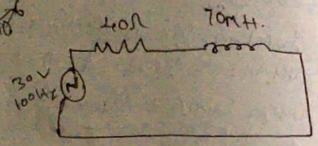
$= 200\pi = 628.31$

~~$X_L = J\omega L$~~

~~$628.31 \times 20 \times 10^{-6}$~~

$= 0.01225$

$f = 100Hz$



$X_L = J\omega(L)$

$= 628.31 \times 70 \times 10^{-6} = 0.04398 \times 100$

$= 43.98\Omega$

$Z = R + JX_L$

$Z = (40 + J \times 43.98) \tan^{-1}\left(\frac{43.98}{40}\right)$

$= \tan^{-1}\left(\frac{43.98\,J}{40}\right) \sqrt{(40)^2 + (43.98)^2}$

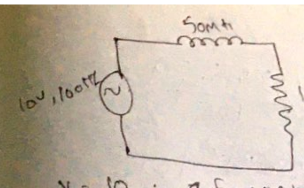
$Z = 59.4494 \angle 47.7133$

Phase angle :-

$i_g = \frac{V_s}{Z} = \frac{30\angle 0°}{59.4\angle 47.71} = 0.5\angle -47.71$

V_s lead i_s by $47.71°$

$\theta = 47.71°$



$V_m = 10$; $f = 100Hz$; $L = 50mH$, $R = 100$

$\omega = 2\pi f$

$= 2\pi \times 100 = 628.31$

$X_L = J\omega L$

$= 628.31 \times 50 \times 10^{-3}$ 31415.5×10^{-3}

$Z = R + JX_L$ -0.00314

$= (100 + J\,31415.5) \tan^{-1}\left(\frac{31415.5}{100}\right)$

$= \sqrt{(100)^2 + (31415.5)^2} \tan^{-1}\left(\frac{31415.5}{100}\right)$

31415×31415

$= \sqrt{10000 +}$

$Z = 31415.15 \angle 89.817$

Phase angle : $i = \frac{V_s}{Z} = \frac{10\angle 0°}{31415.15\angle 89.817} = -0.0003183\angle$

$Z = R + JX_L$

$Z = 100 + J(-0.00314) \tan^{-1}\left(\frac{-0.0031415.5}{100}\right)$

$= \sqrt{(100)^2 + (-0.00314)^2} \tan^{-1}\left(\frac{-0.0031415}{100}\right)$

$= 100 \angle -1.799$

$i_g = \frac{10\angle 0°}{100\angle -1.799 \times 10^{-3}} = 0.1\angle 1.799 \times 10^{-3}$

$= 0.1\angle +0.037$

Scanned with CamScanner

$Z = R + jX_L$

$= 100 + (31415.5)\tan^{-1}\left(\frac{31415.5}{100}\right)$

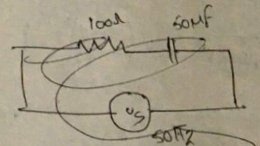
$\sqrt{(100)^2 + (31415.5)^2}\ \tan^{-1}\left(\frac{31415.5}{100}\right)$

$= 104.818\ \angle 17.993$

$i = \frac{V_S}{Z} = \frac{10\angle 0^\circ}{104.818\angle 17.993} = 0.095\angle -17.993$

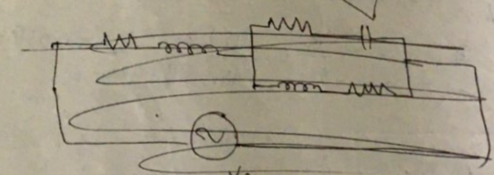
$V_S = iR = 0.095 \times$

P)



~~$V_S = 50Hz$~~ → $R = 100\Omega$; ~~$8.c = 50\mu f$~~

P)



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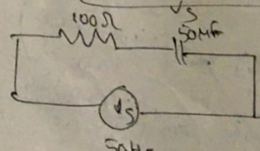


V_S $R = 100\Omega$; $C = 50$

$V_S = ?$ $F = 50Hz$.

$\omega = 2\pi f$

$= 2\pi \times 50 = 100\times\pi = 314.15$

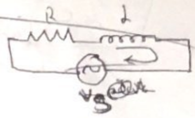
~~$Z =$~~ $X_L = \sqrt{501}$

~~chapter~~

Impedence Diagram:-

* Series of RL circuit

$X_L = \omega L$ → inductance.



$\because \omega = 2\pi f$

impedence :- $Z = \sqrt{R^2 + (j\omega L)^2}$

mH $= 10^{-3}$

1 μf $= 10^{-6}$

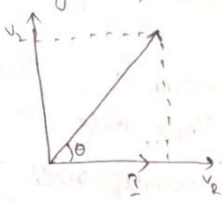
$R = \sqrt{a^2 + b^2}$

$\tan^{-1}\left(\frac{b}{a}\right)$

$Z = (R + j\omega L)\Omega$

$Z = \sqrt{R^2 + (X_L)^2}\ \Omega$ (inductor voltage leads)

current $I = V_S/Z =$ A



Phase angle $\theta = \tan^{-1}\left(\frac{X_L}{R}\right)$

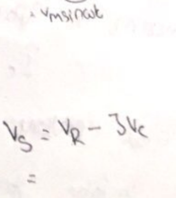
∴ Polar form of total impedence $Z =$

voltage across resistor $V_R = IR$

" " inductive resistance $V_L = IX_L$

* Series of RC circuit:- (capacitor voltage lags)

$X_C = \frac{1}{\omega C}$ $X_C = \frac{1}{2\pi f C}$



$Z = \left(R + \frac{1}{j\omega C}\right)\Omega$

$Z = (R - j\omega C)\Omega$

$Z = \sqrt{R^2 + (X_C)^2}$

$\theta = \tan^{-1}\left(-\frac{X_C}{R}\right)$.

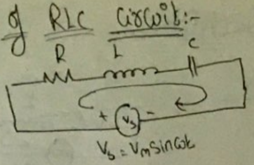
$I = V_S/Z$

Capacitive voltage $V_C = IX_C$ total voltage applied $V_S = V_R - jV_C$

Resistive voltage $V_R = IR$

Scanned with CamScanner

*) **Series of RLC circuit:-**



$X_L = \omega L = 2\pi f L$

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} = -2\pi f C$

impedance $Z = (R + JX_L + J(X_C))\ \Omega$

$Z = \sqrt{R^2 + J(X_L)^2 + J(X_C)^2}$

Current $\hat{I} = V_S / Z$

Phase angle $\theta = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$

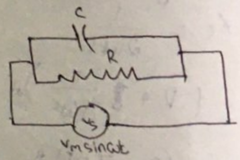
Voltage across $V_R = IR$

" " capacitive ~~reactance~~ reactance $= I X_C =$

" " inductive " $= I X_L =$

*) **Parallel Circuit:-**

RC circuit:-



$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} = -2\pi f C$

Current in resistance

$\hat{I}_R = \frac{V_S}{R}$ (current lags)

Current in capacitive

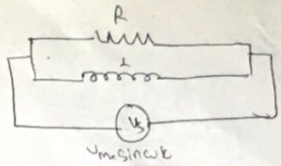
$\hat{I}_C = \frac{V_S}{X_C}$

Total current in two branches :- $\hat{I}_T = (\hat{I}_R + \hat{I}_C)A$

in polar form :- chang in angles

Impedance $Z = \frac{V_S}{\hat{I}_T} = \frac{V_S \angle 0^\circ}{I_T \angle}$

*) **||le RL circuits:-**



$X_L = \omega L = 2\pi f L$

$I_R = \frac{V_S}{R} =$

$\hat{I}_L = \frac{V_S}{X_L} =$

Total current $\hat{I}_T = (\hat{I}_R + \hat{I}_L)$

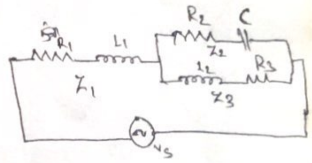
chang in polar form

(current lags behind voltage)

impedence $Z = \frac{V_S}{I_T}$

*) **Compound circuits:-**

here Z_1 is series. and Z_2 and Z_3 are ||le



now :- $Z_1 = (R_1 + JL_1)\Omega$

$Z_2 = (R_2 - JC)\Omega$

$Z_3 = (R_3 + JL_2)\Omega$

Total impedance $Z_T = Z_1 + \frac{Z_2 Z_3}{Z_2 + Z_3}$

Phase angle :-

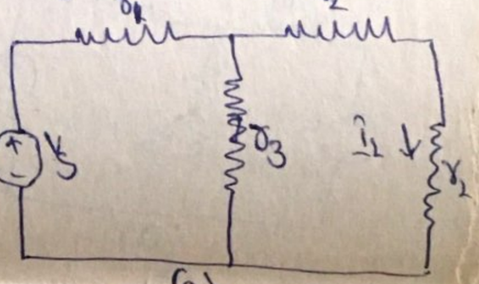
Network Analysis:-

3. Useful theorems in circuit analysis.

1) Thevenin's Theorem:-

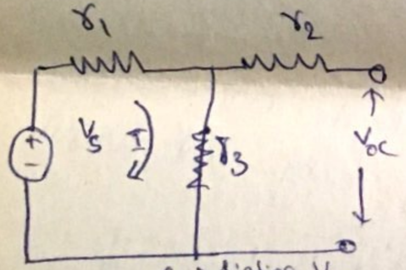
Statement:- Any two terminal bilateral linear dc. circuit can be replaced by Equivalent circuits consisting voltage source and series resistor.

Explanation:-
let us consider a simple dc circuit as shown in fig (a)
we are to find I_L by Thevenins theorem.
In order to find the Equivalent voltage source r_L is removed and $V_{o.c}$ is calculated.

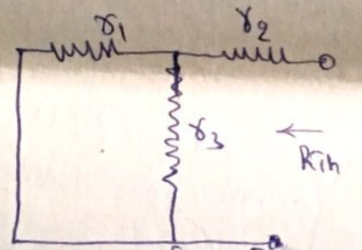


(a)

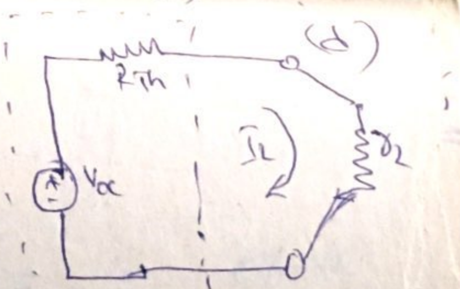
$$V_{oc} = I r_3 = \frac{V_S}{r_1 + r_3} \cdot r_3$$



(b) finding V_{oc}



(c) finding I_L



source network

Next to find the internal resistance of the network in series with V_{oc} the voltage source is moved by a short circuit as shown in fig(c)

$$R_{th} = r_2 + \frac{r_1 r_3}{r_1 + r_3}$$

As per Thevenin's Theoreme the Equivalent circuit being

$$I_L = \frac{V_{oc}}{R_{th} + r_L} \cdot A.$$

noneed:-
* **Steps for solving source network is:-**

1) Remove the load resistance R_L and find the open circuit voltage across open circuited load terminals.
2) Deactive the Constant sources and find internal resistance of the source of side looking trough open circuited load terminals. let this resistance be R_{th}.

