Program	**B.Tech (CSE +ME+CE+EE) (C1 group)**	**Semester: 1**
Subject Code	**BTAM-101-23**	**Subject Title: Engineering Mathematics-I**

ASSIGNMENT

Q No.	Questions
1.	Test the convergence or divergence of $$x^2 + \frac{2^2}{3.4}\, x^4 + \frac{2^2.4^2}{3.4.5.6}\, x^6 + \frac{2^2.4^2.6^2}{3.4.5.6.7.8}\, x^8 + \cdots$$
2.	State Cauchy Integral test. Use it to prove p-test for the convergence and divergence of the series $\sum_{n=1}^{\infty} \frac{1}{n^p}$; p>0.
3.	Test the convergence or divergence of the series: $\sum_{n=1}^{\infty} (-1)^{n-1} \ \frac{n}{2n-1}$.
4.	Discuss the nature of the series: $\frac{1}{2} + \frac{2}{3}\ x + \left(\frac{3}{4}\right)^2 x^2 + \left(\frac{4}{5}\right)^3 x^3 + \cdots$, for x >0 .
5.	Show that the sequence $\{\frac{2n-7}{3n+2}\ \}$ is monotonic increasing. Also check if it is convergent or not?
6.	Test the convergence of the sequence: a) $s_n = 2 + (-1)^n$, b) $s_n = \{\frac{2n^3+7n}{5n^3+3n^2}\}$.
7.	Test the convergence of the series: $\frac{1}{1.2.3} + \frac{3}{2.3.4} + \frac{5}{3.4.6}$+...
8.	Test the convergence or divergence of $\frac{x}{1.2} + \frac{x^2}{2.3} + \frac{x^3}{3.4} + \cdots$, x > 0.
9.	Test the convergence or divergence of $1 + \frac{2x}{2!} + \frac{3^2x^2}{3!} + \frac{4^3x^3}{4!} + \cdots$, x > 0.
10.	Test the convergence or divergence of $\frac{x}{1} + \frac{1}{2}\frac{x^3}{3} + \frac{(1.3)}{2.4}\frac{x^5}{5} + \frac{1.3.5}{2.4.6}\frac{x^7}{7} + \cdots$, x > 0.

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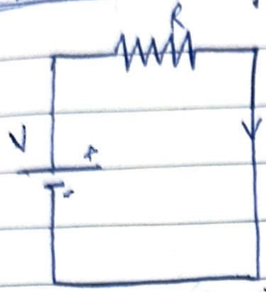
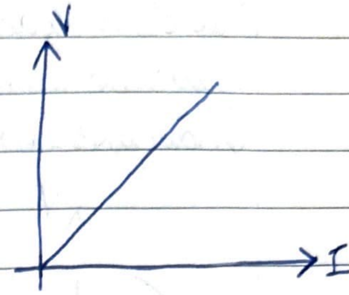
$\boxed{\text{RLC circuits}}$



Ohm's law
to determine the relationship b/w voltage & current.



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

when all physical conditions like temperature remain constant.

Q. Why battery discharges when not in use?
→ because of internal resistance in battery.

Commericial Unit of Energy = KW hr

$\underset{\text{(Watt)}}{P} = VI$

Q. 2 Fans of rating 80W works 10hrs dialy.
4 LEDs of rating 20W works 12hrs dialy.
1 AC of rating 1.5KW works 10hrs dialy.
1 Geyser of rating 3kW works 1 hr dialy.
1 60W charger works 3hrs dialy.
Calculate units consumed per day.

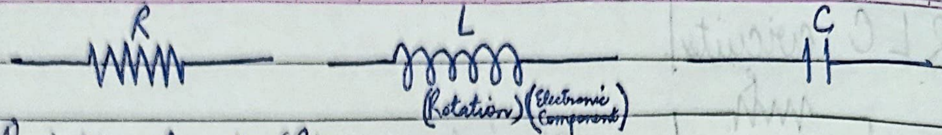
→
$$= \frac{2\times 80\times 10}{1000} + \frac{4\times 20\times 12}{1000} + 1\times 1.5\times 10 + 1\times 3\times 1 + \frac{1\times 60\times 3}{1000}$$

$= 1.6 + 0.96 + 15 + 3 + 0.18$

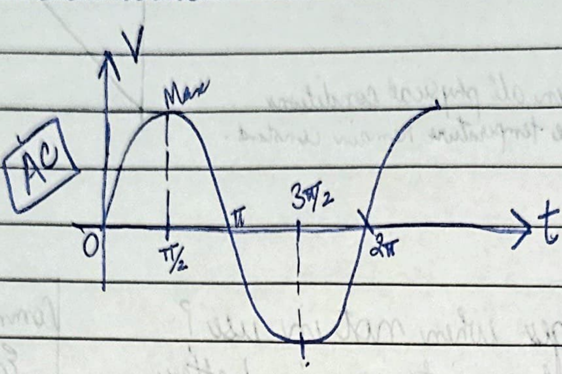
$= \boxed{20.74 \text{ units}}$ Ans

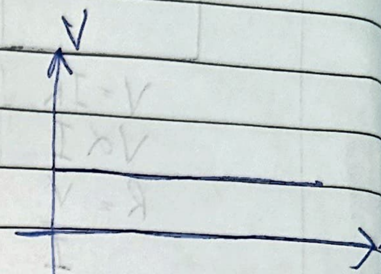
1600/1: 48 ×2 960/100 1500/1000 2

29/01/24



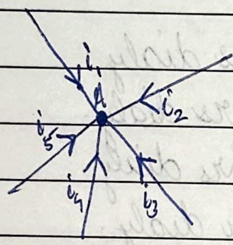
Resistive Load (R)
Capacitive Load (C)
Inductive Load (L)



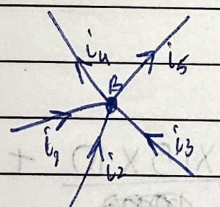


Kirchoff's Laws :- ① KCL $\left(\sum i = 0\right)$
② KVL $\left(\sum V = 0\right)$

KCL

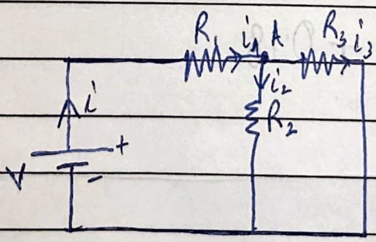


at A $\quad i_1 + i_2 + i_3 + i_4 + i_5 = 0$



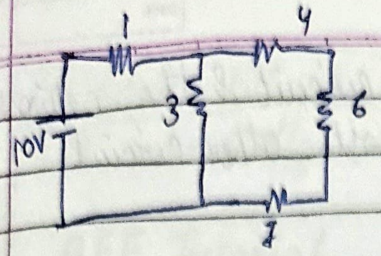
at B $\quad i_1 + i_2 + i_3 = i_4 + i_5$

KCL



KCL at A $\quad i_1 = i_2 + i_3$

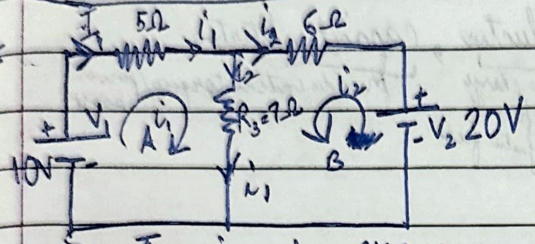
Q:



→ $R_{eq} = \frac{17\times3+20}{20} = \frac{71}{20}$

$i = 10 \times \frac{20}{71} = \boxed{\frac{200}{71} A}$ Ans

Q.



