UNIT

1

< D.C Circuit Analysis >

* *

Qus. 1 > Explain Activ and passiv element

Ans. > The element which supply energy to Network are known as Activ element
Ex. → Voltage Source, current Source etc.
The elements which dissipate or store energy are known as passiv element
Ex. → Resistor, Inductor and Capacitor.

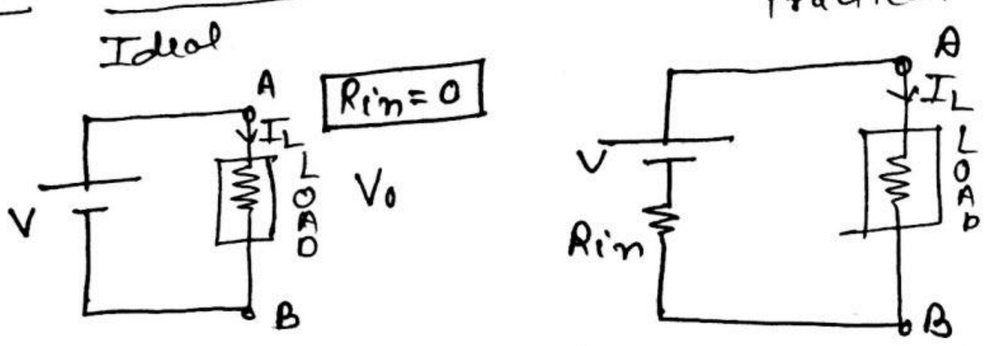
Qus. 2 > Define unilatral and bilatral elements.

Ans > Unilatral → The elements whose property Depend upon the Direction of current are known as Unilatral elements.
Ex. → Diode, Transistor, etc.

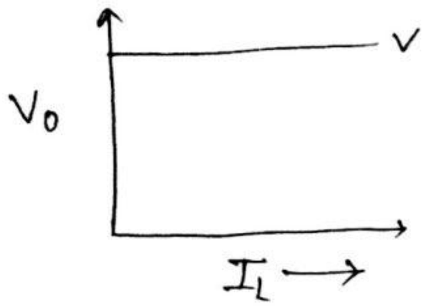
Bilatral → The elements whose properties Does not Depend upon the Direction of current are known as bilatral elements.
Ex. → Resistor, Inductor and Capacitor

Qus. 3 > Explain Ideal and practical Voltage and current Source →

Ans. > Ideal & Practical Voltage Source >

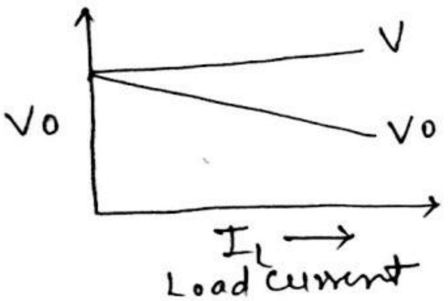


* The Source which maintain a Constant Voltage across the load irrespective of the load current is known as Ideal Voltage Source.



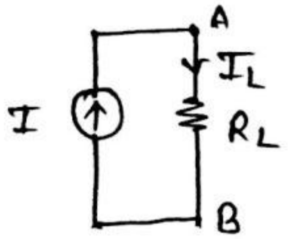
$$\boxed{V_0 = V}$$

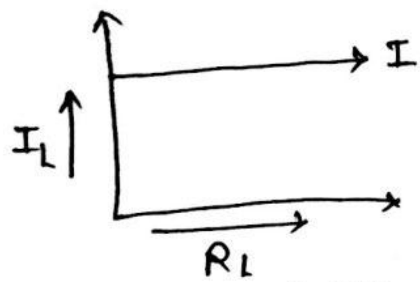
Practical Voltage Source → the Source whose output terminal Voltage Decreases as we increase the load current is known as Practical Voltage Source



$$\boxed{V_0 = V - I_L R_{in}}$$

* Ideal Current Source → the source which delivers Constant current to the load irrespective of the load resistance

