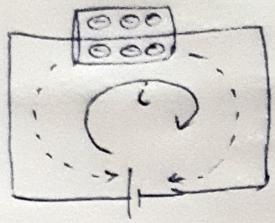
Basics Electrical :

Charge is the electrical property of any material.
Total amount of electrical charge is constant and It cannot be created nor be destroyed.



Current is the rate of change of charge in any circuit with time

i.e. $i = \frac{dq}{dt}$

Q determine the total charge entering in a terminal between $t=1$ and $t=2$ where $i = (3t^2 - t)\,A$

Sol.

$\because i = \frac{dq}{dt}$

so $dq = i\,dt$

$$\int dq = \int_{t=1}^{2} (3t^2 - t)\,dt$$

$$Q = \left[\frac{3t^3}{3} - \frac{t^2}{2}\right]_1^2$$

$$Q = (8-2) - \left(1 - \frac{1}{2}\right)$$

$$= 3.5\,C$$

Voltage : The voltage or Potential difference between two points in any electrical circuit is the amount of energy required to move unit charge between two points.

i.e. $V = \frac{dw}{dq}$ $\boxed{V_{ab} = -V_{ba}}$

Ohm's law : It state that across a resistor or linear circuit the current and voltage are directly proportional to each other, where other conditions are constant.

i.e. $i \propto v$

or $\boxed{v = iR}$

Electrical Network: A combination of various electric element connected in any manner is called electrical Network.

Electrical component are divided into
- ↳ Active
- ↳ Passive

→ Active component are those which supply energy or Power in any electrical circuit. eg Battery

→ Passive component are those which absorbs power and convert them to light or any form of energy. eg inductor or capacitor

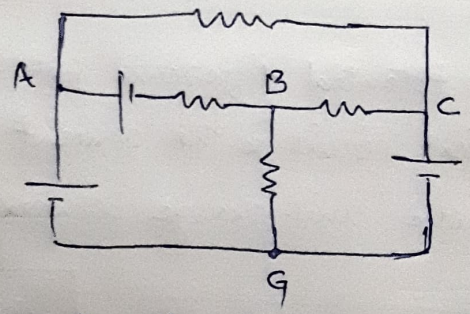
These again can be divided into

↳ **Bilateral**: Conduction of current is possible in both direction with same magnitude in Bilateral.

↳ **Unilateral**: Conduction of current is possible only in one direction eg. diode.

Linear circuit: A linear circuit satisfy homogeneity and additive property.

Kirchhoff's Law:



- **Node**: These are certain points in any electrical circuit where more than 2 elements are connected to each other.
- **Branch**: It is a conducting path between two nodes in a circuit containing some electrical element.

- **Loop**: A Loop is a closed path in an electrical circuit whose Starting and end points is the same node and touches more than one node.

- **Mesh**: A mesh is a special case of loop that does not have any other loop inside a loop.

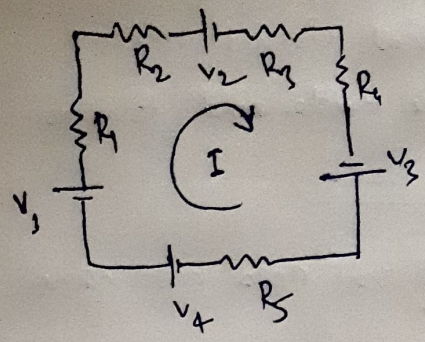
KCL: It states that at any node in a circuit the algebraic sum of current entering and current leaving is equal to zero.

Current enters : +ve sign
Current leaves : -ve sign

KVL: It states that in a closed circuit the algebraic sum of all source of voltages is equal to the sum of all voltage drops.

→ voltage gain = Source voltage only
→ voltage drops = encountered when current flows in an element from higher potential terminal to lower potential terminal.