3) obtain Thevenin's Equivalent circuit by Placing R_{Th} in Series with $V_{o.c}$

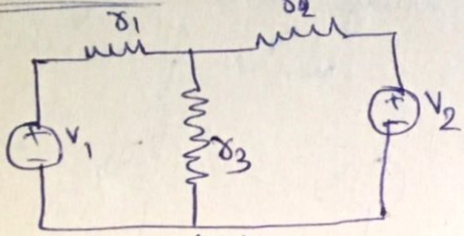
4) Reconnect R_L across the load terminals as shown in fig (d) (Obiviously) I (load current)

$$I_{Th} = \frac{V_{o.c}}{R_{Th} + R_L}.$$

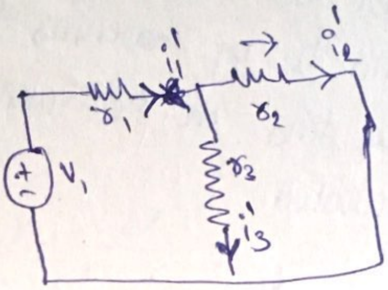
2) Superposition Theorem:-

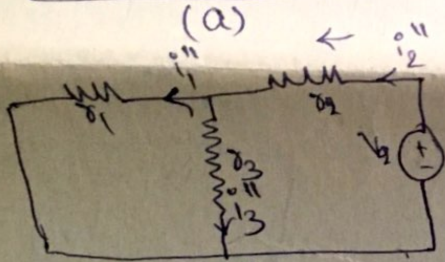
Statement:- This Th finds use in solving a network where two are more sources are present and connected not in series or in parallel.

Explanation:-



(a)





(c)

Let us first take the source V_1 alone at first replacing V_2 by short circuit

~~in fig~~ here $i_1' = \dfrac{V_1}{\dfrac{r_2 r_3}{r_2+r_3} + r_1}$; $i_2' = i_1' \cdot \dfrac{r_3}{r_2+r_3}$; $i_3' = i_1' - i_2'$

next removing V_1 by short circuit let the circuit be energised by only $i_2'' = \dfrac{V_2}{\dfrac{r_1 r_3}{r_1+r_3} + r_2}$ and $i_1'' = i_2'' \cdot \dfrac{r_3}{r_1+r_2}$

$i_3'' = i_2'' - i_1''$.

As per Superposition theorem:-

$$i_3 = i_3' + i_3''$$

$$i_2 = i_2' - i_2''$$

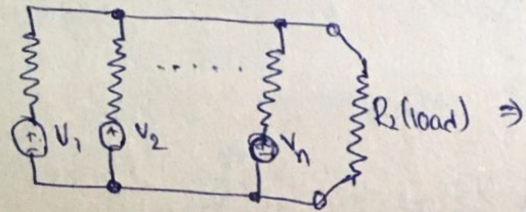
$$i_1 = i_1' - i_1'' //$$

2

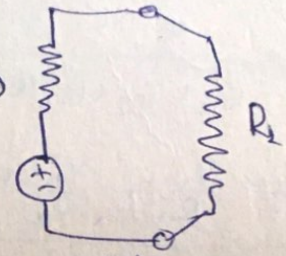
Millman's Theorem:-

Statement:- The utility of this Th is that any no:- of ∥le voltage sources can be reduced to one equivalent one

* when a no:- of voltage sources ($V_1, V_2, \ldots V_n$) are in ∥le having internal resistance ($R_1, R_2, R_3 \ldots R_n$) respectively. The argument can be replaced by single equivalent voltage source V, series resistance 'R'



(a)
no of ∥le voltage source finding power to a load resistance



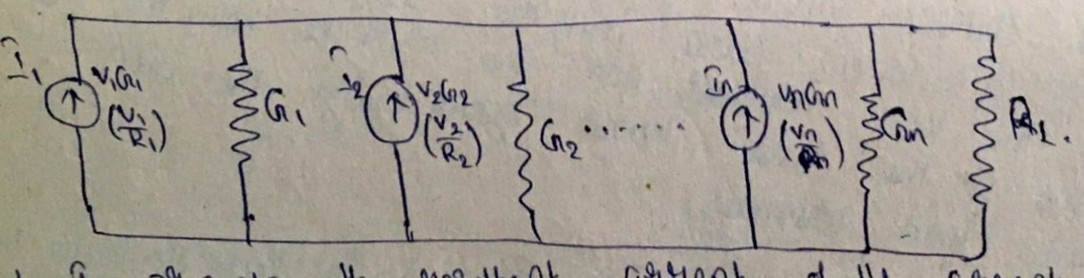
(b)
Equivalent voltage and resistance of the source network following

As per Millmans Th:-

$$V = \frac{\pm V_1G_1 \pm V_2G_2 \pm \cdots \pm V_nG_n}{G_1+G_2+\cdots G_n} \;;\; R = \frac{1}{G} = \frac{1}{G_1+G_2 \cdots G_n}$$

Explaination:-

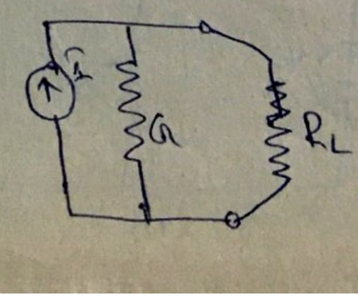
Assuming a dc network of numerous ∥le voltage sources with internal resistance supplying power to a load resistance R_L all voltage sources are connected to current source as shown below

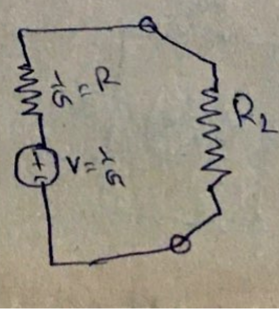


let I represents the resultant current of ∥le current sources while 'G' the equivalent conductance

$$I = I_1 + I_2 + I_3 + \cdots I_n \;;\; G = G_1 + G_2 + G_3 + \cdots G_n$$

$V_0 =$





next the resulting current source is converted to an Equivalent voltage source as depicted in fig above

thus :- wkt $\hat{I} = VR \Rightarrow V = \frac{\hat{I}}{R}$

$$V = \frac{\hat{I}}{G} = \frac{\pm \hat{I}_1 \pm \hat{I}_2 \pm \hat{I}_3 \pm \hat{I}_4 + \cdots \pm \hat{I}_n}{G_1 + G_2 + G_3 + G_4 + \cdots G_n}$$

+ and - ve sign appeared to include the cases where sources ~~is connected to~~ may be supplying current in the same direction

$$R = \frac{1}{G} = \frac{1}{G_1 + G_2 + G_3 + \cdots G_n}$$

$$V = \frac{\pm \frac{V_1}{R_1} \pm \frac{V_2}{R_2} \pm \frac{V_3}{R_3} \pm \cdots \pm \frac{V_n}{R_n}}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots \frac{1}{R_n}}$$

where 'R' is Equivalent resistance connected with Equivalent valve source in series.

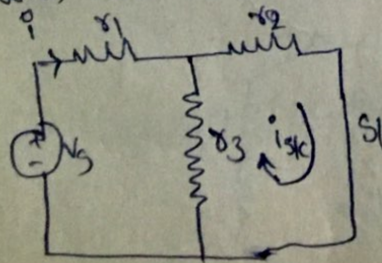
$$V = \frac{\pm V_1 G_1 \pm V_2 G_2 \pm V_3 G_3 \pm V_4 G_4 + \cdots V_n G_n}{G_1 + G_2 + G_3 + \cdots G_n}$$

Norton's Theorem:-

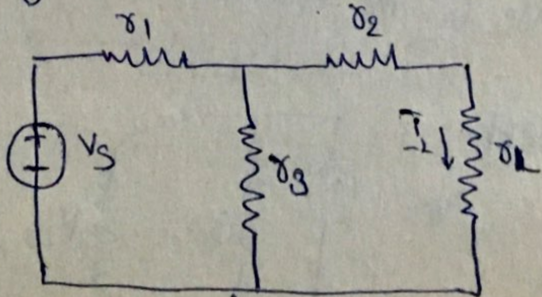
Statement:- A linear active network consisting of independent and or dependant voltage and current source and linear bilateral network elements can be replaced by an Equivalent circuit consisting of a current source being the short circuited current across the load terminal and the resistance being the internal resistance of the source network looking trough the open circuited load terminals.

Explanation:-

in order to find the current trough r_L the load resistance by norton's Th, let us replace r_L by short circuit.



(a)



(b)

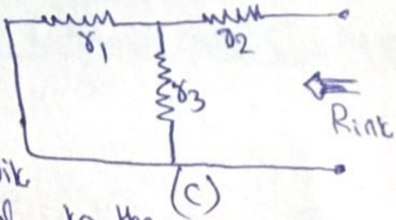
Obiviously:-

$$i = \frac{V_S}{r_1 + \frac{r_2 r_3}{r_2+r_3}} \quad \text{and} \quad i_{sc} = i\frac{r_3}{r_3+r_2}$$

Next the short circuit is removed and the independent source is deactivated as done in Thevenin's Th.

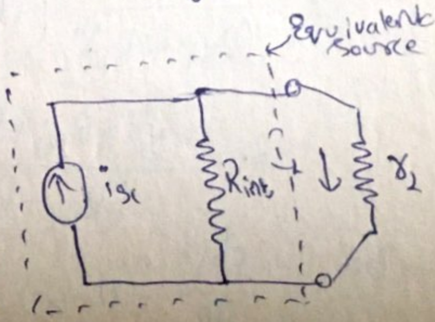
from fig(c)

$$R_{int} = r_2 + \frac{r_1 . r_3}{r_1+r_3}$$



As per norton's Th Equivalent source circuit would contain a current source in Parallel to the internal resistance the current source being the short circuited current across the shorted terminals of the load resistor (from fig (d))

$$\text{obiviously } I_L = i_{s.c} \cdot \frac{R_{int}}{R_{int}+r_L}$$

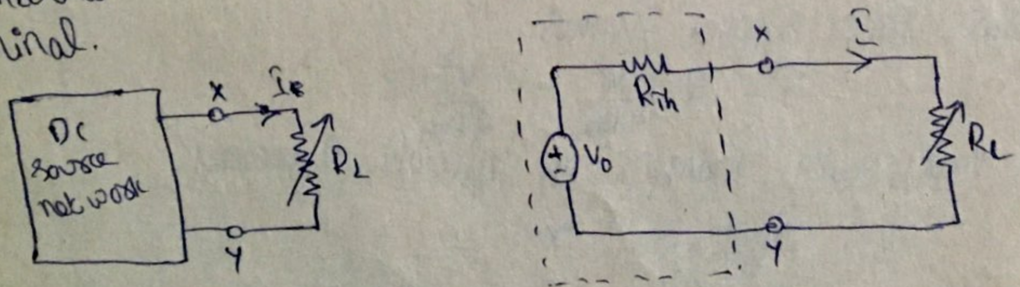


It may be noted here that determination of Rint for the source system norton's Theorem is identical to that of thevenins Theorem already described.

Maximum Power Transfer Th:-

This Th is used to find the value of load resistance for there would be maximum amount of Power transfer from source to load.

Statement:- A Resistance load being connected to dc network receives maximum power when the load resistance is Equal to internal resistance of source network as seen from load terminal.



with reference to fig

$$I = \frac{V_0}{R_{th}+R_L} \rightarrow (1)$$

While the Power delivered to resistive load is

While the power delivered to the resistive load is from Eq ①

$$P_L = i^2 R_L = \left(\frac{V_0}{R_{Th} + R_L}\right)^2 \times R_L \rightarrow ②$$

P_L can be maximised by varying R_L and hence, maximum power can be delivered when $(dP_L/dR_L) = 0$

However :- $\frac{d(P_L)}{dR_L} = \frac{d}{dR_L}\left[\frac{1}{[(R_{Th}+R_L)^2]^2}\right] \times$

(wkt :- $\frac{d}{dx}\left(\frac{u}{v}\right) \Rightarrow u.\frac{dv}{dx} - v.\frac{du}{dx}$)

$$\left[(R_{Th}+R_L)^2 . \frac{d}{dR_L}(V_0^2 R_L) - V_0^2 R_L . \frac{d}{dR_L}(R_{Th}+R_L)^2\right] \rightarrow ③$$

$$= \frac{1}{(R_{Th}+R_L)^4}\left\{(R_{Th}+R_L)^2 V_0^2 - V_0^2 R_L \times 2(R_{Th}+R_L)\right\} \rightarrow ④$$

$$= \frac{V_0^2(R_{Th}+R_L-2R_L)}{(R_{Th}+R_L)^3} = \frac{V_0^2(R_{Th}-R_L)}{(R_{Th}+R_L)^3} \rightarrow ⑤$$

But :- $\frac{dP_L}{dR_L} = 0 \Rightarrow \frac{V_0^2(R_{Th}-R_L)}{(R_{Th}+R_L)^3} = 0 . \rightarrow ⑥$

$$R_{Th} - R_L = 0 \Rightarrow R_{Th} = R_L$$

Hence it is ~~[illegible]~~ proved that power transfer from dc source network to resistive network is maximum when internal resistance of dc network is equal to load resistance.