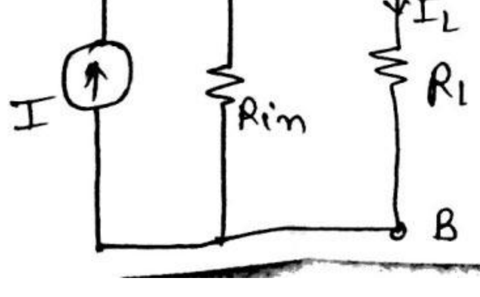


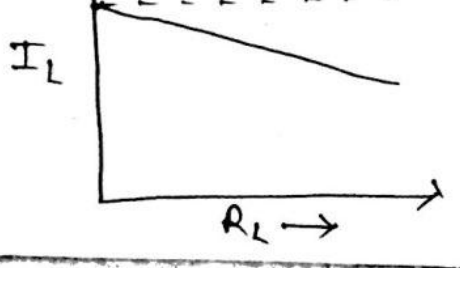


$$\boxed{I_L = I}$$

* Internal Resistance of Ideal Current Source is ∞

* Practical Current Source → The Source whose output current Decreases as we increase the Load Resistance is known as Practical Current Source

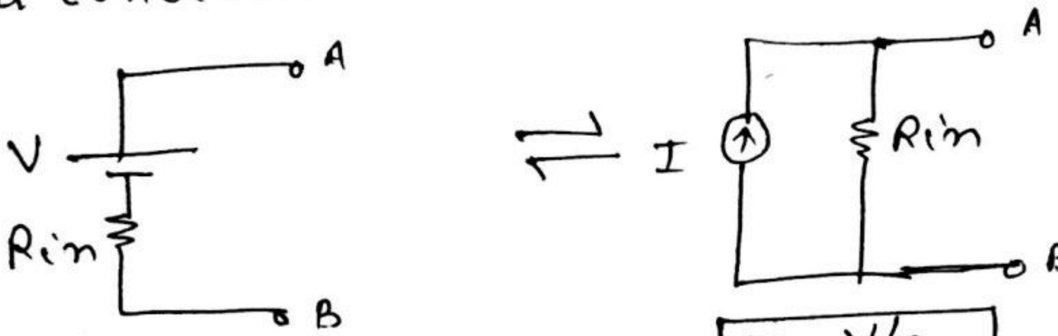




$$\boxed{I_L = \frac{I R_{in}}{R_{in} + R_L}}$$

Que. 3> What is Source Transformation?

Ans. → For the Simplification of Complex Network and Practical Voltage Source can be Converted Into a Practical Current Source and Vice versa. This Conversion is known as Source Transformation.



$\boxed{V = I R_{in}}$ $\boxed{I = V/R_{in}}$

* for Conversion Internal Resistance remains unchanged
* $I = V/R_{in}$ for Voltage to Current Source Conversion.
* $V = I R_{in}$ for Current to Voltage Source Conversion

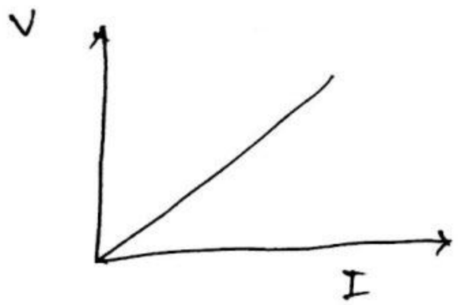
Que. 4> Explain Linear & Non linear elements.

Ans. → The elements Whose V-I charachteristics is straight line are known as Linear elements.

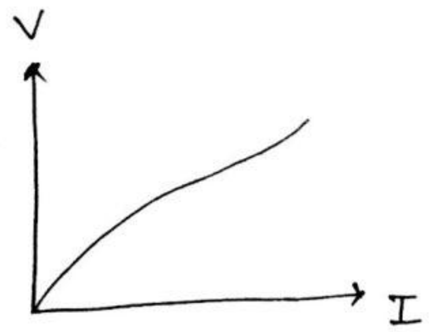
Ex. → Resistor, Inductor & Capacitor

The elements Whose V-I charachteristics is other than straight line is known as Non-linear elements

Ex. → Diode



Linear elements



Non linear elements

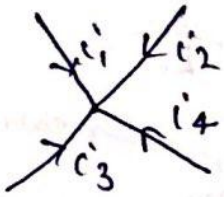
Ques.5 → Differentiate between Mesh & loop.

Ans. → Any closedpath in a given Network is known as loop

The loop Which does not Contain any other loop whithin it is known as Mesh.

Ques.6 → What is KCL & KVL Explain their limitation?

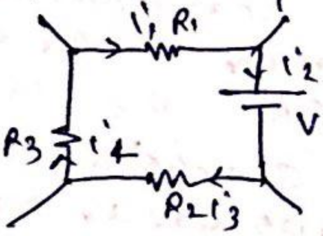
Ans. → (i) Kirchhoff's Current law → (KCL) → according to KCL Algebaric Sum of All the current entering or leaving at a Node is equal to zero.