$I = i_1 + i_2$ (KCL)

→ around A: $10 - I_1\times5 - 7\times(i_2+i_1) = 0$ (KVL) ⇒

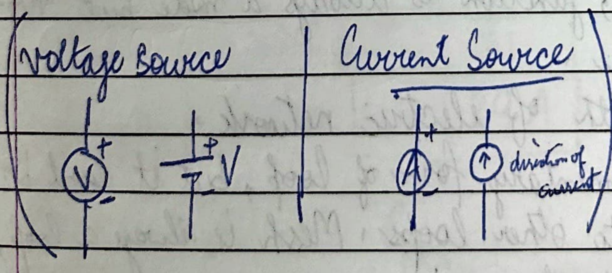
around B: $20 - 6i_2 - 7(i_2+i_1) = 0$ ⇒

30/01/24

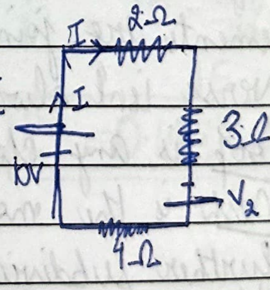
Electrical Network → no loop
not connected

Combo of various electric elements (L, C, R) voltage source, current source

Types :- ① Passive Elements ② Active Elements



Eg



$I = \frac{15}{9}$

KVL $15 - \frac{15}{9}\times2 - \frac{15}{9}\times3 - \frac{15}{9}\times4$
$= 0$

Active Elements supply energy to the circuit & the network containing these sources together with other circuit elements.

Old Regulators → Resistance based
Same power on all ~~xxx~~ fan speeds.

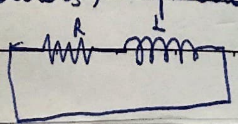
Passive Elements receive energy/absorb energy and then either convert it into heat or stored it in an Electric/magnetic field is called Passive Elements.
Eg Resistor, transformer, inductor, capacitor/Starter
inductor – store charge in form of magnetic field
capacitor/Starter – provides initial torque/power boost

Bilateral & Unilateral Elements

→ If by reversing the terminal connections of element in circuit, the circuit response remains same. Eg L, C, R

→ If by reversing the terminal connections of an element in a circuit, the circuit response gets changed. Eg Voltage Source, Diode, Current Source

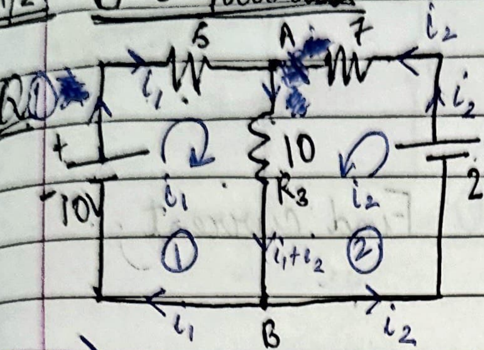
- A **Node** of a Network is an equipotential surface at which two or more circuit elements are joined.
- A **Junction** is that point in an electric circuit where three/more elements are joined. So, junction is always a node but vice-versa isn't always true.
- **Loop** is any closed path of electric network.
- **Mesh** is the most elementary form of loop, but it can't be further subdivided into other loops. Mesh is always a loop, but vice-versa isn't always true.
- **Lumped Network** is a network in which physically separate resistors, capacitors and inductors can be represented.



- Distributed Network in which R, L, C can't be physically separated and individually isolated as separate elements. Eg Transmission Line

31/01/24 **BEE Tutorial**

Q1



Find current across R_3

$\cancel{I_{R_3} = \frac{V_{AB}}{R_3} = \frac{20-10}{10} = 1A}$

in loop ①

$$10 - 5i_1 - 10(i_1 + i_2) = 0$$

$$10 = 15i_1 + 10i_2 \Rightarrow \frac{10 - 10i_2}{15} = i_1$$

in loop ②

$$20 - 7i_2 - 10(i_1 + i_2) = 0$$

$$20 = 17i_2 + 10i_1$$

$$17 \times 3 = 51$$

$$20 = 17i_2 + \cancel{10}^{2}\left(\frac{10 - 10i_2}{\cancel{15}_{3}}\right)$$

$$60 = 51i_2 + 20 - 20i_2$$

$$40 = 31i_2$$

$$\boxed{i_2 = \frac{40}{31} A} \Rightarrow i_1 = \frac{10 - \frac{400}{31}}{15} A$$

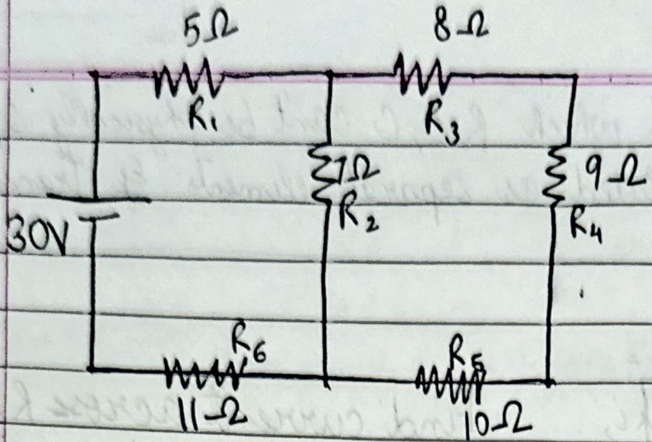
$$\boxed{i_2 = 1.29 A} \qquad \boxed{i_1 = -0.1935 A}$$

Current across R_3 = $i_1 + i_2$

$\boxed{\cancel{i = 1.1888A}}$ Ans

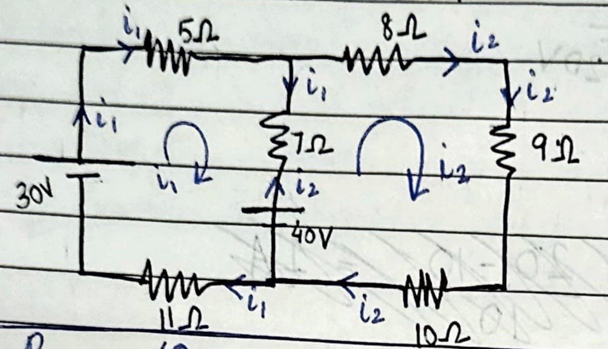
$i = 1.0965A$

Q②



Find current flowing in the circuit.

Q③



Find current.