Again here $R_{Th} = R_L$. substituting in ②

$$P_{max} = \left(\frac{V_0^2 R_{Th}}{(R_{Th}+R_{Th})^2}\right) = \frac{V_0^2 R_{Th}}{4R_{Th}^2} = \frac{V_0^2}{4R_{Th}} //.$$

This is power consumed by the load.

load power and source power being the same the total power supplied is thus.

$$P = 2 . \frac{V_0^2}{4R_{Th}} = \frac{V_0^2}{2R_{Th}}$$

During max power transfer the efficiency η becomes

$$\eta = \frac{P_{max}}{P} \times 100 = 50\% //.$$

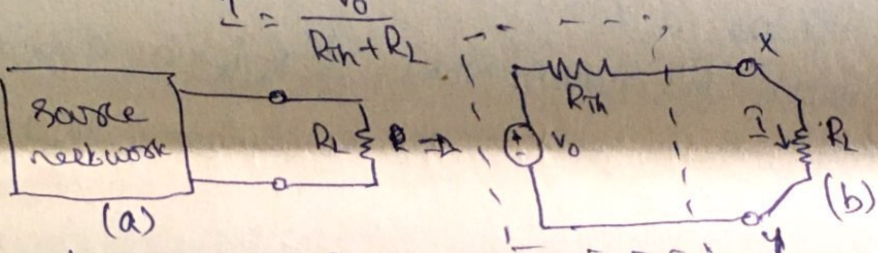
(4)

Compensation Th:-

Statement:- In a linear time-invariant network when the resistance (R) of an incoupled branche, carrying a current ($\bar{I}$) is changed by (ΔR) the currents in all branches would change and can be obtained by assuming that an ideal voltage source of (V_c) has been connected [such that $V_c = \bar{I}(\Delta R)$] in series with ($R+\Delta R$) when all other sources in network are replaced by their internal resistance.

Explanation:-
Let us assume a load R_L be connected to a dc source network whose Thevenins Equivalent gives V_0 as the thevenin voltage and and R_{th} as Thevenins resistance as Evident from fig (a)

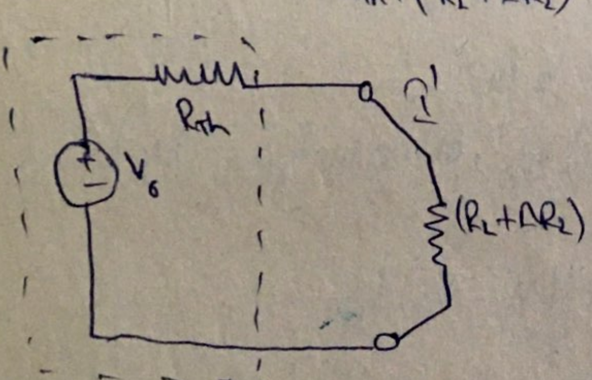
$$\bar{I} = \frac{V_0}{R_{th}+R_L}$$



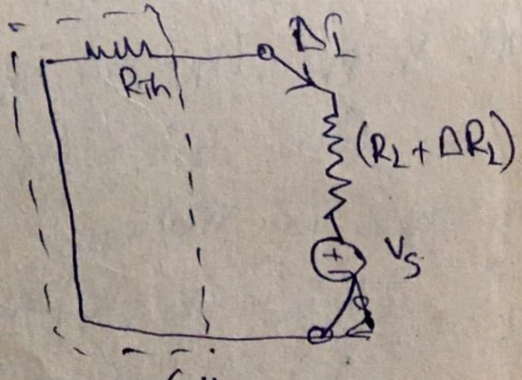
(a) (b)

Let the load resistance R_L be changed to $(R_L+\Delta R_L)$ since the rest of the circuit remains unchanged, the thevenin Equivalent network remains the same

here:- $$\bar{I}' = \frac{V_0}{R_{th}+(R_L+\Delta R_L)}$$



(c)



(d)

The change of current being termed as $\Delta \bar{I}$, we find

$$\Delta \bar{I} = \bar{I}' - \bar{I}$$

$$= \frac{V_0}{R_{th}+(R_L+\Delta R_L)} - \frac{V_0}{R_{th}+R_L}$$

$$\frac{V_0\left(R_{Th}+R_L-(R_{Th}+R_L+\Delta R_L)\right)}{(R_{Th}+R_L+\Delta R_L)(R_{Th}+R_L)}$$

$$= -\left(\frac{V_0}{R_{Th}+R_L}\right)\cdot\frac{\Delta R_L}{R_{Th}+R_L+\Delta R_L} = -\frac{i\,\Delta R_L}{R_{Th}+R_L+\Delta R_L}$$

$$= \frac{-V_c}{R_{Th}+R_L+\Delta R_L}.$$

V_c is Equal to $i(\Delta R_L)$ and is termed as Compensating voltage)

Tellegen's Th:-

__Statement:-__ Tellegen's Th is applicable to any network made up of lumped two terminal elements.

For any given time, the sum of power delivered to each branch of any electric network is zero

Thus for k^{th} branch this theorem states $\sum_{k=1}^{n} V_k i_k = 0$; n being the number of branches V_k the drop in the branch and i_k the trough current.

__Explanation:-__

let $i_{pq}(=i_k) =$ kth branch through current.

V_k = Voltage drop in branch $k = V_p - V_q$ while V_p and V_q are the respectively node voltages at P and q nodes.

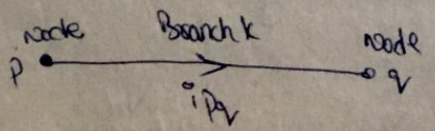
we have $V_k i_{pq} = (V_p - V_q)\, i_{pq} = V_k i_k$

(also $V_k i_k = (V_q - V_p)\, i_{qp}$, obviously $i_{qp} = -i_{pq}$)

Summing these two relations

$$2 V_k i_k = (V_p - V_q)\, i_{pq} + (V_q - V_p)\, i_{qp}$$

$$V_k i_k = \frac{1}{2}\left[(V_p - V_q)\, i_{pq} + (V_q - V_p)\, i_{qp}\right].$$



Such an Eq Can be written for Every branch (5)
of the network assuming n branches generalisation yields

$$\sum_{k=1}^{n} v_k i_k = \frac{1}{2}\sum_{p=1}^{n}\sum_{q=1}^{n}(v_p - v_q)\, i_{pq}$$

$$= \frac{1}{2}\sum_{p=1}^{n} v_p\left(\sum_{q=1}^{n} i_{pq}\right) - \frac{1}{2}\sum_{q=1}^{n} v_q\left(\sum_{p=1}^{n} i_{pq}\right)$$

However following kirchoff's current law the algebraic sum of currents at Each node is Equal to zero.

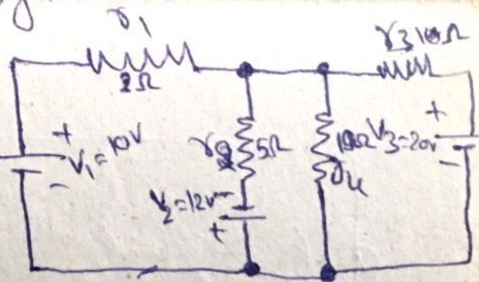
$$\sum_{p=1}^{n} i_{pq} = 0 \; ; \; \sum_{q=1}^{n} i_{qp} = 0$$

with this finally we get $\sum_{k=1}^{n} v_k i_k = 0$

Problems:-

Thevenin's Th:-

in a ~~circuit~~ network then find current through 10 Ω resistor utilising Thevenin's Th.-



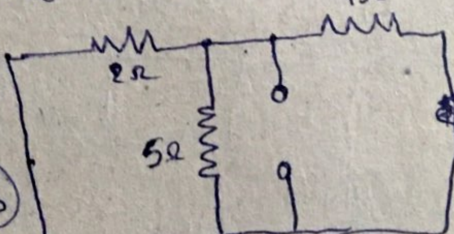
(a)

Sol:- In the Given circuit Voltages of

$V_1 = 10V$; $V_2 = 12V$; $V_3 = 20V$

$r_1 = 2\Omega$; $r_2 = 5\Omega$; $r_3 = 10\Omega$; $r_4 = 10\Omega$

& let the resistance r_4 be removed and the circuit Exhibited in below circuit



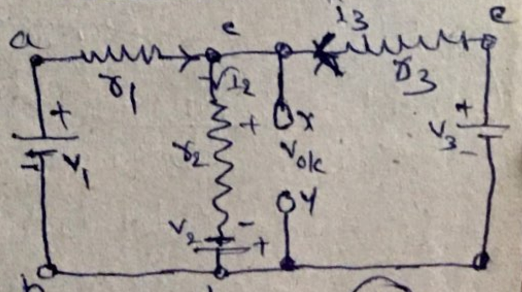
(b)

At nod 'c', application of KCL Yields

$$i_1 + i_3 - i_2 = 0$$

$\boxed{\text{wkt } I = \frac{V}{R}}$

$$\frac{V_1 - V_{oc}}{r_1} + \frac{V_3 - V_{oc}}{r_3} - \frac{V_{oc} + V_2}{r_2} = 0.$$



(c)

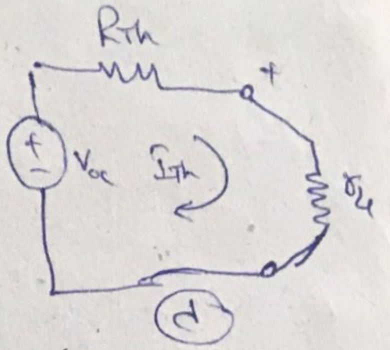
Summing the open circuits of fig (c). terminal x-y to be $V_{o.c}$ is obiviously The Potential at c node is $V_{o.c}$

$$\frac{10-V_{oc}}{2}+\frac{20-V_{oc}}{1}-\frac{V_{oc}+12}{5}=0$$

$$-0.5V_{oc}-V_{oc}-0.2V_{oc}=2.4-20-5$$

$$1.7V_{oc}=+22.6V$$

$$V_{oc}=13.29V.$$



$\therefore$ here $\frac{1}{R_{Th}}=\frac{1}{2}+\frac{1}{5}+\frac{1}{1}$

$$R_{Th}=\frac{10}{17}\,\Omega$$

Thevinins Eq circuit being show in fig (c)

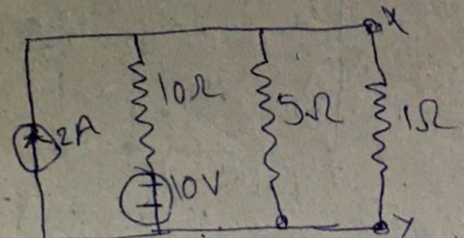
$$I_4 = I_{Th}=\frac{V_{oc}}{R_{Th}+r_4}$$

$$I_4=\frac{13.29}{\frac{10}{17}+10}=1.26A\ \text{Ans.}$$

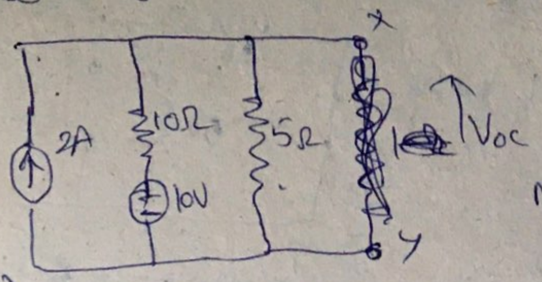
5/17 (2.4
10
30

$5-0.5V_0-20-V_{oc}$
$-0.2V_{oc}+2.($

2) Given an circuit of fig find the Power lss in 1Ω resistor by Thevenin's Th:- $\frac{1}{2}+\frac{1}{5}+\frac{1}{1}$



Sol let us first remove 1Ω resistor from x-y terminal



now Applying KCL at x y term when $I=2$ another voltage of 10V resistance are 5, 10.