$\sum I = 0$

$\boxed{i_1 + i_2 + i_3 + i_4 = 0}$

(ii) Kirchhoff's Voltage Law > (KVL) this law is applicable in a closed path (loop) according to this law algebraic Sum of Voltage and Voltage drop in a closed path is equal to zero.



$i_1 R_1 + V + i_3 R_2 + i_4 R_3 = 0$

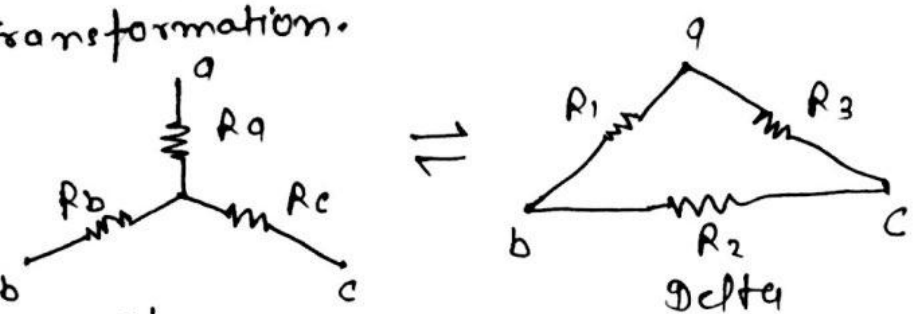
$\boxed{\sum V + \sum I_i \cdot R_i = 0}$

Limitation's → (1) KCL & KVL both depend upon lumped element Model only.

(II) KCL, in its usual form is depend upon the assumption that current only flow in Conductor.

Que. 6 > Explain Star-Delta Transformation.

Ans. → For Solving the Complicated Circuits We have to Convert Star Network into Delta Network and Vice-Versa this Conversion is known as Star-Delta Transformation.



Star Delta

* For conversion eq. resistance b/w any two terminal of given Network must be same.

For star Network →

R_{ab_s}(eq. resistance b/w terminal a-b) = $R_a + R_b$

R_{bc_s}(" " " b-c) = $R_b + R_c$

R_{ac_s}(" " " a-c) = $R_a + R_c$

For Delta Network →

R_{ab_D}(eq. resistance b/w terminal a-b) = $R_1 \parallel (R_2 + R_3)$

R_{bc_D}(" " " b-c) = $R_2 \parallel (R_1 + R_3)$

R_{ac_D}(" " " a-c) = $R_3 \parallel (R_1 + R_2)$

⇒ Now for conversion eq. resistance b/w given terminal of both the network must be same.

$$R_{a-b(S)} = R_{a-b(D)}$$
$$R_{b-c(S)} = R_{b-c(D)}$$
$$R_{a-c(S)} = R_{a-c(D)}$$

Now →

$$R_a + R_b = \frac{R_1(R_2+R_3)}{R_1+R_2+R_3} \quad \text{——— (i)}$$

$$R_b + R_c = \frac{R_2(R_1+R_3)}{R_1+R_2+R_3} \quad \text{——— (ii)}$$

$$R_a + R_c = \frac{R_3(R_1+R_2)}{R_1+R_2+R_3} \quad \text{——— (iii)}$$

by Solving eq. (i) (ii) & (iii)