Sol②

$$R_{eq} = \frac{(9+8+10)\times 7}{9+8+10+7} + 5 + 11$$

$$R_{eq} = \frac{27\times 7}{34} + 5 + 11 = 21.558\,\Omega$$

$$i = \frac{V}{R_{eq}} = \frac{30}{21.558} = \boxed{1.391\text{ A}}$$ **Ans**

Sol③

loop①

$$30 - 5i_1 - 11i_1 - 40 - 7(i_1 - i_2) = 0$$

$$30 - 40 = 23i_1 + 7i_2$$

$$-10 = 23i_1 + 7i_2 \Rightarrow \frac{-10 - 23i_1}{7} = i_2$$

loop②

$$40 - 7(i_2 - i_1) - 8i_2 - 9i_2 - 10i_2 = 0$$

$$40 = -7i_1 + 34i_2$$

$$40 = -7i_1 + 34\left(\frac{-10 - 23i_1}{7}\right)$$

$$280 = -49i_1 - 340 - 782$$

$$49i_1 = -1402$$

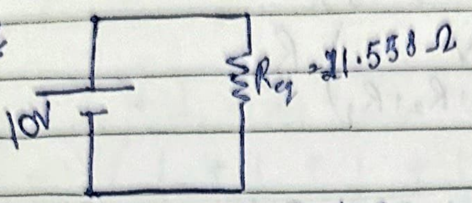
$$i_1 = -28.61\text{ A}$$

$$i_2 = -\frac{10 - 23(-28.61)}{7} = 92.58\text{ A}$$

Current $= i_1 + i_2 = 121.19\,A$

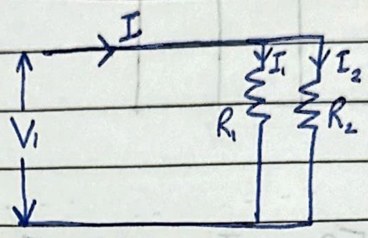
$\therefore \boxed{\text{Current in Circuit} = 121.19\,A}$ Ans

Alternate



$$i = \frac{10}{21.558} = 0.463\,A$$

5/02/24 **Current Division Rule :-**



$$I_1 = \frac{V_1}{R_1}, \quad I_2 = \frac{V_1}{R_2}$$

$$I = I_1 + I_2 \quad \because (KCL)$$

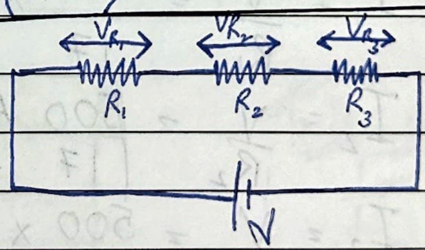
$$I = \frac{V_1}{R_1} + \frac{V_1}{R_2} = V_1\left(\frac{R_1+R_2}{R_1 \times R_2}\right)$$

$$V_1 = I\left(\frac{R_1 R_2}{R_1+R_2}\right)$$

$$I_1 = \frac{V_1}{R_1} = \frac{I}{R_1}\left(\frac{R_1 R_2}{R_1+R_2}\right) = I\left(\frac{R_2}{R_1+R_2}\right)$$

$$I_2 = \frac{V_1}{R_2} = \frac{I}{R_2}\left(\frac{R_1 R_2}{R_1+R_2}\right) = I\left(\frac{R_1}{R_1+R_2}\right)$$

Voltage Division Rule :-



$$V_{R_1} = IR_1 \quad \text{—(1)}$$
$$V_{R_2} = IR_2 \quad \text{—(2)}$$
$$V_{R_3} = IR_3 \quad \text{—(3)}$$

$$V = V_{R_1} + V_{R_2} + V_{R_3} \quad \because (KVL)$$

$$\cancel{V = V_{R_1} + V_{R_2} + V_{R_3} \because (KVL)}$$

$$V = IR_1 + IR_2 + IR_3$$

$$V = I(R_1 + R_2 + R_3)$$

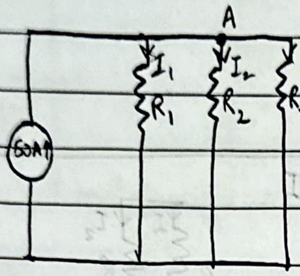
$$I = \frac{V}{R_1 + R_2 + R_3}$$

$$V_{R_1} = I \times R_1 = \left(\frac{V}{R_1+R_2+R_3}\right) R_1$$

$$V_{R_2} = I \times R_2 = \left(\frac{V}{R_1+R_2+R_3}\right) R_2$$

$$V_{R_3} = I \times R_3 = \left(\frac{V}{R_1+R_2+R_3}\right) R_3$$

Ques)



Find current in all resistance using KCL.

$$\begin{pmatrix} R_1 = 2\Omega \\ R_2 = 1\Omega \\ R_3 = 5\Omega \end{pmatrix}$$

→

$$50 = I_1 + I_2 + I_3$$

$$50 = V_A\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right) = V_A\left(\frac{1}{2} + 1 + \frac{1}{5}\right) = V_A\Big(\frac{5+10}{10}$$

$$50 = V_A\left(\frac{17}{10}\right)$$

(p.d) $\boxed{V_A = \frac{500}{17} V}$

$$I_1 = \frac{V}{R_1} = \frac{500}{17} \times \frac{1}{2} = \boxed{\frac{250}{17} A = I_1}$$ Ans

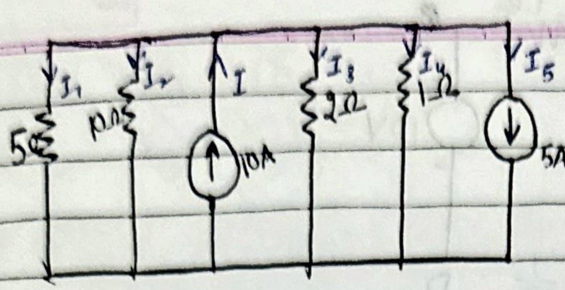
$$I_2 = \frac{V}{R_2} = \boxed{\frac{500}{17} A = I_2}$$ Ans

$$I_3 = \frac{V}{R_3} = \frac{500}{17} \times \frac{1}{5} = \boxed{\frac{100}{17} A = I_3}$$ Ans

---

* Ground Potential = 0

Ques)



→ $I = I_1 + I_2 + I_3 + I_4 + I_5$

$I - I_5 = V_A\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}\right)$

$5A = V_A\left(\frac{1}{5} + \frac{1}{10} + \frac{1}{2} + \frac{1}{1}\right) = V_A\left(\frac{20+10+50+100}{100}\right)$

$5 = V_A\left(\frac{180}{100}\right)$

$\boxed{\frac{50}{18}V = V_A}$

$I_1 = \frac{V_1}{R_1} = \frac{50}{18} \times \frac{1}{5} = \boxed{\frac{10}{18}A = I_1}$ Ans

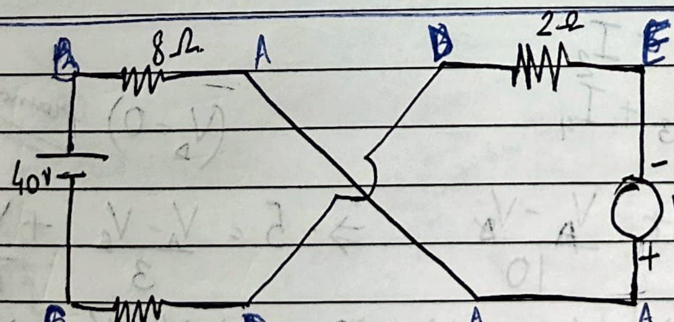
$I_2 = \frac{V_1}{R_2} = \frac{50}{18} \times \frac{1}{10} = \boxed{\frac{5}{18}A = I_2}$ Ans

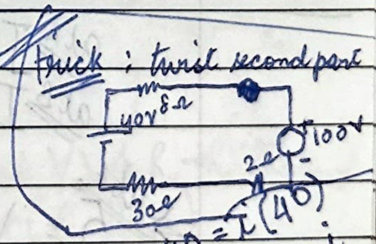
$I_3 = \frac{V_1}{R_3} = \frac{50}{18} \times \frac{1}{2} = \boxed{\frac{25}{18}A = I_3}$ Ans

$I_1 = \frac{V_1}{R_4} = \frac{50}{18} \times \frac{1}{1} = \boxed{\frac{50}{18}A = I_4}$ Ans

5/02/24

Ques)