$(\because I=\frac{V}{R})$

$$\frac{V_{oc}}{5}+\frac{V_{oc}-10}{10}=2$$

$$0.2V_{oc}+0.1V_{oc}-1=2$$

$$0.2V_{oc}+0.1V_{oc}-1=2 \quad \Rightarrow \quad 0.3$$

$$V_{oc}=\frac{3}{0.3}=$$

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$V_{oc}(0.2+0.1) = 3$

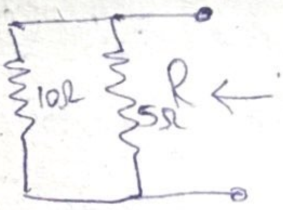
$V_{oc}(0.3) = 3$

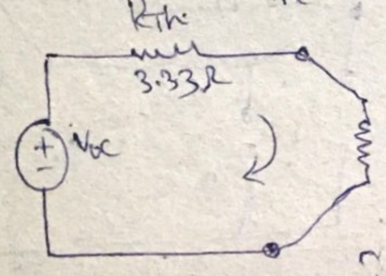
$V_{oc} = 10\,V$

here $\frac{1}{R_{Th}} = \frac{1}{5}+\frac{1}{10}$

$\frac{1}{R_{Th}} = \frac{10+5}{50} = \frac{15}{50}$

$R_{Th} = \frac{50}{15} = 3.33\,\Omega$





here 1Ω resistor is given by

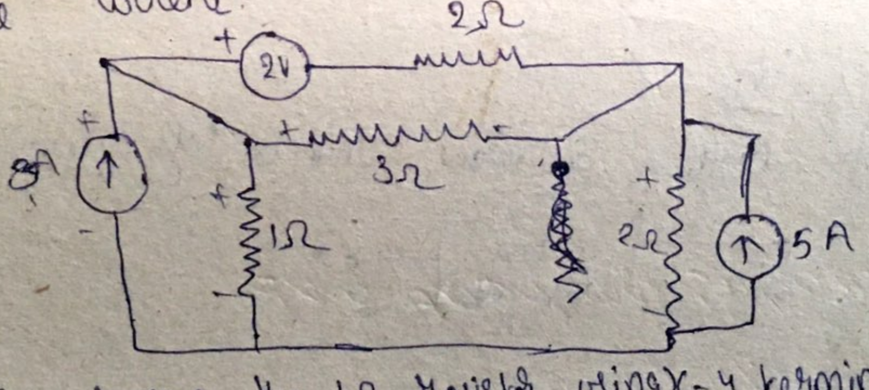
$I_{Th} = \frac{V_{oc}}{R_{Th}+1} = \frac{10}{3.33+1} = \frac{10}{4.33}$

$= 2.3077$

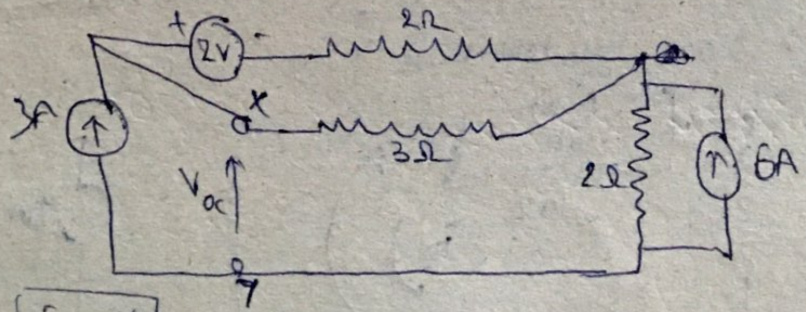
Power loss in 1Ω resistor is $P = I^2 r = (2.30)^2 \times 1 = 5.3255$

p) Test Papers:-

Given an circuit and we are to find 1Ω resistor in the current:-



let us remove the 1Ω resistor using x-y terminals



W.K.T:- $\boxed{I = \frac{V}{R}}$

now Apply KCL to above circuits of x y ter

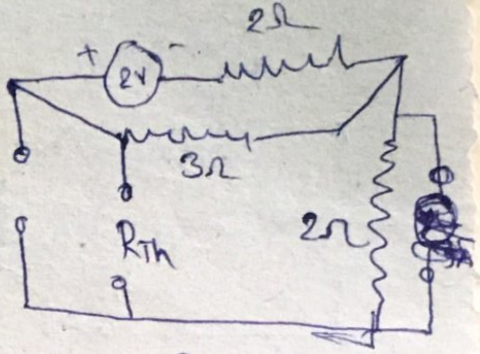
$$\frac{V_{oc}-2}{2} + \frac{V_{oc}}{3} = 3A$$

$$0.5V_{oc} - 1 + 0.33\,V_{oc} = 3$$

$$V_{oc}(0.5+0.33) - 1 = 3$$

$$V_{oc} = \frac{4}{0.833} = 4.8019\,V$$

$$V_{oc} = 4.8019\ V$$



now $V_{xy} = \underset{i}{5} \times \underset{R}{2} = 10\,V$

Obiviously $V_{x,y}$ is identical to V_{th}

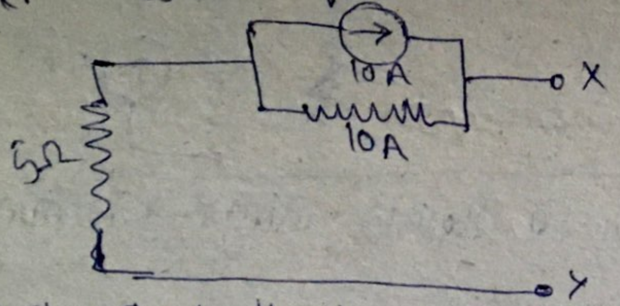
$$\frac{1}{R_{Th}} = \frac{1}{\frac{2\times 3}{2+3}} = \frac{2+3}{2\times 3} = \frac{5}{6}$$

$$R_{Th} = \frac{6}{5} = 1.2\,\Omega$$

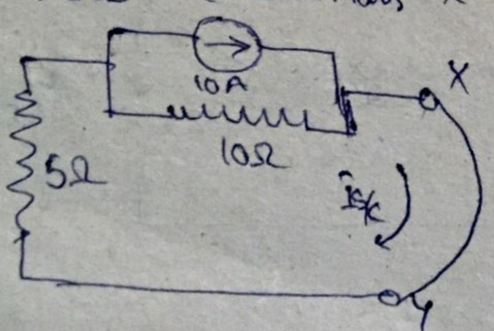
$$I_{1\Omega} = I = \frac{V_{oc}}{R_{Th}+1} = \frac{4.8019}{1.2+1} = \frac{4.8019}{2.2} = 2.18268184\,A$$

Norton's Th:-

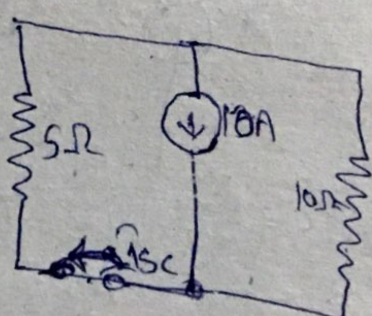
1) find nortons Equivalent circut to left of terminal x, y



Sol first short the terminals x - y



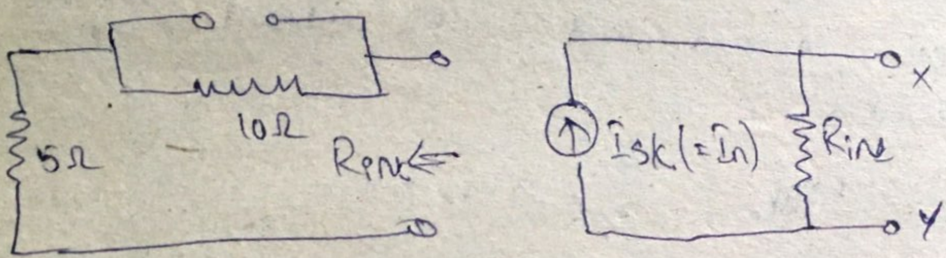
⇒



I_{SC} is current through the 5Ω resistor

$$I_{sc} = 10 \times \frac{10}{10+5} = 6.67A \quad \left(\because I_{sc} = \frac{r_3}{r_3+r_2} \right)$$

to determine the equivalent resistance sc short circuit of of circuit looking through x-y constant source is deactivated as show in fig

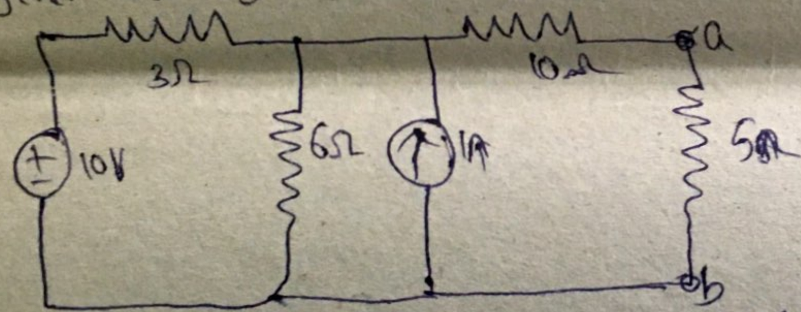


$R_{int} = 10+5 = 15Ω$

nortons equivalent circuit has been shown in

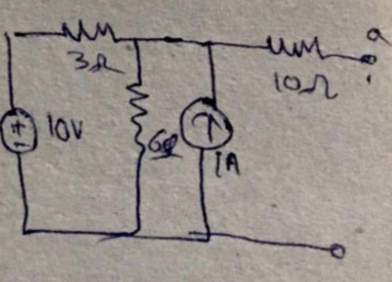
$I_n = 6.67A \; ; R_{int} = 15A$.

p) find current in 5Ω resistor.