Date 13/3/23

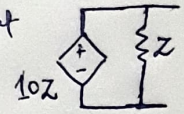


$$V_1 - iR_1 - iR_2 - V_2 - iR_3 - iR_4 + V_3 - iR_5 + V_4 = 0$$

$$V_1 - V_2 + V_3 + V_4 = iR_1 + iR_2 + iR_3 + iR_4 + iR_5$$

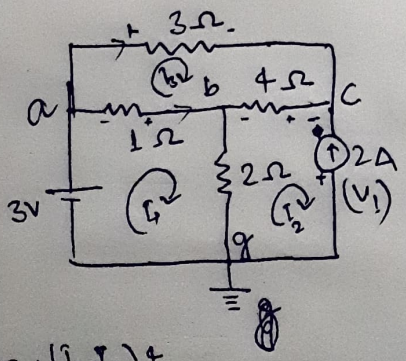
$$V_1 - V_2 + V_3 + V_4 = i\left(\sum_{i=1} R_i\right)$$

Source
- Independent
  - voltage (will provide voltage that does not upon any other element) $\oplus$
  - current (will provide current " " " " " ") $\uparrow$
- Dependent
  - voltage dependent voltage source → will provide voltage in any circuit and the value of the source will depend upon some voltage in the circuit



  - current dependent voltage source → will provide voltage and depend upon some current in the circuit
  - current dependent current source → will provide current and depend upon some current in the circuit.
  - voltage dependent current source → will provide current and depend upon some voltage in the circuit

Q



find out I_{ab}, V_{gc} by using KVL.

$$3 - i_{ab} - i_{bg}2 = 0$$

$$\boxed{3 = i_{ab} + 2i_{bg}}$$

$$+I_3(3) + (I_3 - I_2)4 + (I_3 - I_1) = 0$$

$$5I_3 - 4I_2 + I_3 - I_1 = 0$$

$$\boxed{6I_3 - 4I_2 - I_1 = 0}$$

$$2i_{bg} - 4i_{bc} = 0$$

$$\boxed{i_{bg} = 2i_{bc}}$$

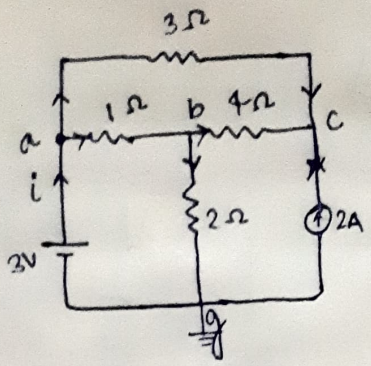
$I_1 = 0.9A$

$I_3 = 1.08A$

$$\boxed{I_{ab} = I_1 - I_3}$$

$V_{gc} = 6.27V$

Q



Solve using KCL. (I_{ab} and V_g)

Soln:

Node a.

$$i - \frac{(V_a - V_b)}{1} - \frac{(V_a - V_c)}{3} = 0 \Rightarrow i = (V_a - V_b) - \frac{(V_a - V_c)}{3}$$

$$i = \frac{2V_a - 3V_b + V_c}{3}$$

$$\boxed{V_a = 3}$$

Node b

$$\frac{(V_a - V_b)}{1} - \frac{(V_b - V_c)}{4} - \frac{(V_b - \cancel{V_g})}{2} = 0 \qquad i = \frac{6 - 3V_b + V_c}{3}$$

Node c,

$$2 + \frac{(V_b - V_c)}{4} + \frac{(V_a - V_c)}{3} = 0$$

$$\frac{24 + 3V_b - 3V_c + 4V_a - 4V_c}{12} = 0$$

$$\frac{24 + 3V_b - 3V_c + 12 - 4V_c}{12} = 0$$

$$\frac{36 + 3V_b - 7V_c}{12} = 0$$

$$3 - V_b - \frac{(V_b - V_c)}{4} - \frac{V_b}{2} = 0$$

$$3 = V_b + \frac{(V_b - V_c)}{4} + \frac{V_b}{2}$$

$$3 = \frac{4V_b + V_b - V_c + 2V_b}{4}$$

$$\boxed{12 = 7V_b - V_c} \quad \times +3$$

$$-36 = 3V_b - 7V_c$$

$$+36 = 21V_b - 3V_c$$

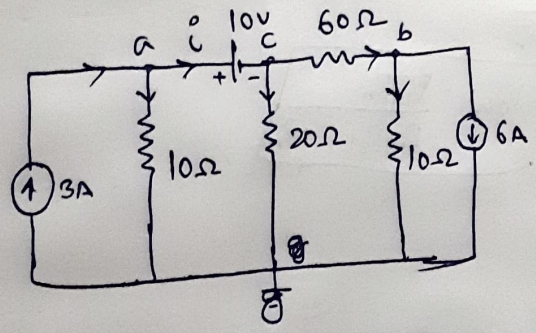
$$-36 = 3V_b - 7V_c$$

$$0 = 24V_b - 10V_c$$

$$10V_c = 24V_b$$

$$\boxed{V_c = 2.4V_b}$$

Q



Solve for i using KCL

Soln

Node a

$$3 - \left(\frac{V_a - V_g}{10}\right) - i = 0$$

$$3 - \frac{V_a}{10} - i = 0$$

$$\Rightarrow i = 3 - \frac{V_a}{10} \quad \text{--- (I)}$$

$$\boxed{V_a - V_c = 10} \quad \text{--- (IV)}$$

If no. of current source is more use KCL and
If no of voltage source is more use KVL.