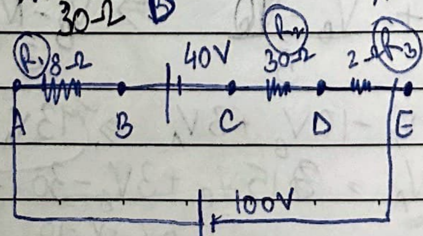


$100 - 40 = i(40)$

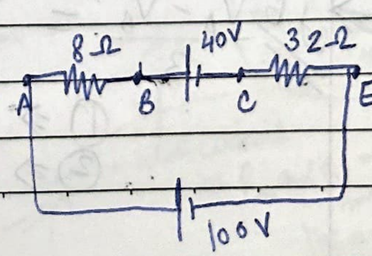
$\frac{60}{40}A = i$

$\boxed{i = \frac{3}{2}A}$ Ans

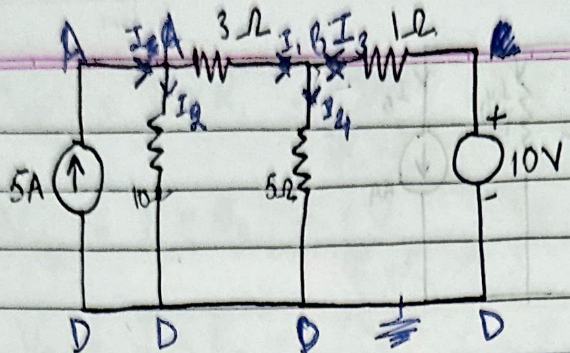
→

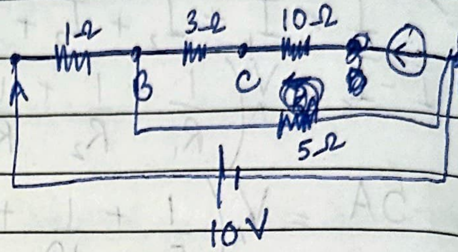


⇒



Ques)





$R_{eq} = 1 + \frac{13 \times}{1}$

~~$I = I_1 + I_2$~~
~~$I_1 = I_3 + I_4 + I_2$~~
~~$I =$~~

$$\boxed{I_{10\Omega} = \frac{180}{83} A}$$

$$I = \frac{10}{10+3+1} = \frac{10}{14} A$$

$$V_{AD} = \frac{180}{83} V$$

$$I = \frac{10}{83} \times 18 = \frac{180}{83}$$

$$V_{BD} = 10 - \frac{180}{83} = \frac{650}{83} V$$

$$\begin{array}{r} 830 \\ -180 \\ \hline 650 \end{array}$$

$$\boxed{I_{5\Omega} = \frac{130}{83} A}$$

$$\frac{\cancel{650}^{130} \times 1}{83 \times \cancel{5}}$$

$$I = I_1 + I_2$$
$$I_1 = I_3 + I_4$$
$$I = I_3 + I_4 + I_2$$
$$I = -5 +$$

at A $I = I_1 + I_2$

at B $I_1 = I_3 + I_4$

$(V_D = 0)$ Ground Potential

$\Rightarrow$ at A $5 = \frac{V_A - V_B}{3} + \frac{V_A - V_D}{10} \Rightarrow 5 = \frac{V_A - V_B}{3} + \frac{V_A}{10}$ — (1)

$\Rightarrow$ at B $\frac{V_A - V_B}{3} = \frac{V_B - V_C}{1} + \frac{V_B - V_D}{5} \Rightarrow \frac{V_B - V_A}{3} = \frac{V_B}{5} + \frac{V_B}{1}$

(1) $\Rightarrow 5^{\times 30} = 10V_A - 10V_B + 3V_A \Rightarrow 13V_A - 10V_B = 150$

(2) $\Rightarrow 5V_B - 5V_A = 15V_B + 3V_B - 30 \Rightarrow$

$5V_B + V_B - 10$

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~~$10V_A - V_B = 15$~~
~~$V_B = 10V_A - 15$~~

~~③ ⇒ $13V_A - 10(10V_A - 15) = 150$~~
~~$13V_A - 100V_A + 150 = 150$~~
~~13~~

$-13V_B - 5V_A = -30$
$5V_A + 13V_B = 30$
$V_A = \frac{30 - 13V_B}{5}$

③ ⇒ $13\left(\frac{30 - 13V_B}{5}\right) - 10V_B = 150$

$390 - 169V_B - 50V_B = 750$

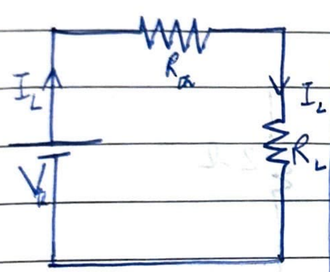
$-219V_B = 360$

$$\boxed{V_B = \frac{-360}{219}\,V}$$ Ans

$$V_A = \frac{30 - 13\left(\frac{-360}{219}\right)}{5}$$

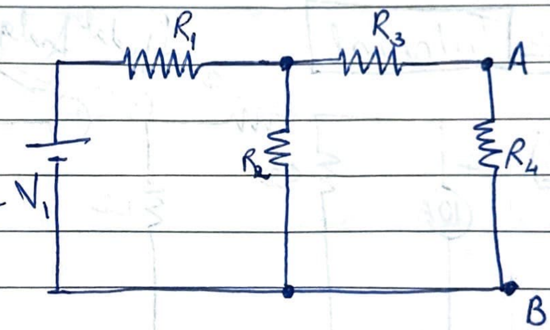
$$\boxed{\begin{array}{l} V_A = 19.85V \\ V_B = 10.9V \end{array}}$$ Ans

6/02/24 **Thevanin's Theorem :-**



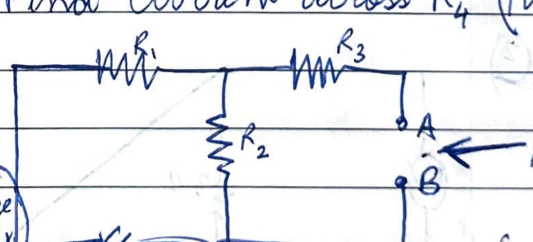
$$I_L = \frac{V_{th}}{R_{th} + R_L}$$

Q



Find current across R_4 (Find I_L)

→ Step ①



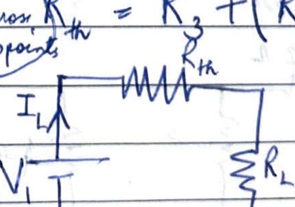
Short voltage make A+B point

Step ② (Remove R_4 and V_1) Open & $R_4 \to R_L$ (Load Resistance)

Find R_{th} across those two points

$R_{th} = R_3 + (R_1 \| R_2)$

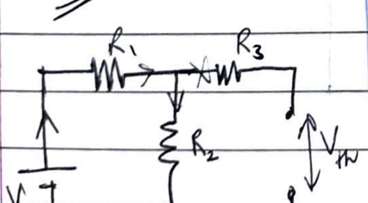
Create a loop with V_1 and R_L & R_{th}



$$\boxed{I_L = \frac{V_1}{R_{th} + R_L}}$$ Ans

Step ③ Replace whole circuit with R_{th} and R_L and make Thevanin's circuit

V_{th}

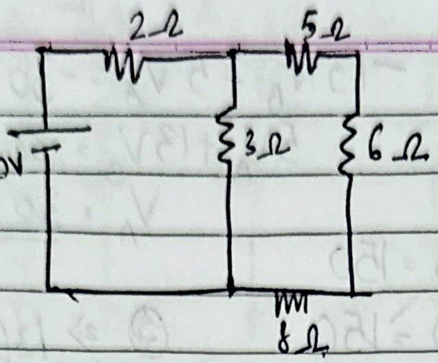


$V_{th} = I \times R_2$

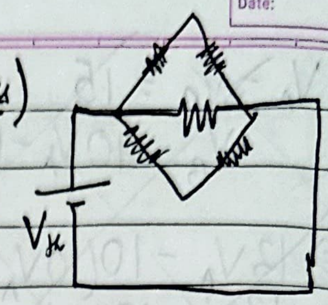
$V_{th} = R_2 \times \frac{V_1}{R_1 + (R_2)}$