* for star to Delta →

$$R_1 = R_a + R_b + \frac{R_a R_b}{R_c}$$

$$R_2 = R_b + R_c + \frac{R_b R_c}{R_a}$$

$$R_3 = R_a + R_c + \frac{R_a R_c}{R_b}$$

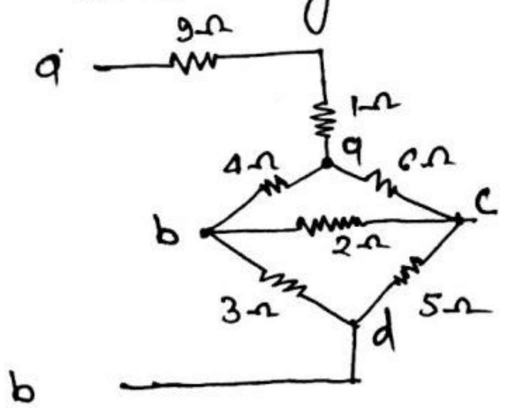
* For Delta to star →

$$R_a = \frac{R_1 R_3}{R_1 + R_2 + R_3}$$

$$R_b = \frac{R_2 R_1}{R_1 + R_2 + R_3}$$

$$R_c = \frac{R_2 R_3}{R_1 + R_2 + R_3}$$

Que. → Solve the given ckt by star - Delta Transformation →



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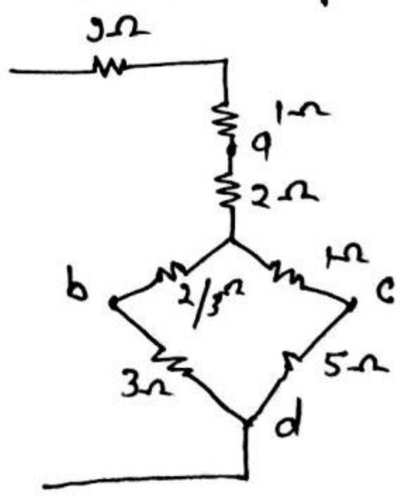

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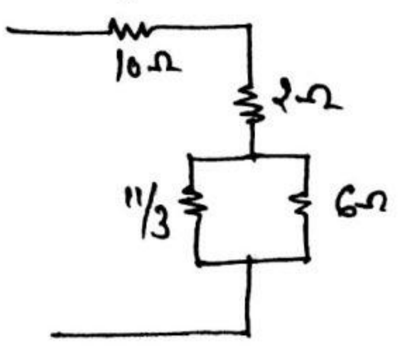


$\boxed{R_{ab} = 16.276\,\Omega}$ Ans

Que. 7> Write the statement of following Theorem.
(i) Superposition Theorem (ii) Thevenin Theorem
(iii) ~~[illegible]~~ Norton's Theorem

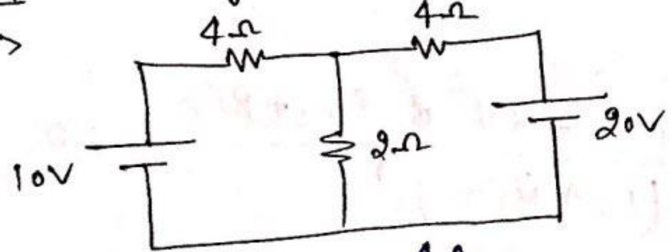
Ans. 7> (i) **Superposition Theorem>** according to this Theorem ~~[illegible]~~ a linear resistive network containing two or more voltage sources the current through any element may be determined by adding together algebraically the current produced by each source acting alone, when all other sources are deactivated.

(ii) **Thevenin's Theorem>** According to this Theorem any complicated two terminal electrical Network can be converted into a Voltage Source (V_T) and resistance (R_T) in Series.

(iii) **Norton's Theorem>** According to this Theorem any complicated two terminal electrical Network can be converted into a current Source (I_s) and Resistance (R_N) in Parallel.

Que. 8> using thevenin Theorem find current in 2Ω.

Ans.>



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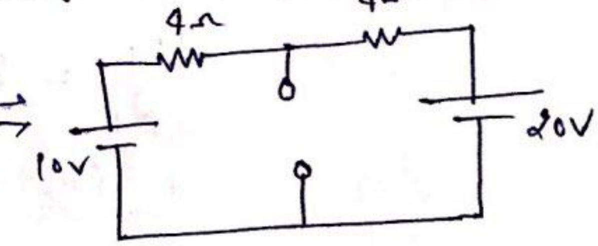
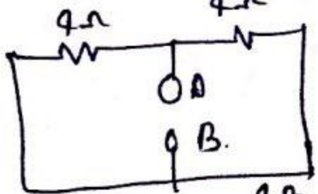
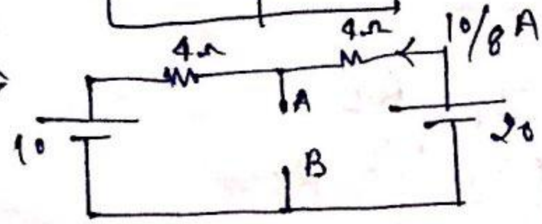