Sol. let us first remove 5Ω resistor and short the a-b terminals

Assuming the voltage to be +ve at node 1 in fig



$$\frac{V-10}{3} + \frac{V-1}{6} + \frac{V}{10} = 0$$

$0.33V - 3.33 + 0.16V + 0.1V = 0$

$V(0.33 + 0.16 + 0.1) = 3.33 + 1$

$$V = \frac{4.33}{0.59} = 7.33V.$$

Apply KVL at right most loop (1 - a, b - 2)

$$-V + I_{s.c} \times 10 = 0$$

$$-7.22 \times 10 I_{sc} = 0$$

$$I_{sc} = 0.722\ A\ (= I_n)$$

To find norton's Equivalent resistance through a & b, 5 Ω1 resistance removed and all the constant sources are deactivated.

here $R_{int} = \frac{3 \times 6}{3+6} + 10 = 12\ \Omega$

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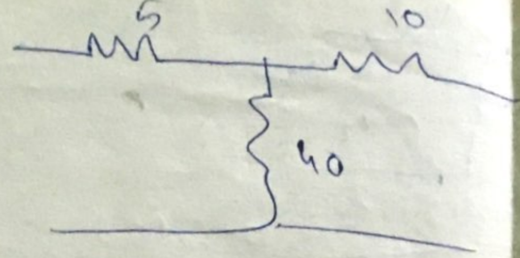
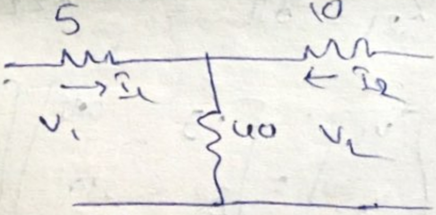
b) 

Z parameter

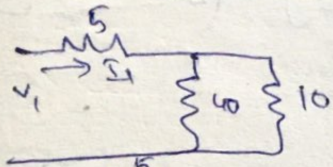
$V_1 = Z_{11} I_1 + Z_{12} I_2$ $\qquad V_1 = I_1 \quad I_2$

$V_2 = Z_{21} I_1 + Z_{22} I_2$ $\qquad V_2 = I_1 \quad I_2$

when $i_2 = 0$ then

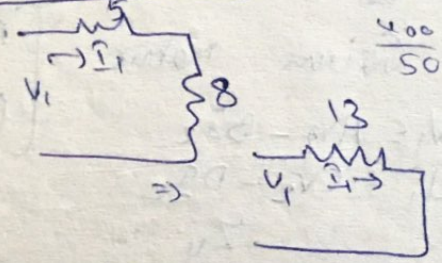


$Z_{11} = \frac{V_1}{I_1}\Big|_{I_2=0}$



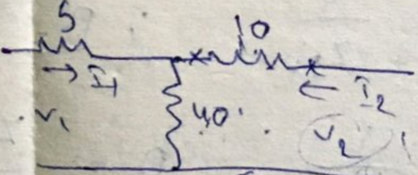
$V_1 = 13 \times I_1$

$Z_{11} = \frac{13 \times I_1}{I_1} = 13\Omega$



$\frac{400}{50}$

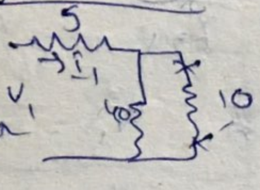
$Z_{21} = \frac{V_2}{I_1}\Big|_{I_2=0}$ $\quad \frac{I_1}{2}\times$



$V_2 = \frac{I_1}{2} \times \left(\frac{\cancel{\quad}}{40+10}\right) \times 40$

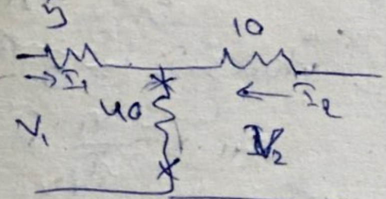
$V_2 = I_1\, 0.4\Omega$

$\frac{I_1}{2\times50} \times 40$



now:- $Z_{21} = \frac{I_1 \times 0.4}{I_1} = 0.4\Omega$

when $I_1 = 0$ then



$Z_{12} = \frac{V_1}{I_2}\Big|_{I_1=0}$

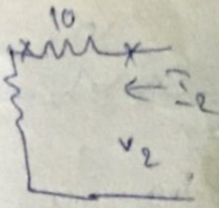
$V_1 = \frac{I_2}{40} \times 10 =$

$\Rightarrow I_2 \times 0.4$

$Z_{12} = \frac{I_2 \times 0.4}{I_2} = 0.4\Omega$

$\frac{I_2}{2} \times \frac{\cancel{\quad}}{40} \times 40$

$$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0}$$



shown in fig

$$V_2 = I_2 \times 10$$

$$Z_{22} = \frac{\cancel{I_2} \times 10}{\cancel{I_2}} = 10\Omega$$

$$\therefore Z_{11} = 13\Omega \;;\quad Z_{12} = 0.4\Omega$$

$$Z_{21} = 8\Omega \qquad Z_{22} = 10\Omega$$

$$\begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{bmatrix} 13 & 0.4 \\ 8 & 10 \end{bmatrix} \begin{pmatrix} I_1 \\ I_2 \end{pmatrix}.$$

3)

Given matrix $\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 2 & 8 \\ 9 & 16 \end{bmatrix}$

$V_1 = AV_2 - BI_2$

$I_1 = CV_2 - DI_2$

$$A = \frac{Z_{11}}{Z_{21}} \;;\quad B = \frac{\Delta Z}{Z_{21}}$$

$$V_2 = \frac{\frac{V_1 + BI_2}{A}}{\frac{CV_2}{I_2}}$$

$$C = \frac{1}{Z_{21}} \qquad D = \frac{Z_{22}}{Z_{21}}$$

sol:- $V_1 = Z_{11} I_1 + Z_{12} I_2$

$V_2 = Z_{21} I_1 + Z_{22} I_2$

when $I_2 = 0$

$$Z_{11} = \frac{V_1}{I_1} \Rightarrow \frac{A\cancel{V_2}}{C\cancel{V_2}} = \frac{A}{C} = \frac{2}{9} = 0.22\Omega$$

$$Z_{21} = \frac{V_2}{I_1} = \frac{\cancel{V_2}}{C\cancel{V_2}} = \frac{1}{C} = \frac{1}{9} = 0.11\Omega$$

when $I_1 = 0$

find H

$$Z_{12} = \frac{V_1}{I_2} = \frac{AV_2 - BI_2}{\frac{DI_2}{C}}$$

$V_1 = AV_2 - BI_2$

$\Rightarrow \frac{V_1 + BI_2}{A} = V_2$

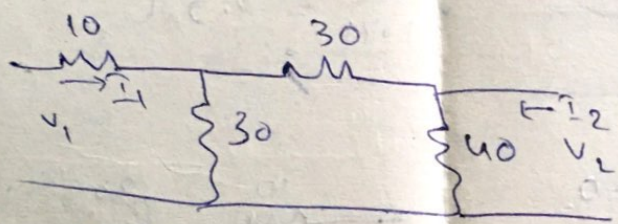
$$Z_{12} = \frac{C(AV_2 - BI_2)}{DI_2}$$

$$Z_{12} = \frac{\Delta T}{C} = \frac{(AB - BC)}{C} = \frac{32 - 72}{9} = \frac{-40}{9} = -4.44\,\Omega$$

$$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} = \frac{D}{C} = 1.77\,\Omega$$

now $\begin{pmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{pmatrix} = \begin{bmatrix} 0.22 & -4.44 \\ 0.11 & 1.77 \end{bmatrix}$.

1) Y-parameter

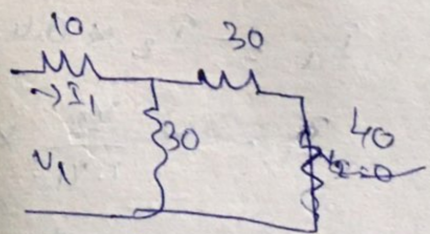


$$I_1 = Y_{11}V_1 + Y_{12}V_2$$
$$I_2 = Y_{21}V_1 + Y_{22}V_2$$

$I_1 = V_1 \quad V_2$

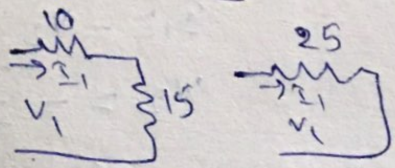
$-I_2 = V_1 \quad V_2$

$$Y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0}$$

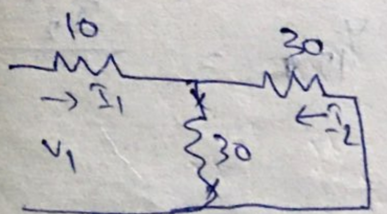


$V_1 = 25 \times I_1 \Rightarrow I_1 = \frac{V_1}{25}$

$$Y_{11} = \frac{\cancel{I_1}}{25 \times \cancel{I_1}} = \frac{1}{25} = 0.04\,\Omega$$



$$Y_{21} = \left.\frac{I_2}{V_1}\right|_{V_2=0}$$



$$-I_2 = \frac{I_1}{30 + 30} \times 30$$

$-I_2 = I_1 \times 0.5 \Rightarrow I_2 = -\frac{V_1}{25} \times 0.5 \Rightarrow I_2 = V_1 \times 0.02$

$V_1 = -\frac{I_2}{0.02}$

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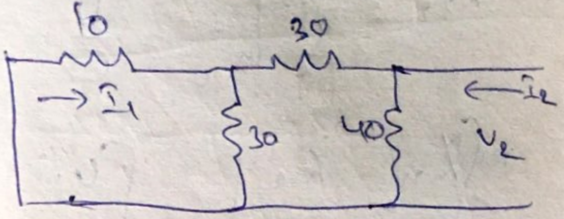
shown in fig

$Y_{21} = \frac{I_2}{-V_1}$

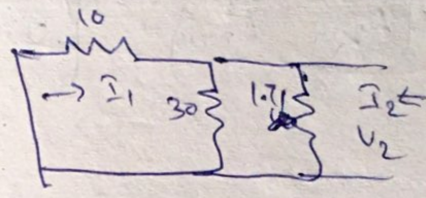
$Y_{21} = \frac{I_2}{-\frac{I_2}{0.02}} \Rightarrow \frac{-0.02 \times \cancel{I_2}}{\cancel{I_2}} = -0.02\,\Omega$

when $V_1 = 0$



$Y_{22} = \frac{I_2}{V_2}\Big|_{V_1=0}$

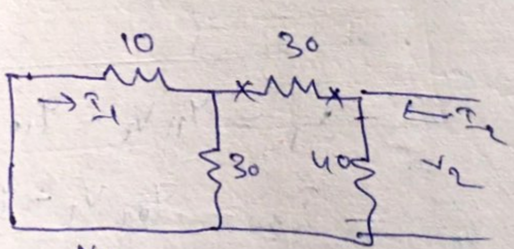
$V_2 = I_2 \times \frac{120}{70}$



$V_2 = I_2 \times 1.71 \Rightarrow I_2 = \frac{V_2}{1.71}$

$Y_{22} = \frac{\cancel{I_2}}{\cancel{I_2} \times 1.71} = \frac{1}{1.71} = 0.5\,\Omega$

$Y_{12} = \frac{I_2}{V_2}\Big|_{V_1=0}$



$-I_1 = \frac{I_2}{70} \times 30$

$-I_1 = I_2 \times 0.42 \Rightarrow -I_1 = \frac{V_2}{1.71} \times 0.42$

$I_1 = -I_2 \times 0.42 \Rightarrow I_2 = \frac{I_1}{0.42}$

$I_1 = -\frac{V_2}{1.71} \times 0.42$

$I_1 = -V_2 \times 0.25 \Rightarrow V_2 = -\frac{I_1}{0.25}$

$V_2 = -\frac{I_1}{0.25}$

$Y_{12} = \frac{I_2}{\ }$

find $V_1 = h_{11} I_1 + h_{12} V_2$
$I_2 = h_{21} I_1 + h_{22} V_2$

$V_1 = I_1 \quad V_2$
$I_2 = I_1 \quad V_2$

$V_1 = Z_{11} I_1 + Z_{12} I_2$ — Z
$V_2 = Z_{21} I_1 + Z_{22} I_2$

$I_1 = Y_{11} V_1 + Y_{12} V_2$ — Y
$I_2 = Y_{21} V_1 + Y_{22} V_2$

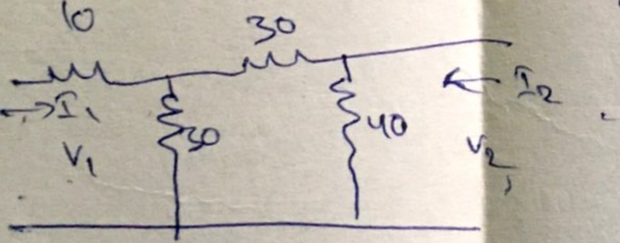
$V_1 = A V_2 - B I_2$ — ABCD
$I_1 = C V_2 - D I_2$