(no current will flow through R_3 as open circuit there)

Ques)



Ques)



Steps :-

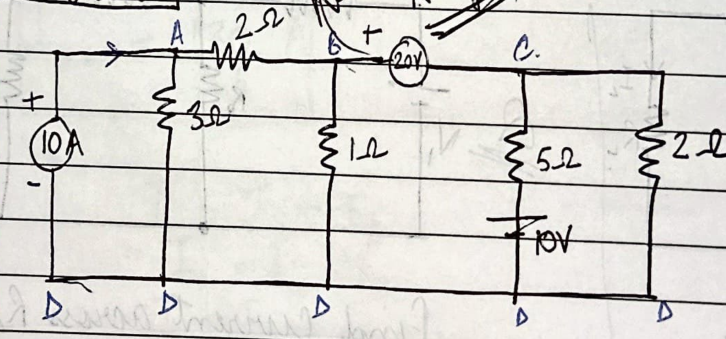
1. Remove/open R_4 and name it as R_L. and make points/ends A + B across it.
2. Short voltage (V)
3. Find R_{th} across those two points A & B.
4. Replace whole circuit with R_{th}, R_L and V and call it as Thevanin's Circuit.
5. Find I_L

Firstly find V_{th} then R_{th}

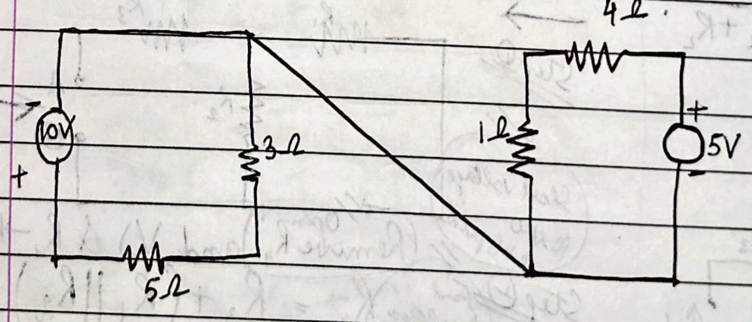
7/02/24 Tutorial

Nodal Analysis

Q(1)

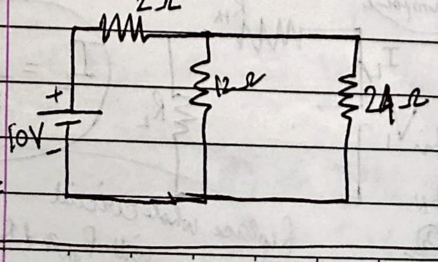


Q(2)



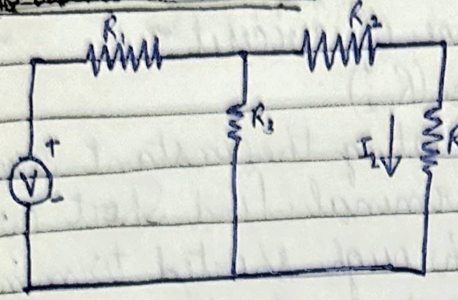
Q(3)

Thevanin's Theorem



13/02/24

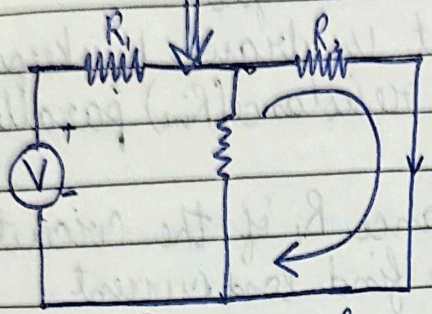
Norton's Theorem :-

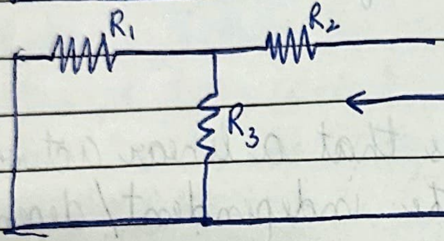


$$I = \frac{V}{\left(R_1 + \frac{R_2 R_3}{R_2 + R_3}\right)}$$

And short circuit (I_{sc})

$$I_{sc} = I\left(\frac{R_3}{R_3 + R_2}\right)$$





$R_{INT} - R_{eq} = R_N$

$$R_{int} = R_2 + \frac{R_1 R_3}{R_1 + R_3}$$

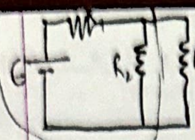
Any two terminal linear network with current source, voltage source and resistance can be replaced by equivalent circuit consisting of a current source in parallel with resistance, the value of current source is the short circuit current between the two terminals of circuit and network of the resistance is the equivalent resistance measu between terminals of network with all the source replaced by their Internal Resistance.

I_L = Load Current

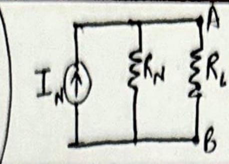
I_{sc} = Short Circuit Current

R_{int} = Internal Resistance of circuit

R_L = Load resistance



① R_L, I_L
② I_N
③ R_N
④ Parallel



$I_L = \frac{(\text{total current}) \times (\text{opposite branch resistance})}{(\text{total Resistance})} = I_N \cdot \frac{R_N}{R_N + R_L}$

$\left(I_N = \frac{E}{R_1}\right)$ by removing R_L & join single wire

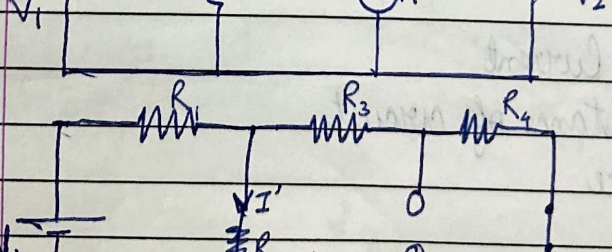
$\left(R_N = \frac{R_1 R_2}{R_1 + R_2}\right)$ remove E and remove R_L & make open wire across

Steps of Norton Theorem :-

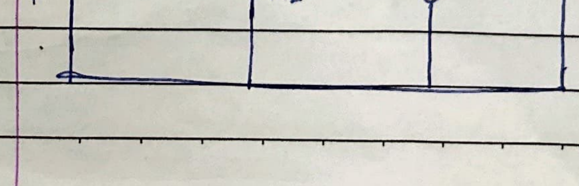
① Remove the load resistance of circuit.
② Find the internal resistance (R_{int})
③ Source Network by deactivating the constant source.
④ Now, short the load terminal. Find Short circuit current (I_{sc}) following through shorted terminal using conventional network analysis.
⑤ Norton equivalent circuit is drawn by keeping the ~~equivalent~~ internal resistance (R_{int}) parallel with I_{sc}.
⑥ Reconnect the load resistance R_L of the circuit across load terminal and find load current through it (I_L).