for R_T →



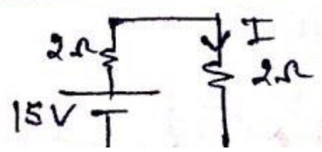
$R_T = 2\Omega$

for V_T →



$V_T = V_{AB} = 4 \times 10/8 + 10$

$V_T = 15\ V$

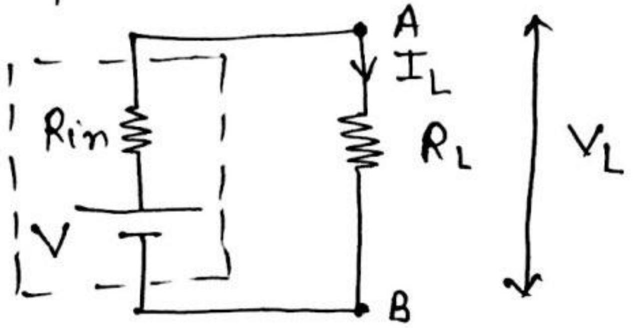


$\boxed{I = 15/4\ A}$ Ans

Ques. 9 > State & Prove Max. Power Transfer Theorem

Ans → "According To this Theorem Max. Power is Delievered to the load by a Voltage Source when Internal Resistance of Voltage Source becomes equal to Load Resistance"

Prove →



* Current in load resistance is given by

$$I_L = \frac{V}{R_L + R_{in}}$$

Now Power Delievered to the load

$$P_L = I_L^2 R_L$$

$$P_L = \left(\frac{V}{R_L + R_{in}}\right)^2 R_L = \frac{V^2 R_L}{(R_L + R_{in})^2}$$

For Power to be maximum

$$\frac{dP_L}{dR_L} = 0$$

$$\frac{dP_L}{dR_L} = \frac{V^2 (R_L + R_{in})^2 - 2V^2 R_L (R_L + R_{in})}{(R_L + R_{in})^4} = 0$$

$$\boxed{R_L = R_{in}}$$

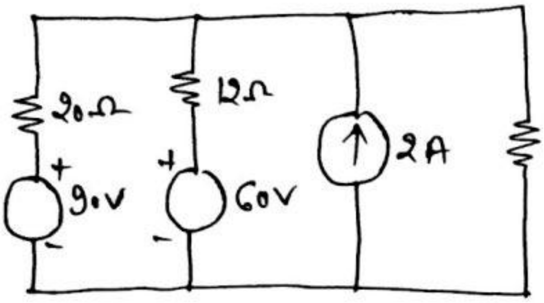
Value of Max. Power →

$$P_{Lmax} = I_L^2 R_L$$

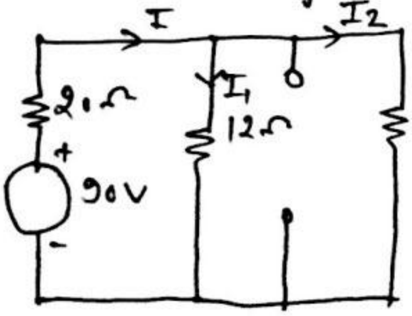
$$= \left(\frac{V}{2R_{in}}\right)^2 \cdot R_{in}$$

$$\boxed{P_{max} = \frac{V^2}{4R_{in}}}$$

Ques. 12 → using Superposition Theorem find the current in 20 Ω Resistor.