$V_1 = h_{11} I_1 + h_{12} V_2$ → h
$I_2 = h_{21} I_1 + h_{22} V_2$

$I_x = \frac{\cancel{I_1 \times 5}}{2}$

<u>S - I :-</u>

1) Y-Par

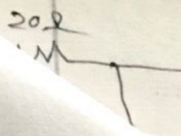


$I_1 = Y_{11} V_1 + Y_{12} V_2$
$I_2 = Y_{21} V_1 + Y_{22} V_2$

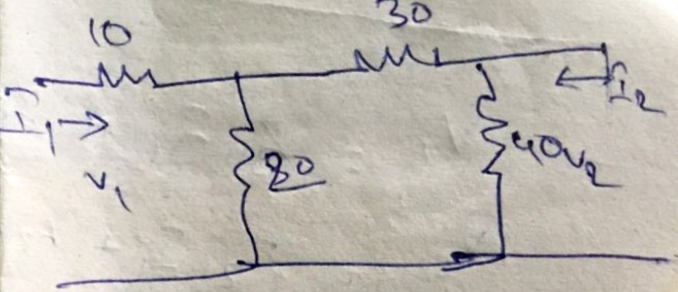
when $V_2 = 0$

$I_1 = Y_{11} V_1 \qquad Y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0}$

Network shown in fi

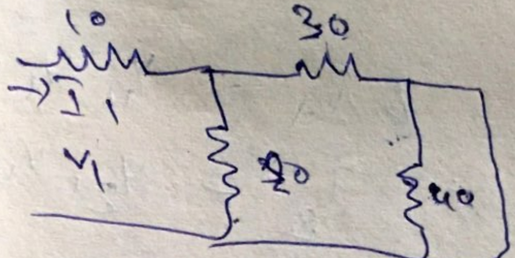


$$Y_{11} = \frac{I_1}{V_1}\Bigg|_{V_2=0}$$



$$\therefore V_1 = I_1 \times R_{eq}$$

$$V_1 = I_1 \times 25$$

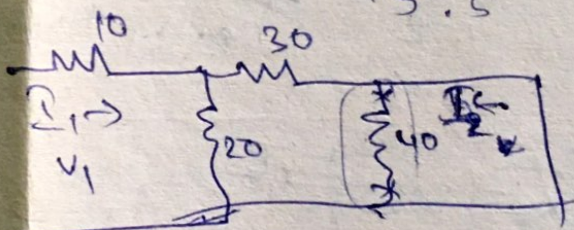


$$Y_{11} = \frac{\cancel{I_1}}{\cancel{I_1}\times 25} = 0.04$$

20 || 70

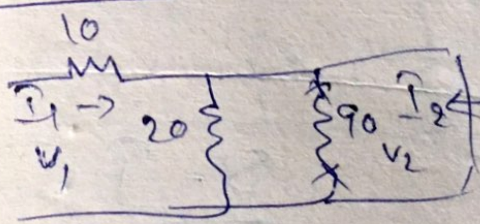
$$Y_{21} = \frac{I_2}{V_1}\Bigg|_{V_2=0}$$

15.6

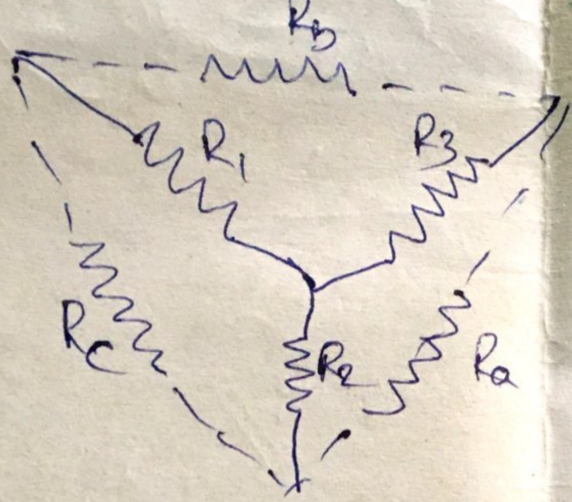


$$-I_2 = \frac{-I_1}{90} \times 20$$

$$= \frac{-I_1}{}$$



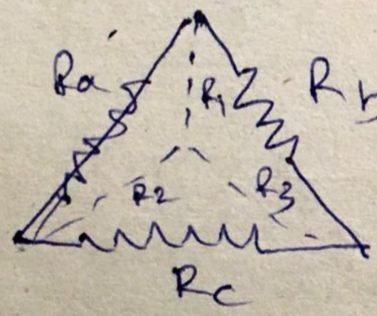
$(D^2+4D+3)y = e^x \sin x + x$



$$R_a = \frac{1}{R_1}(R_1R_2 + R_2R_3 + R_3R_1)$$

$$R_b = \frac{1}{R_2}(R_1R_2 + R_2R_3 + R_3R_1)$$

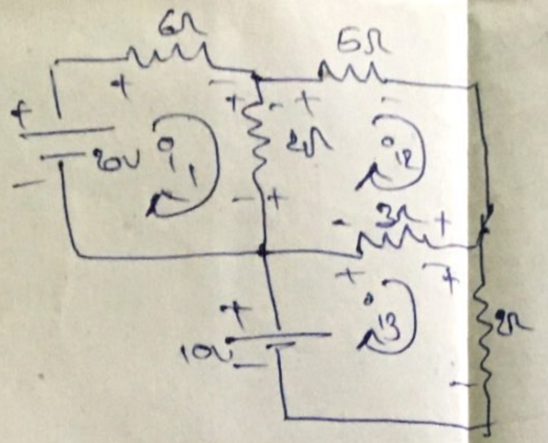
$$R_c = \frac{1}{R_3}(\quad \text{''} \quad)$$



$$R_1 = \frac{R_a R_b}{R_a+R_b+R_c}$$

$$R_2 = \frac{R_a R_c}{R_a+R_b+R_c}$$

$$R_3 = \frac{R_b R_c}{R_a+R_b+R_c}$$



$$20 - 6i_1 - 4i_1 + 4i_2 = 0 \rightarrow (1)$$

$$-4i_2 + 4i_1 - 5i_2 - 3i_2 + 3i_3 = 0 \rightarrow (2)$$

$$10 - 3i_3 + 3i_2 - 2i_3 = 0 \rightarrow (3)$$

$$20 = 10i_1 - 4i_2$$

$$-12i_2 + 4i_1 + 3i_3 = 0$$

$$10 = i_3 - 3i_2$$

$$\begin{bmatrix} 10 & -4 & 0 \\ 4 & -12 & 3 \\ 0 & -3 & 1 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 20 \\ 0 \\ 10 \end{bmatrix}$$

$$\Delta = \begin{vmatrix} 10 & -4 & 0 \\ 4 & -12 & 3 \\ 0 & -3 & 1 \end{vmatrix} = -14$$

$$\Delta_1 = \begin{vmatrix} 20 & -4 & 0 \\ 0 & -12 & 3 \\ 10 & -3 & 1 \end{vmatrix} = -180$$

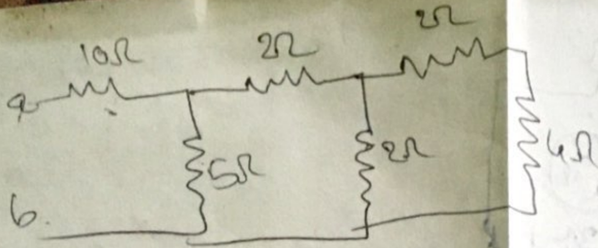
$$\Delta_2 = \begin{vmatrix} 10 & 20 & 0 \\ 4 & 0 & 3 \\ 0 & 10 & 1 \end{vmatrix} = -380$$

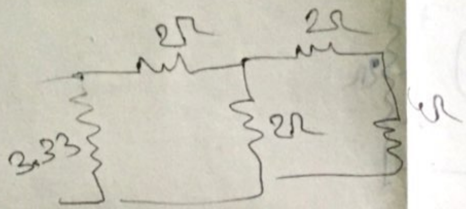
$$\Delta_3 = \begin{vmatrix} 10 & -4 & 20 \\ 4 & -12 & 0 \\ 0 & -3 & 10 \end{vmatrix} = -1280$$

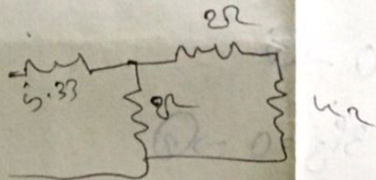
$$i_1 = \frac{\Delta_1}{\Delta} = 12.86$$

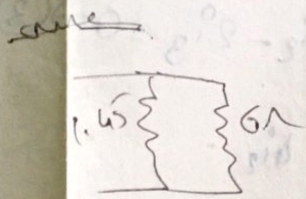
$$i_2 = \frac{\Delta_2}{\Delta} = 27.14$$

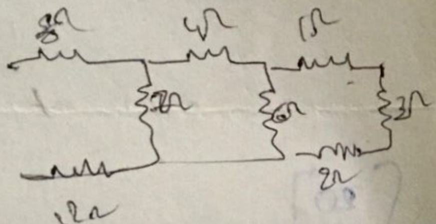
$$i_3 = \frac{\Delta_3}{\Delta} = 91.42$$

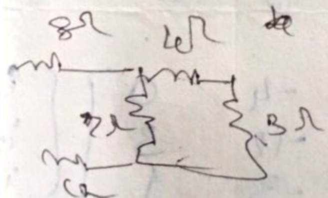


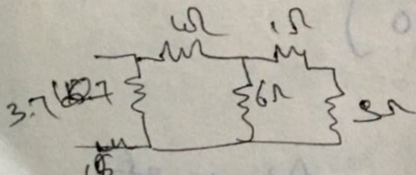


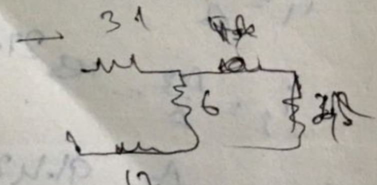


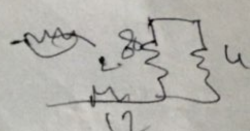












3.5

$2i_2 = 4 + \frac{2i_2 - v_2}{2}$

$8 + 2i_2 - v_2$

$2i_2 + 8$

$i_2 = 2$

$4i_2$

$\frac{2i_2 - 2i_2 + 2v_2}{2} = v_2$

$\frac{-2i_2 + 2v_2}{2} = v_2$

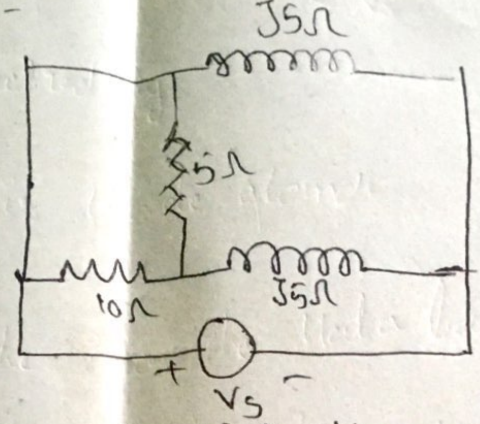
$-2i_2 + 2v_2 = 2v_2$

$-i_2 = 12$

$v_2 - i_2 = 0$

$2i_2 = 0$

Given ckt:-



Given $P = 100$ watts in 5Ω resistion

$\therefore \quad (\because P = VI)$

$P = I^2 \times R$

$100 = I^2 \times 5$

$\Rightarrow I^2 = \frac{\cancel{100}^{20}}{\cancel{5}} \Rightarrow I_5 = \sqrt{20} = 4.47A$

now:- $V = \frac{P}{I} = \frac{100}{4.47} = 22.3V$

Power $P = 100$ watts in 10Ω resistor:-

$P = VI$

$P = I^2 \times R$

$\Rightarrow 100 = I^2 \times 10$

$I^2 = \frac{\cancel{100}}{10} = \cancel{10}\ 2.23$

$I_{10} = \cancel{3.16A}\ 2.23$

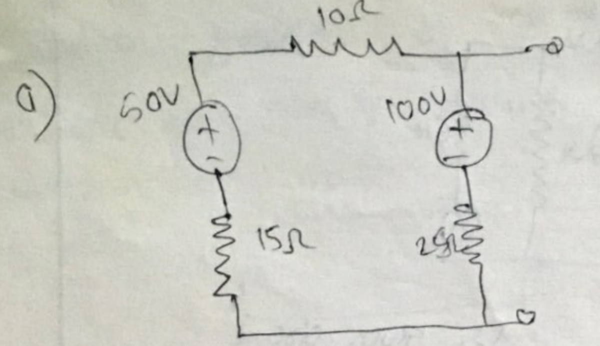
now:- $V = \frac{P}{I} = \frac{100}{2.23} = \cancel{31.62V}\ 44.84$