⇒ Norton's theorem states that a linear active network consisting of the independent/dependent voltage source/current source. Various circuit elements can be substituted by eq. circuit consistency of the current source in parallel with resistance. The current source being I_{sc} across load terminal & resistance being R_{int} of the source network.

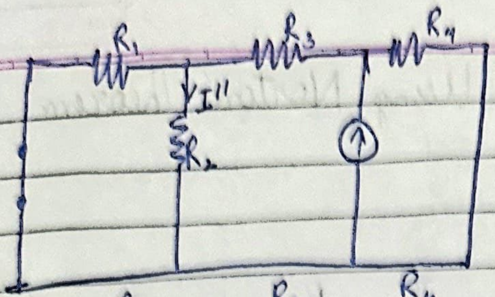
Superposition Theorem :-



①

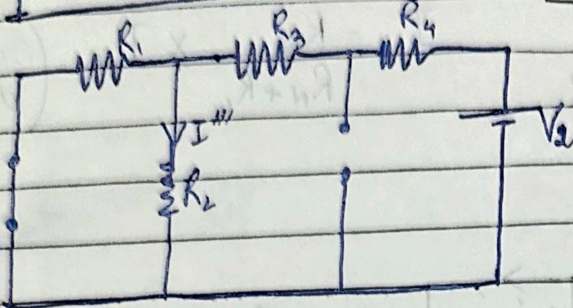


(2)



- If deactivate Voltage Source → Short Circuit
- If deactivate Current Source → Open Circuit

(3)

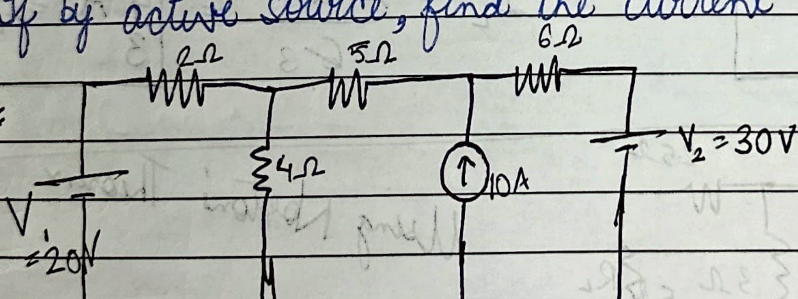


⇒ Superposition theorem states that in any linear, active bilateral network having more than one source, the response across any element is the sum of response obtained from each source, consider separately and all other sources are replaced.

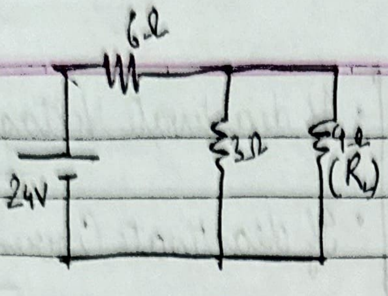
Steps of SuperPosition Theorem :-

1. Take only one source voltage or current source and deactivate other sources.
2. Find the current through the first source while if voltage source is shorted and current source is open.
3. If by active source, find the current I', I'', I''', etc.

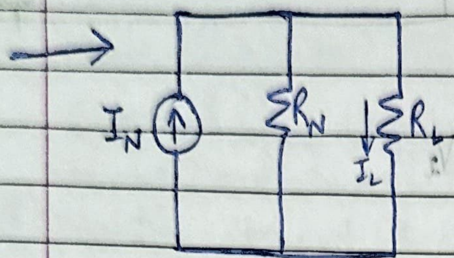
Eg



Ques ①

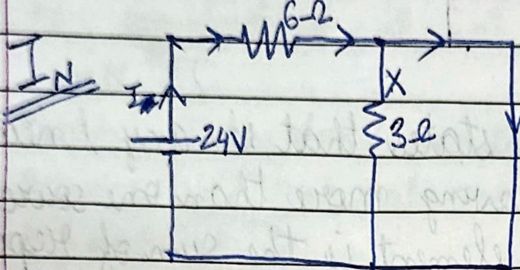


Using Norton's Theorem



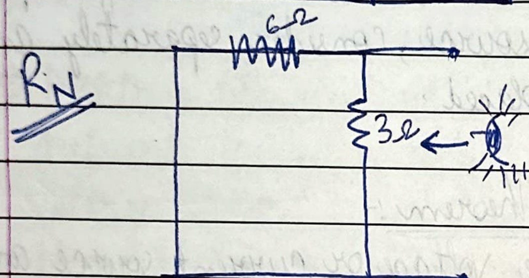
$$I_L = \frac{R_N}{R_N + R_L} \times I_N$$ (current division theorem)

I_N

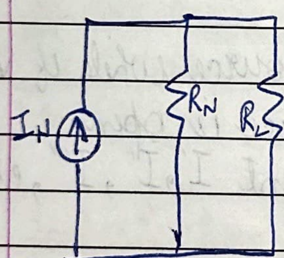


$$I_N = \frac{24}{6} = 4A$$

R_N



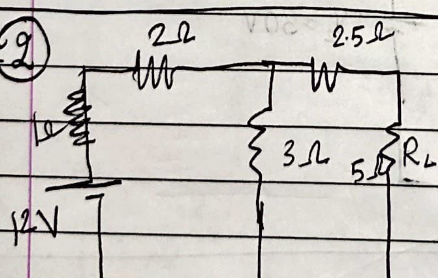
$$R_N = \frac{6 \times 3}{6+3} = \frac{\cancel{6}^{2} \times \cancel{3}}{\cancel{9}} = 2\Omega$$



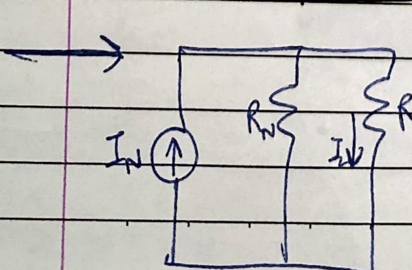
$$I_L = \frac{R_N}{R_N + R_L} \times I_N = \frac{2}{2+4} \times 4$$

$$I_L = \frac{\cancel{2} \times 4}{\cancel{6}\,3} = \boxed{\frac{4}{3}\,A = I_L}$$ Ans

Ques ②



Using Norton's Theorem



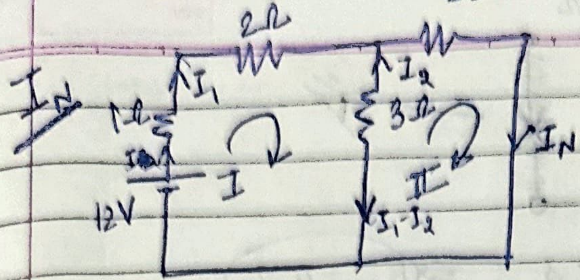
$$I_L = \frac{R_N}{R_N + R_L} \times I_N$$

Using KVL $12 - I_1 - 2I_1 - 3(I_1 - I_2) = 0 \Rightarrow 6I_1 + 3I_2 = 12 \Rightarrow 2I_1 + I_2 = 4$