Ans. → first taking 90 V voltage source →

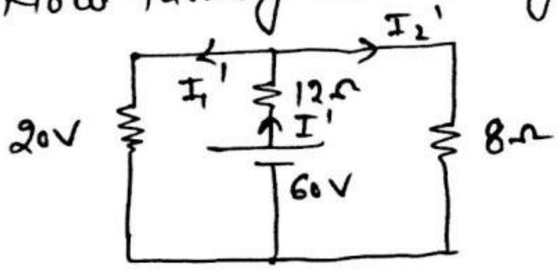


$R = (12 \| 8) + 20$

$= \frac{96}{20} + 20 = 24.8 \Omega$

$I = \frac{90}{24.8} = 3.63 A$

* Now taking 60V Voltage Source →



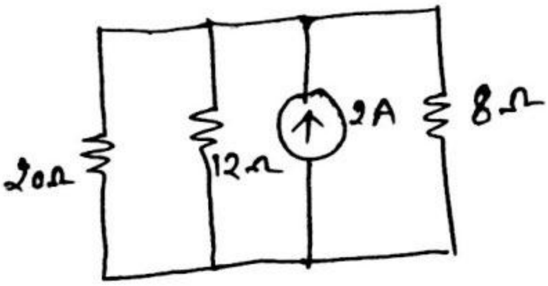
$R = (20 \| 8) + 12$

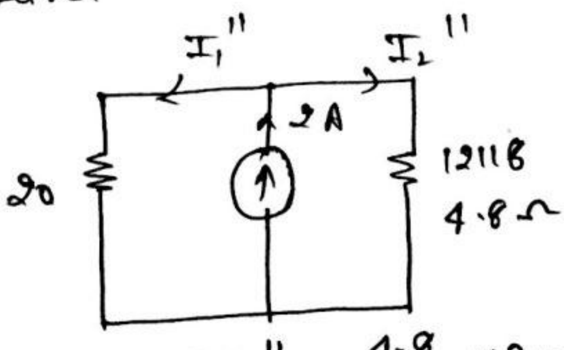
$= \frac{160}{28} + 12 = 17.71 \Omega$

$I' = \frac{60}{17.71} = 3.39 A$

$I_1' = \frac{8}{28} \times I' = 0.97 A$

* Now taking 2 A current Source



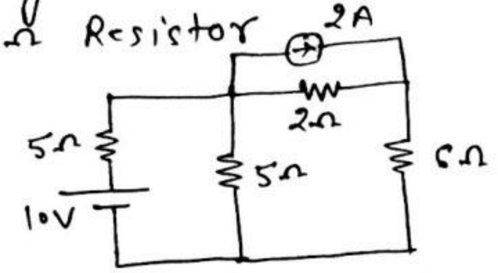


$I_1'' = \frac{4.8}{24.8} \times 2 = 0.39 A$

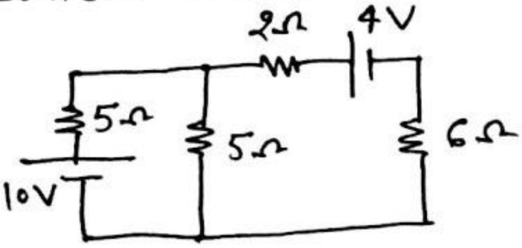
total current in 20 Ω $= 3.63 - 0.97 - 0.39$

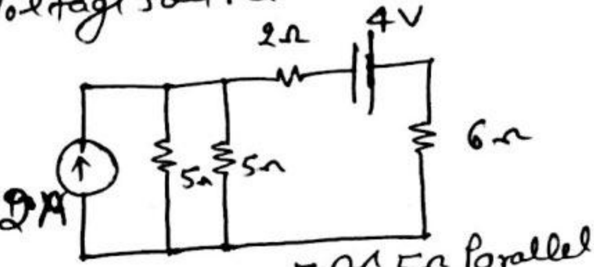
$= 2.27$ Am

Que. 10 → using Source Transformation find the current in 6 Ω Resistor

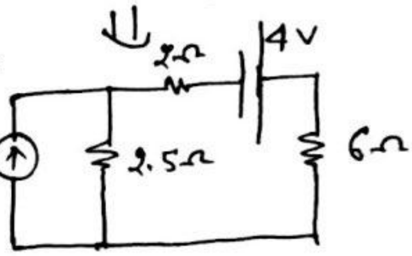


Ans. → Convert Current Source into Voltage Source

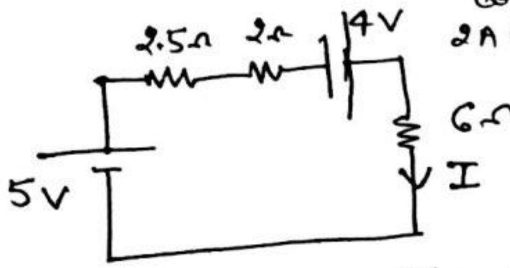




5Ω & 5Ω Parallel

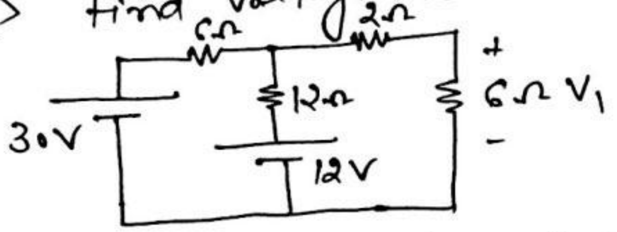


Convert 2A current Source to Voltage

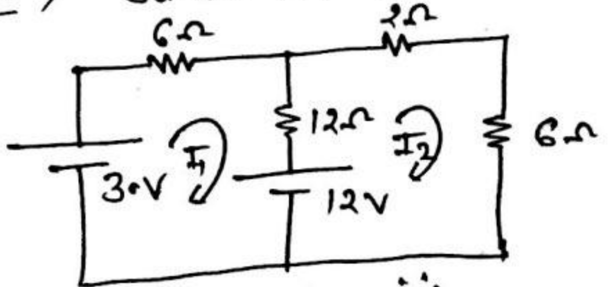


$$I = \frac{9}{10.5}\ A \quad \text{Ans}$$

Que. 11 > Find Voltage across 6Ω resistor



Ans. > Solve the Circuit using Maxwell's theorem



apply KVL in loop (i)

$$6I_1 + 12(I_1 - I_2) + 12 - 30 = 0$$

$$3I_1 - 2I_2 = 3 \quad \text{—(i)}$$

apply KVL in loop (ii)

$$-12 + 12(I_2 - I_1) + 2I_2 + 6I_2 = 0$$

$$2I_1 - 3I_2 = -2 \quad \text{—(ii)}$$

Solve the eq. (i) & (ii)