Node b

$$\left(\frac{V_c - V_b}{60}\right) - \left(\frac{V_b}{10}\right) = 6$$

$$\frac{V_c - V_b}{6} - V_b = 60$$

$$\boxed{V_c - 7V_b = 360} \quad \text{--- (II)}$$

Node c,

$$i - \frac{V_c}{20} - \frac{(V_c - V_b)}{60} = 0$$

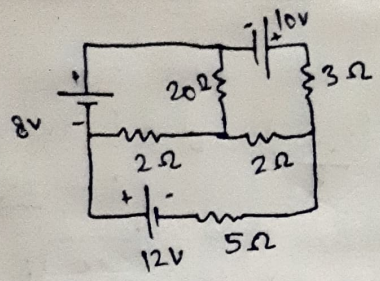
$$\boxed{i = \frac{V_c}{20} + \frac{V_c - V_b}{60}} \quad \text{--- (III)}$$

$V_a = 16.99V$

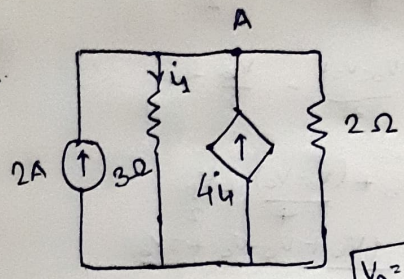
$V_b = -50.99V$

Q Determine the current in 5Ω resistance $\boxed{3.63A}$

Solve



Q



find out the value of i_1.

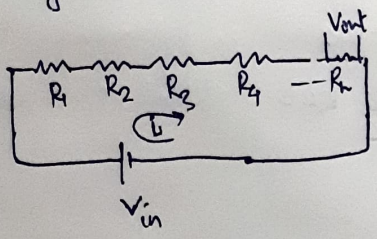
Soln: Node A

$$2 - i_1 + 4i_1 - \frac{V_A}{2} = 0$$

$$i_1 = \frac{V_A}{3}$$

$\boxed{V_A = -4V}$

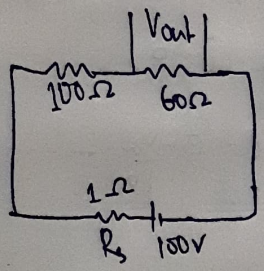
Voltage divider circuit :



$$I = \frac{V_{in}}{R_1 + R_2 + \cdots + R_n}$$

$\boxed{V_{out} = IR_n} \rightarrow \boxed{V_{out} = \frac{V_{in} R_n}{R_1 + R_2 + \cdots + R_n}}$

Q



(1) Calculate Vout ignoring internal resistance R_s

(2) Recalculate Vout taking R_s.

Soln.

(1) $I = \frac{V_{in}}{R_1 + R_2} = \frac{100}{160}$

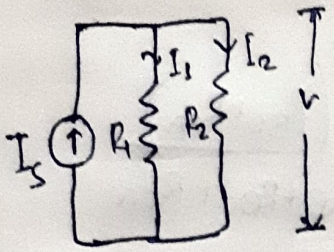
$= 0.625\ A$

$V_{out} = 0.625 \times 60$

(1) $I = \frac{V_{in}}{R_1 + R_2 + R_s} = \frac{100}{161}$

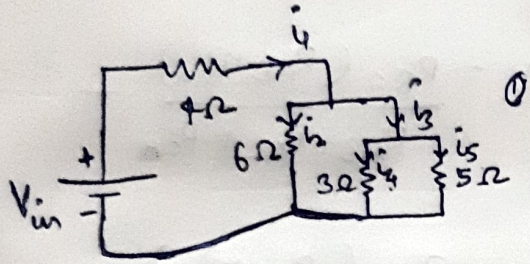
$V_{out} = \frac{100}{161} \times 60$

Current divider circuit:



$$I_s = \frac{V}{\frac{1}{R_1}+\frac{1}{R_2}}$$

Q



① current across 3Ω is 4A.
find out current across other branches.