$3(I_1 - I_2) - 2.5 I_2 = 0$

$\boxed{I_2 = I_N = 1.5A}$

I_N

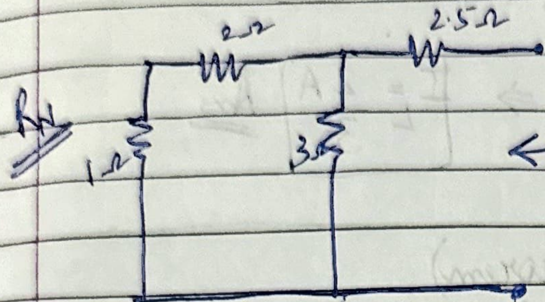


$\cancel{I_N = \frac{12}{1+2+\frac{2.5\times3}{2.5+3}} = \frac{12}{3+\frac{5\times3\times2}{2\times11}}}$

$\cancel{I_N = \frac{12}{3+\frac{15}{11}} = \frac{12\times11}{33+15} = \frac{12\times11}{48}}$

$\cancel{I_N = \frac{11}{4}A}$

R_N



$R_N = 2.5 + \frac{3\times3}{3+3}$

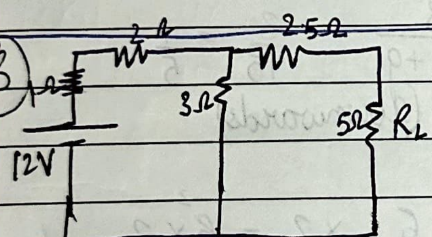
$R_N = 2.5 + \frac{3\times\cancel{3}}{\cancel{6}\,2} = \frac{5}{2} + \frac{3}{2}$

$R_N = 4\Omega$

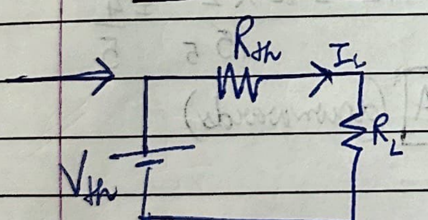
$I_L = \frac{R_N}{R_N + R_L} \times I_N = \frac{4}{4+5} \times \frac{3}{2} = \frac{4 \times 3}{9 \times 2} = \frac{6}{9}$

$\boxed{I_L = \frac{2}{3} A}$ Ans

Ques 3

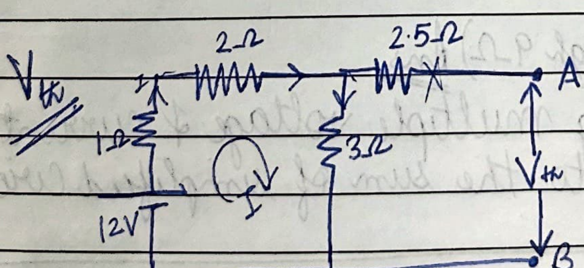


Using Thevenin's Theorem



$I_L = \frac{V_{th}}{R_{th} + R_L}$

V_{th}

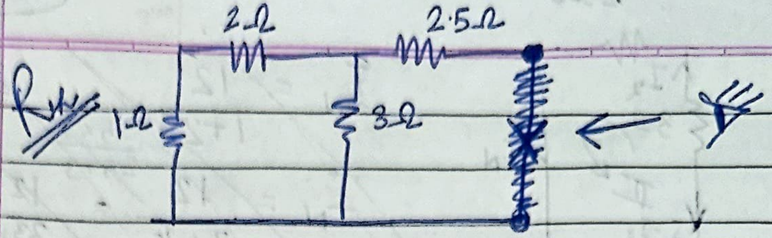


$V = IR$

$I = \frac{V}{R} = \frac{12}{1+2+3} = 2A$

$V_{th} = I \times 3\Omega = 2 \times 3\ V$

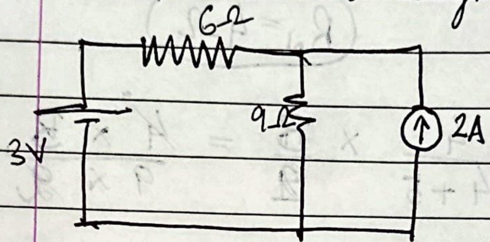
$V_{th} = 6V$

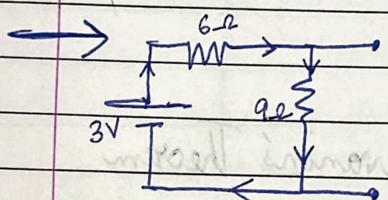


$$R_{th} = 2.5 + \frac{3 \times 3}{3+3} \Rightarrow R_{th} = 4\Omega$$

$$I_L = \frac{V_{th}}{R_{th}+R_L} = \frac{6}{4+5} \Rightarrow \boxed{I_L = \frac{2A}{3}}$$ Ans

Q4 (Using Superposition Theorem)
Find current through 9Ω resistor

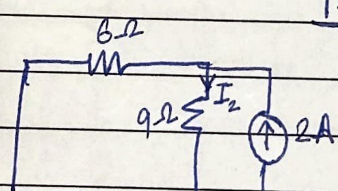




$V = IR$

$$I_1 = \frac{V}{R} = \frac{3}{6+9} = \frac{3}{15} = \frac{1}{5}$$

$\boxed{I_1 = 0.2A}$ (downwards)



$$I_2 = \frac{6}{9+6} \times 2 = \frac{6 \times 2}{15} = \frac{4}{5}$$

$\boxed{I_2 = 0.8A}$ (downwards)

$I = I_1 + I_2$

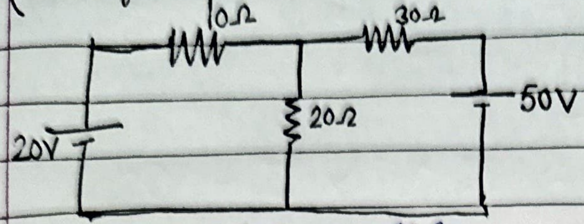
$I = 0.2 + 0.8$

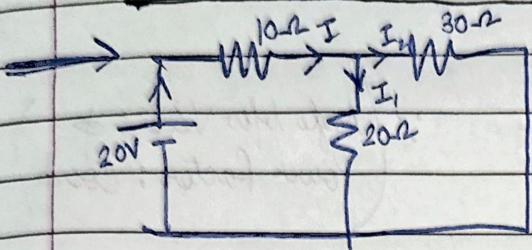
$\boxed{I = 1A}$ (through 9Ω) Ans

"In a circuit having multiple voltage & current sources is equal to the sum of simplified circu

Q⑤ (Using Superposition Theorem)

Find current through 20Ω Resistor





$\cancel{I_1 = \frac{20}{10+\frac{20\times30}{20+30}} = \frac{20}{10+\frac{20\times30}{50}}}$

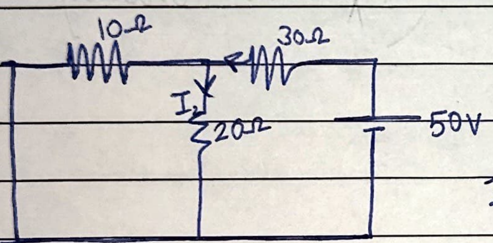
$I = \frac{20}{10+\frac{20\times30}{20+30}}$

$I = 0.9A$

$I_1 = \frac{30}{30+20}\times 0.9$

$I_1 = \frac{3\cancel{0}}{5\cancel{0}}\times\frac{9}{10} = \frac{27}{50}$

$I_1 = 0.54\ A$ (downwards)



$I = \frac{50}{30+\frac{20\times1\cancel{0}}{3\cancel{0}}} = \frac{50\times3}{90+20} = \frac{5\cancel{0}\times3}{11\cancel{0}} = \frac{15}{11}A$