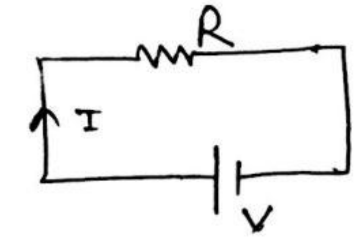
$$I_2 = 12/5 = 2.4\ A$$

$$\text{Voltage across } 6\Omega = 2.4 \times 6$$

$$= 14.4\ V \quad \text{Ans}$$

Ques. 12 > Explain R, L & C as a linear element.

Ans. > Resistor >



In Case of Resistor ($V = IR$) which is a linear relation ship So Resistor is linear element.

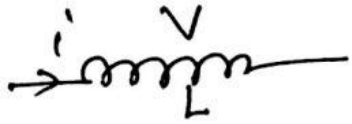
Inductor & Capacitor > both L & C Voltage and current as function of time depend is a linear way on each other

Linearity means principal of Super position holds

$$f(ax + by) = af(x) + bf(y)$$

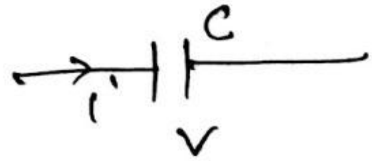
* So In case of Inductor

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



* capacitor

$$V = \frac{1}{C}\int i\,dt$$



Intigeration & differentiation both follow principal of Super position.

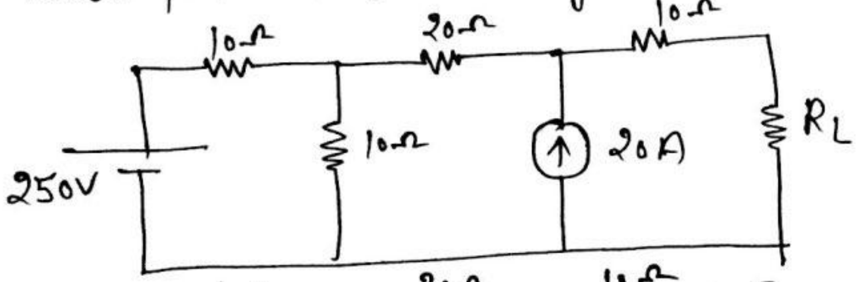
"So R, L, & C are be behaves as a linear element."

$$\boxed{V_1 + V_2 = L_1\frac{di_1}{dt} + L_2\frac{di_2}{dt}}$$

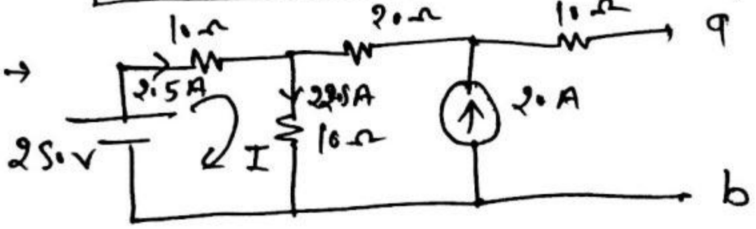
"Linear elements"

$$\boxed{I_1 + I_2 = C_1\frac{dV}{dt} + C_2\frac{dV}{dt}}$$

Ques. 13> Find the Value of R_L so that Max. Power developed in it also find the value of Max. Power