$\therefore$ Voltage across $j5Ω = (I_5 + I_{10})\, j5$

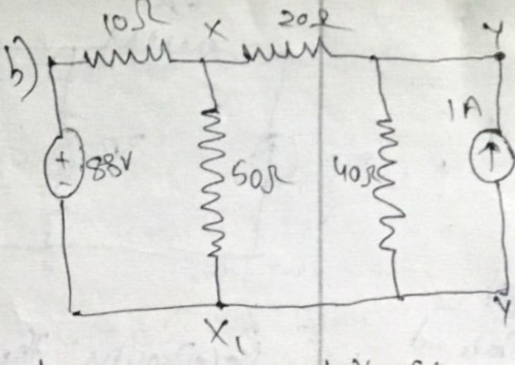
$= (4.47 + 3.164)\, j5$

) find the Thevines Equivalent At A&B for Network Shown in fig

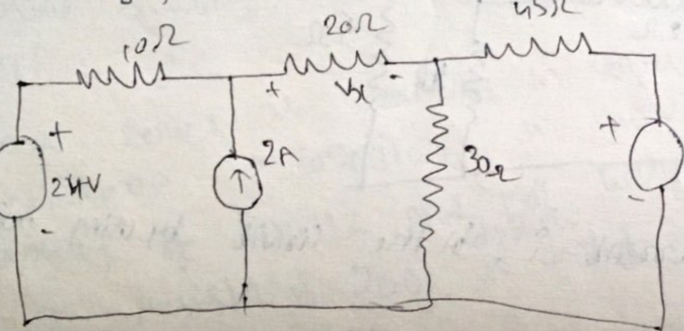
a)



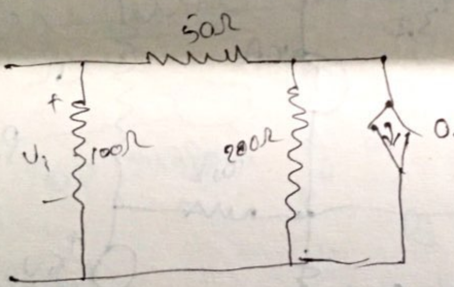
b)



2) By using Super Position Principle find the value of V_x as shown in fig.

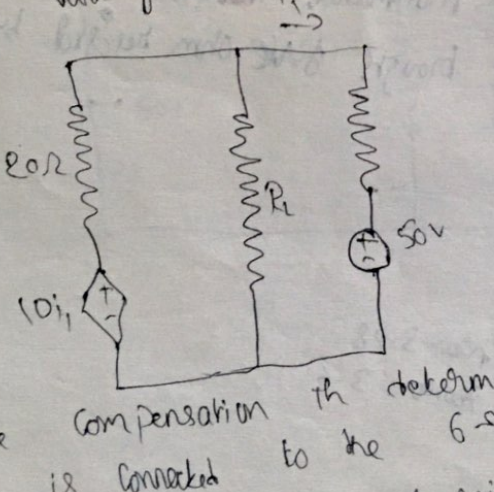


3) find the notons Equivalent for Given Circuit:-



State and
4) Derive Condition for the Maximum Power Condition Transfer Theorem

5) Determine value of R_L to which maximum Power Can be delivered



6) Using the Compensation th determine the ammeter reading where it is Connected to the 6 Ω Resistor as Shown in fig The internal resistance of Ammeter is 2Ω

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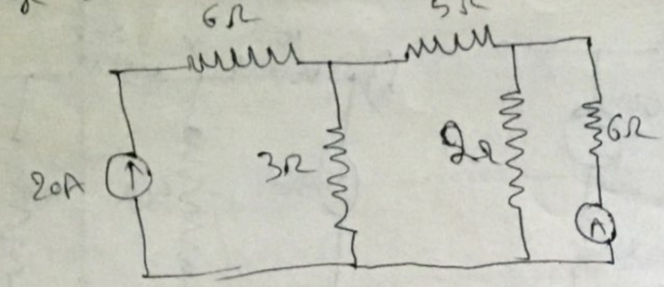
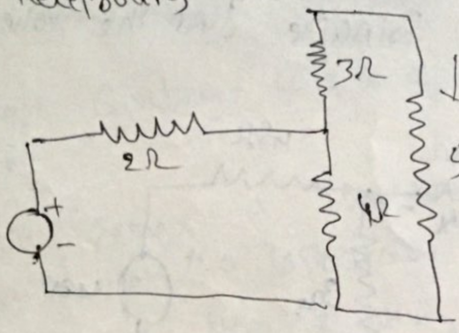
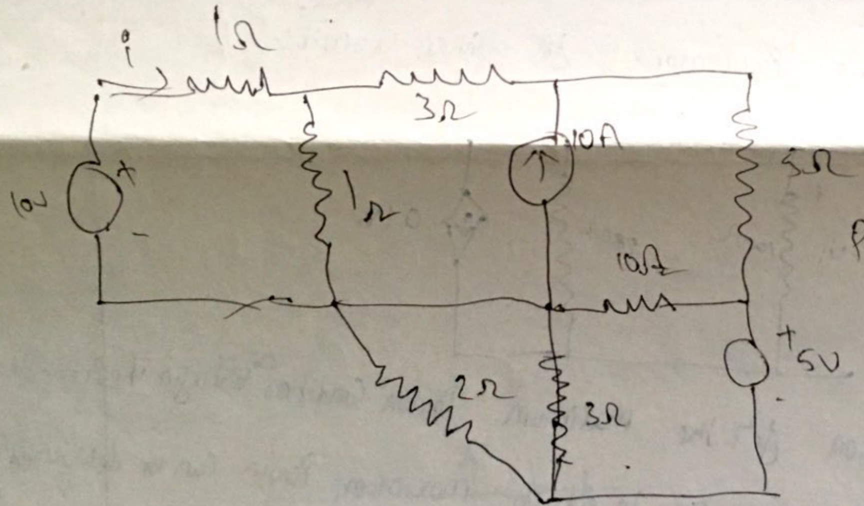
NW Page 3.35 Q -3.13



7) State and verify the Reciprocity Theorme for given circuit



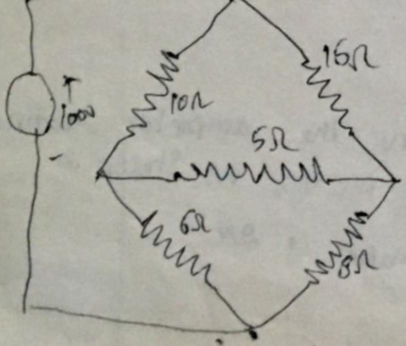
8) determine the Current 'i' in the circuit by using Superposition Theo



P.no:- 348

9a) State and Explain the Maximum Theorem

10) find the current following through five ohm resistor by using Norton Equivalent circuit



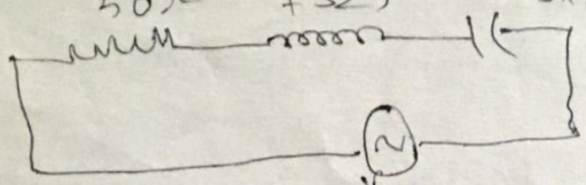
P.no:-3.28
Probno:- 3.6

11) Define resonance in an Electrical circuit and determine the resonance frequency for an R_{LC} Series circuit

12) determine the values of capacitive reactance and impedance for given circuit

8)

50Ω $+j25$ $-jX_C$



Prob:- 8.22

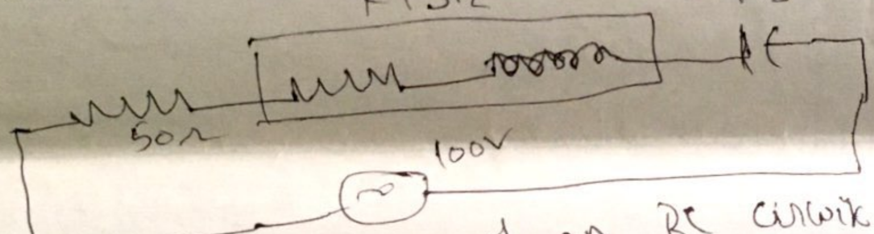
Prob:- No:- 8.9

8) Define band width RLC circuit and determine the Equivalent approximate in terms of circuit parameters

9/4) Determine Quality circuit of for consisting $r = 10\Omega$; $L = 0.1$ Henry, $C = 10\ \mu F$

15) A 50Ω series is connected in series with resistor having internal resistance a capacitor an 100V variables is at a frequency of 200 HZ and max current of 0.7 Amp and voltage across resistor is 200 determine circuit is constant

$R + jX_L$ $-jX_C$



50Ω

100V

15) Determine Step response of an RC circuit

" " " RL "

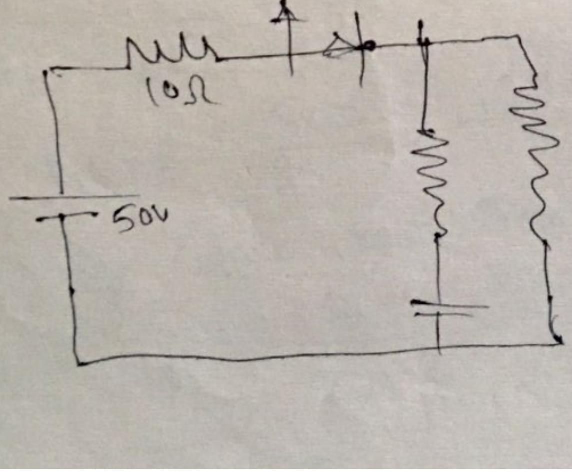
" " " RL "

17) " Sinusoidal "

18) " circuit shown fig find current for when switch s is opened

a) for

b) $t = 0$

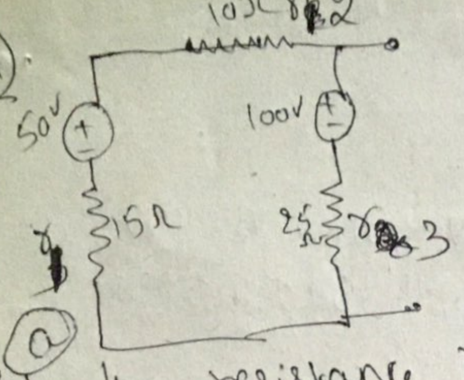


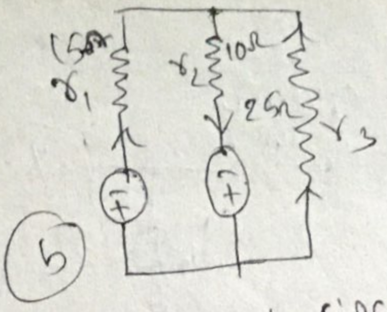
10Ω

50V

1A).

a)

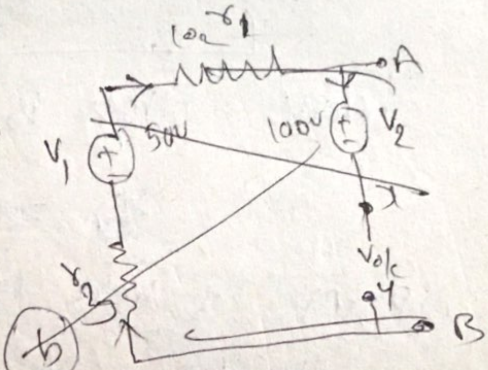




let the resistance r_3 be removed and circuit exhibited in below circuit.