$I_2 = \frac{10}{10+20}\times\frac{15}{11} = \frac{1\cancel{0}}{3\cancel{0}}\times\frac{\cancel{15}^{5}}{11} = \frac{5}{11}A$

$I_2 = 0.45A$ (downwards)

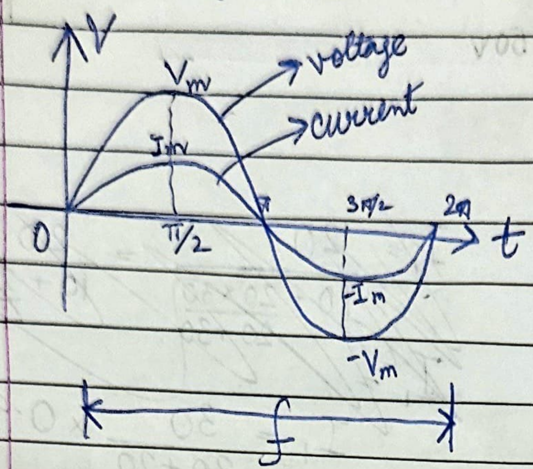
$I = I_1 + I_2$ (↑)

$I = 0.54 + 0.45$

$\boxed{I = 1A}$ (through 20Ω) Ans

19/02/24

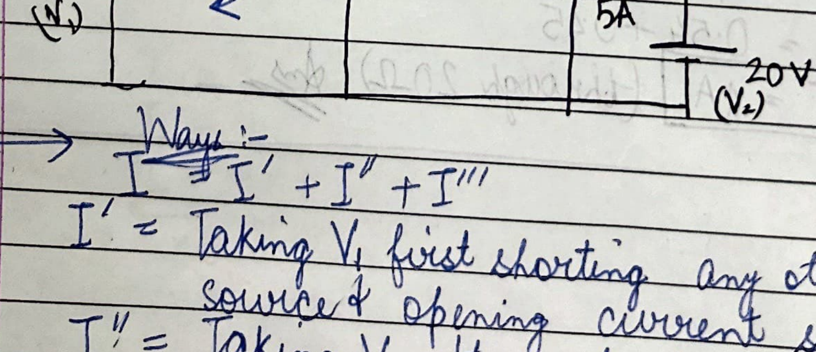
Power (AC Waveform)



$\because$ (Angle b/w V & I : ϕ
Power factor : $\cos\phi$)

$$P(t) = V(t) \times I(t)$$
$$P = VI \times \cos 0^\circ$$ $\because$ (in purely resistive circuit)
$$P = IRI$$
$$\boxed{P = I^2R} \star$$
$$P = \left(\frac{V}{R}\right)^2 R$$
$$\boxed{P = \frac{V^2}{R}} \star$$

Q. ★★★



Using SuperPosition Problem

→ Ways :-
$I = I' + I'' + I'''$

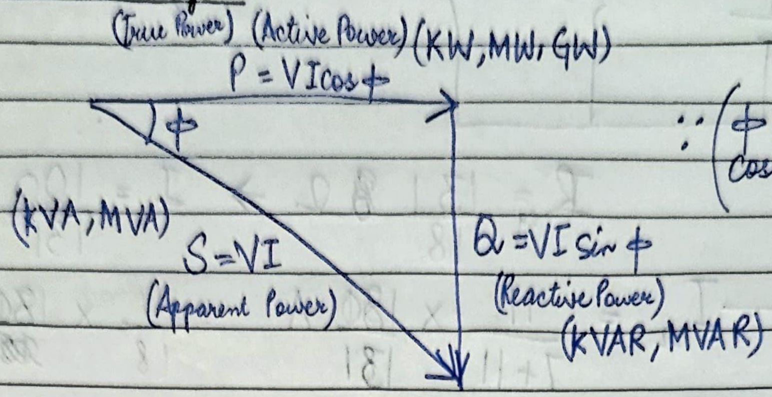
I' = Taking V_1 first shorting any other voltage source & opening current source

I'' = Taking V_2 then shorting V_1 & opening current source

I''' = Shorting all the voltage sources.

17/02/24

Power Triangle :-



$\because$ (φ : Angle between V & I
cos φ : Power factor)

$$S^2 = P^2 + Q^2$$

- **Loads:** Resistive Load — where V & I are in same phase & P is always +ve. Eg Electric Heater, Breaking Resistor, Light Lamp
  Inductive Load — I lags V Eg Transformer, Motor, Fan, Mobile Charger
  Capacitive Load — I leads V Eg

⇒ for single phase : (AC Circuit)
$$P = VI\cos\phi$$

⇒ for three phase : (AC Circuit)
$$P = \sqrt{3}\, VI\cos\phi$$

Instantaneous Power :- $\boxed{P(t) = V(t) \times I(t)}$

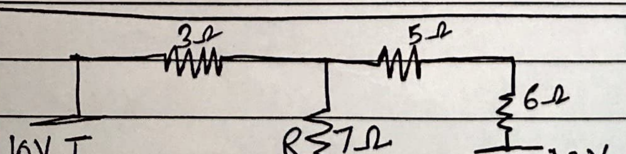
$\boxed{I = \frac{V}{Z\text{(impedence)}}}$ and $\boxed{Z = \sqrt{R^2 + (X_c - X_L)^2}}$

$\boxed{X_L = 2\pi f_L}$ and $\boxed{X_c = \frac{1}{2\pi f_c}}$

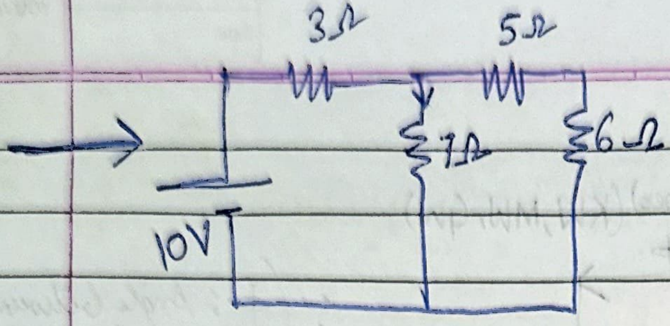
- $P = VI\cos\phi$ (Active Power)

⇒ P↑ in order to compensate the decrease in (cos φ) value.

Q①)



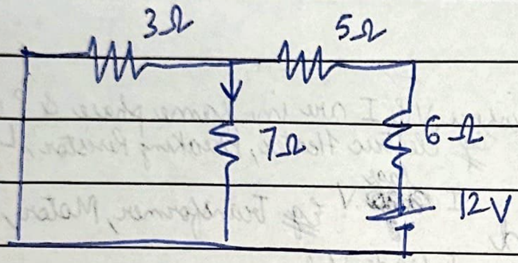
Find current through 7Ω.



$\frac{7\times 11}{18}+3$ $\quad$ $\frac{77+54}{18}$

$R_{eq} = \frac{131}{18}\,\Omega \Rightarrow I = \frac{180}{131}$ A

① — $I_{7\Omega} = \frac{11}{7+11} \times \frac{180}{131}$ A $= \frac{11}{18} \times \frac{180}{131}$ A (downwards)



$\frac{7\times 3}{10} = \frac{21}{10} + 11$ $\quad$ $\frac{21+110}{10}$ $\quad$ $\frac{131}{10}$

$R_{eq} = \frac{131}{10}\,\Omega \Rightarrow I = \frac{120}{131}$ A

② — $I_{7\Omega} = \frac{3}{10} \times \frac{120}{131}$ A (downwards)

18×18

① + ② = Total Current through 7 Ω resistor