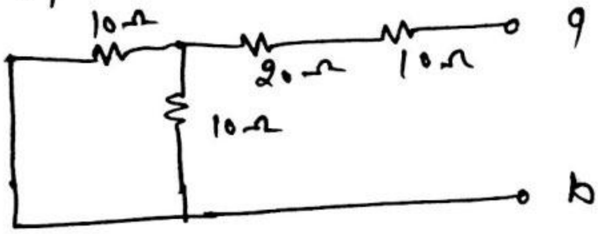


for $V_T \rightarrow$

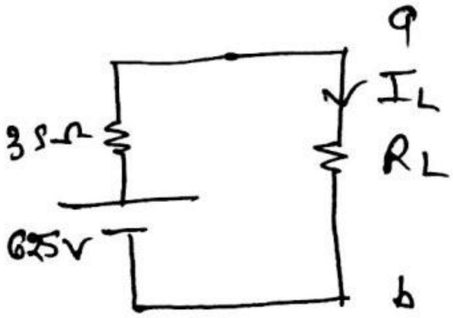


$$V_T = +400V + 225V = 625V$$

for $R_T \rightarrow$



$R_T = 35\Omega$



for Max power $R_L = R_{in}$

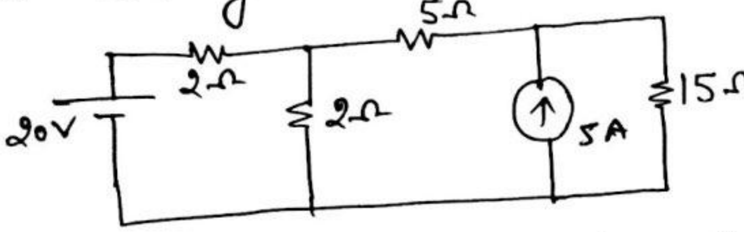
$R_L = 35\Omega$

$$I_L = \frac{625}{70} = 8.926\,A$$

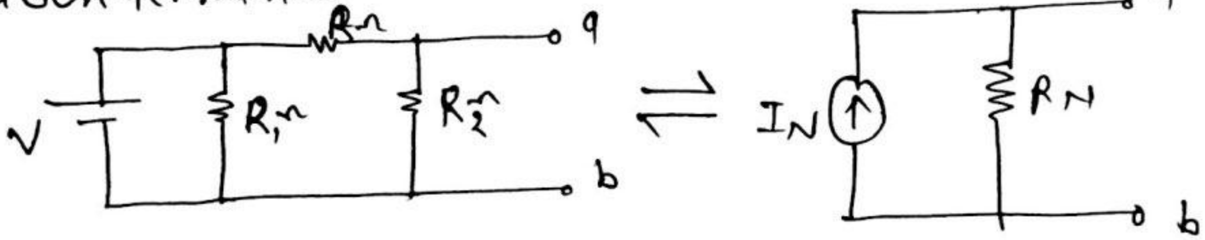
$$P_m = I_L^2 R_L = (8.926)^2 \cdot 35$$

$$\boxed{P_m = 2788.58\,W}$$

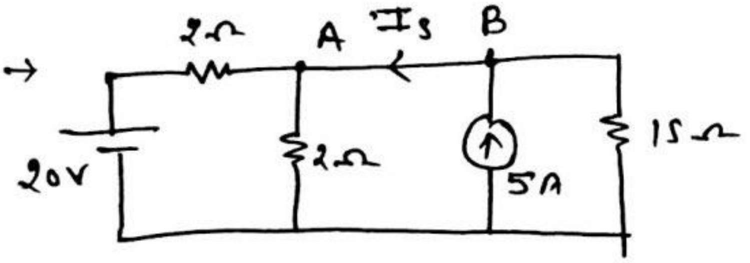
Ques. 14> State Norton's Theorem. Then find current in 5Ω using Norton's Theorem.



Ans. > "According to this Theorem Any linear active, resistive, complicated Network can be converted into a equivalent circuit containing a current source with Resistance in parallel b/w the given terminal"

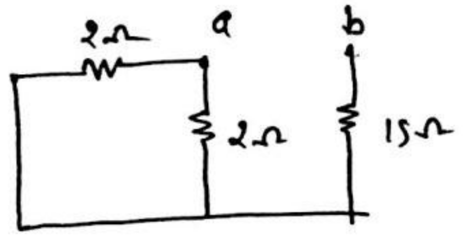


for I_N →

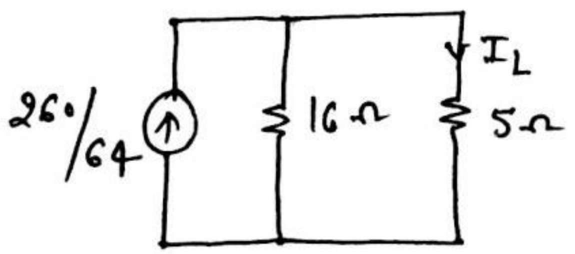


$I_s = 260/64$ A

for R_N →



$R_N = 16\Omega$



$$I_L = \frac{260/64 \times 16}{21}$$

$$\boxed{I_L = \frac{65}{21} \text{ A}}$$

Ans