Sol: given $i_4 = 4A$

$$i_4 = \frac{i_3 \times 5}{5+3}$$

$$4 = \frac{i_3 \times 5}{8}$$

$$i_3 = 6.4\ A$$

$$i_3 = \frac{i_4 \times 6}{6+\frac{15}{8}}$$

$$6.4 = \frac{(i_4 \times 6)8}{63}$$

$$\frac{0.8 \times 63}{6} = i_4$$

$$i_4 = 8.4$$

So, $i_2 = i_4 - i_3$

$= 8.4 - 6.4$

$i_2 = 2A$

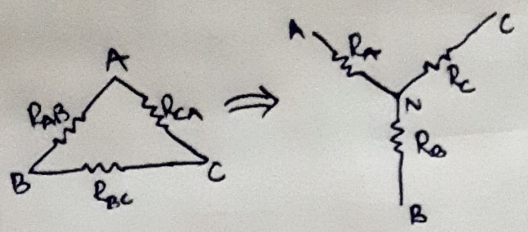
$i_5 = i_4 + i_5$

$i_5 = 6.4 - 4$

$= 2.4\ A$

Date
17/3/23

Delta to Star



Between A & B

$$R_A + R_B = \frac{R_{AB}(R_{BC}+R_{CA})}{R_{AB}+R_{BC}+R_{CA}} \quad \text{--- (I)}$$

Between B & C

$$R_B + R_C = \frac{R_{BC}(R_{AB}+R_{CA})}{R_{AB}+R_{BC}+R_{CA}} \quad \text{--- (II)}$$

Between C & A

$$R_A + R_C = \frac{R_{CA}(R_{AB}+R_{BC})}{R_{AB}+R_{BC}+R_{CA}} \quad \text{--- (III)}$$

Add eqn (I), (II) and (III)

$$\cancel{2}(R_A+R_B+R_C) = \frac{\cancel{2}(R_{AB}R_{BC}+R_{BC}R_{CA}+R_{CA}R_{AB})}{R_{AB}+R_{BC}+R_{CA}} \quad \text{--- (IV)}$$

$$\boxed{(R_A+R_B+R_C)(R_{AB}+R_{BC}+R_{CA}) = R_{AB}R_{BC}+R_{BC}R_{CA}+R_{CA}R_{AB}}$$

Now,

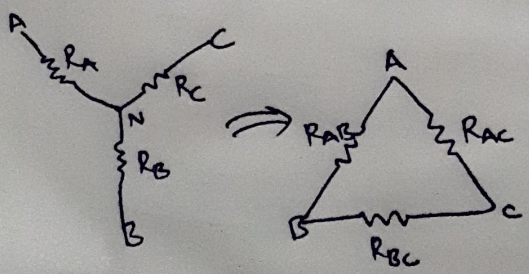
Eqn (IV) − (I), $R_C = \dfrac{R_{BC}R_{CA}}{R_{AB}+R_{BC}+R_{CA}}$ --- (V)

Eqn (IV) − (II), $R_A = \dfrac{R_{CA}R_{AB}}{R_{AB}+R_{BC}+R_{CA}}$ --- (VI)

Eqn (IV) − (III), $R_B = \dfrac{R_{AB}R_{BC}}{R_{AB}+R_{BC}+R_{CA}}$ --- (VII)

Remember it

Star to Delta



Solve for

$$R_AR_B + R_BR_C + R_CR_A = \frac{(R_{CA}R_{AB})(R_{AB}R_{BC})}{(R_{AB}+R_{BC}+R_{CA})^2} + \frac{(R_{AB}R_{BC})(R_{BC}R_{CA})}{(R_{AB}+R_{BC}+R_{CA})^2} + \frac{(R_{BC}R_{CA})(R_{CA}R_{AB})}{(R_{AB}+R_{BC}+R_{CA})^2}$$

So,

$$\boxed{R_AR_B + R_BR_C + R_CR_A = \frac{R_{AB}R_{BC}R_{CA}}{R_{AB}+R_{BC}+R_{CA}}} \quad \text{--- (VIII)}$$