When no current $I = 0$

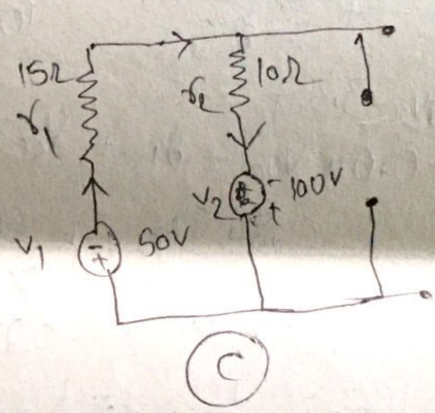
At nod application by KCL yields terminal 'XY'



Now:

$$\frac{V_1 - V_{oc}}{r_1} - \frac{V_2 + V_{oc}}{r_2} = 0$$

$$\frac{50 - V_{oc}}{15} - \frac{V_{oc} + 100}{10} = 0$$



$$3.3 - 0.06V_{oc} - 0.1V_{oc} - 10 = 0$$

$$-0.16V_{oc} - 7 = 0$$

$$-0.16V_{oc} = 7$$

$$V_{oc} = -\frac{7}{0.16} = 42V.$$

here:- $$\frac{1}{R_{Th}} = \frac{1}{15} + \frac{1}{10}$$

$$R_{Th} = \frac{15 \times 10}{25} = \frac{150}{25} = 6\Omega$$

by Thevines Eq circuit being shown in fig c

$$I_3 = I_{Th} = \frac{V_{oc}}{R_{Th} + r_3} = \frac{42}{6 + 25} = 1.354A$$

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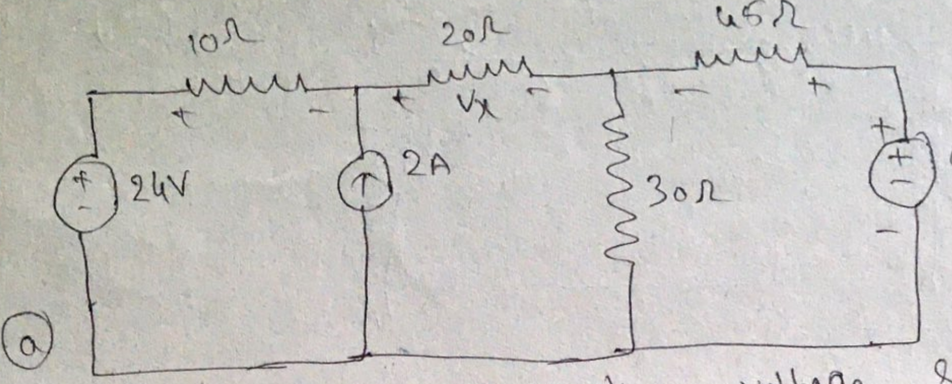
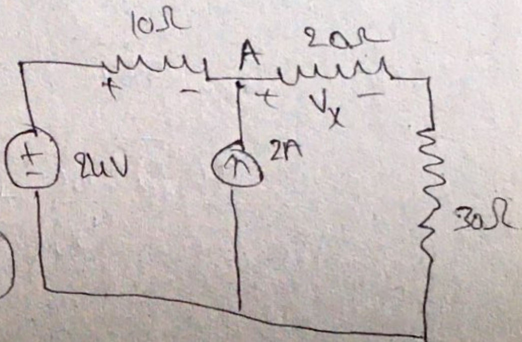
2)



(a)

first we have to find out the voltage source at 20Ω then

assuming voltage V'_{oc} at nodes 'A'



(b)

when the resistance of 20Ω and 30Ω are in series so resistance is 50Ω

now:- $\frac{V_{oc}-24}{10} + \frac{V_{oc}}{50} = 2$

$$0.1\,V_{oc} - 2.4 + 0.02\,V_{oc} = 0$$

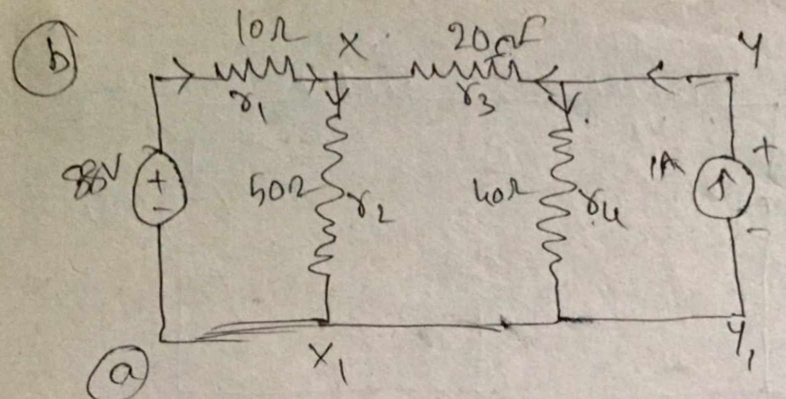
$$0.12\,V_{oc} = 2.4$$

$$V_{oc} = \frac{2.4}{0.12} = 20V$$

The voltage across 20Ω due to voltage source of 24V is

$$V_x = \frac{V_{oc}}{50} \times 20 = \frac{20}{50} \times 20 = 8V$$

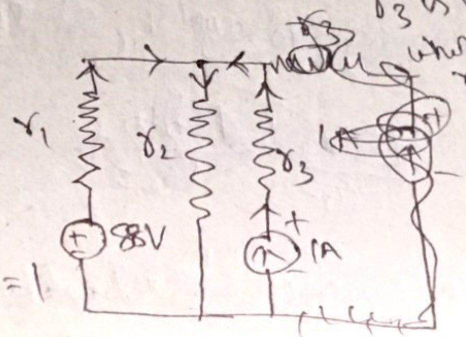
now we have to find out the voltage across 20Ω resistor due to 48V source while other source are set equal to zero. The circuit is as follows



let the resistance r_4 be removed
now applying KCL for AB terms when $I = 1$ another
Voltage = 88V   Resistance $r_1 = 10\Omega$; $r_2 = 50\Omega$; $r_3 = 20\Omega$

r_3 is in series i.e. when $r_1 r_2$ ∥le to each other

$$\frac{V_{oc} - 88}{10} - \frac{V_{oc}}{50} + \frac{V_{oc}}{20} = 1$$



$$0.1 V_{oc} - 8.8 - 0.02 V_{oc} + 0.05 V_{oc} = 1$$

$$0.13 V_{oc} = 1 + 8.8$$

$$V_{oc} = \frac{9.8}{0.13} = 75.3\ V$$

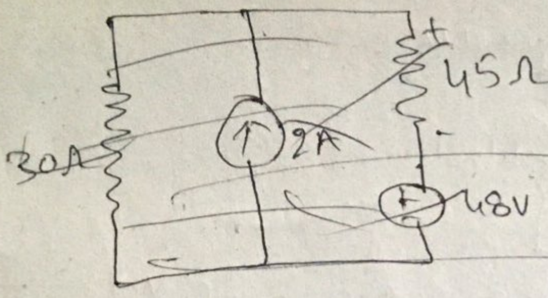
$$\frac{1}{R_{Th}} = \frac{1}{10} + \frac{1}{50}$$

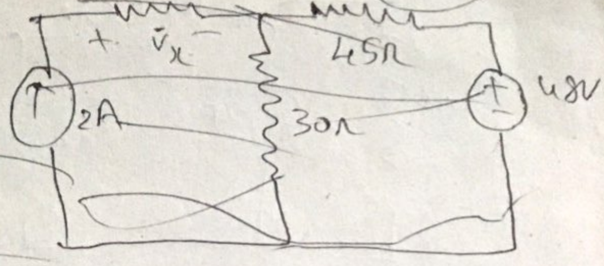
$$R_{Th} = \frac{10 \times 50}{60} = \frac{500}{60} = 8.33\ \Omega$$

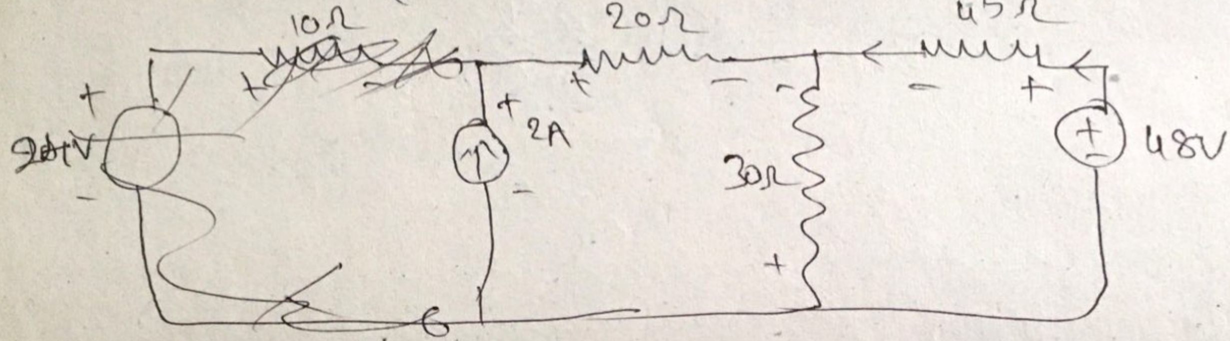
∴ By Thevenin's theorem the current of

$$I_{Th} = \frac{V_{oc}}{R_{Th} + r_4} = \frac{75.3}{8.3 + 40} = \frac{75}{8 + 40} = 1.56\ A$$

$$I_{Th} = 1.5\ A$$







$$\frac{V_{oc}}{50} + \frac{V_{oc}+48}{45} = 0$$

$$0.02\,V_{oc} + 0.02\,V_{oc} + 1.06 = 0$$

$$0.04\,V_{oc} = -1.06$$

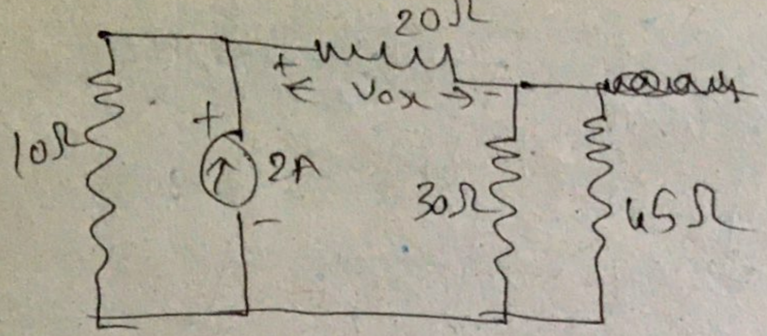
$$V_{oc} = -\frac{1.06}{0.04} = 26.6\,V$$

The voltage across 20Ω resistor due to the 48V source

$$V_{ox} = \left(\cancel{\frac{V_{oc}}{50}}\right) * \left(\frac{V_{oc}+48}{45}\right) \times 20$$

$$V_{ox} = \frac{26+48}{45} \times 20 = 32.88V$$

now we have to find out the voltage across 20Ω resistor due to '2A' current source while other source are set equal to zero The circuit is



$V = IR$

$I = \frac{V}{R}$

The current through 20Ω resistor $= 20 \times \left(\frac{30 \times 45}{30+45}\right)$

$\cancel{IR} \; \cancel{\frac{V}{R}} =$

$I =$