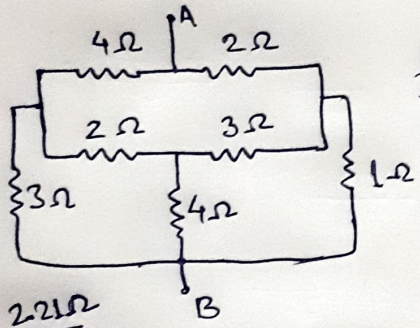
Now eqn $\frac{(VIII)}{(V)}$, $R_{AB} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_C}$

eqn $\frac{(VIII)}{(VI)}$ $R_{CA} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_B}$

eqn $\frac{(VIII)}{(VII)}$ $R_{BC} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_A}$

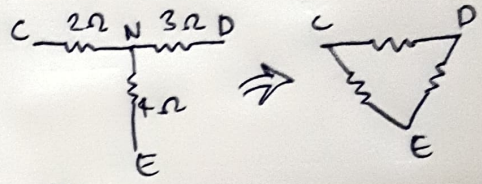
Remember it

Q.



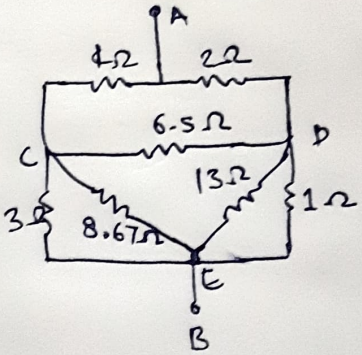
find the equivalent Resistance b/w A & B.

Soln:-



Ans: $R_{eq} = 2.21\Omega$

So,



$R_{CD} = \frac{R_C R_D + R_D R_E + R_C R_E}{R_E}$

$= \frac{(2)(3) + (3)(4) + (2)(4)}{4}$

$= \frac{6+12+8}{4}$

$= 6.5\Omega$

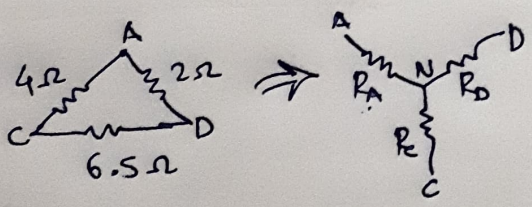
$R_{DE} = \frac{26}{2}$

$= 13\Omega$

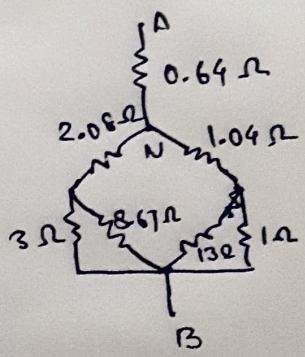
$R_{CE} = \frac{26}{3}$

$= 8.66\Omega$

Now



So,



$R_{AB} + R_{DC} + R_{CA} = 4 + 6.5 + 2$

$= 12.5\Omega$

$R_A = \frac{R_{AD} R_{AC}}{12.5\Omega}$

$= \frac{(2)(4)}{12.5}$

$= 0.64\Omega$

$R_B = \frac{R_{DC} R_{AD}}{12.5}$

$= \frac{(6.5)(2)}{12.5}$

$= 1.04$

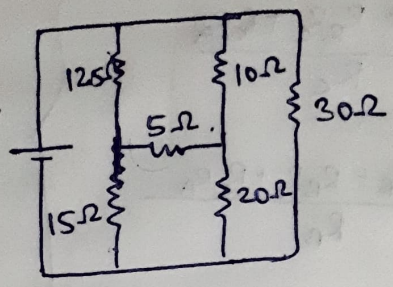
$R_C = \frac{R_{AC} R_{DC}}{12.5}$

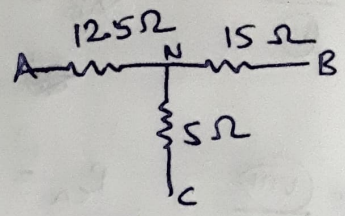
$= \frac{(4)(6.5)}{12.5}$

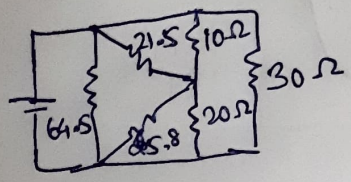
$= 2.08$

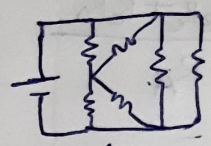
Q find out R_{AB}

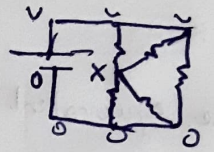
Soln:

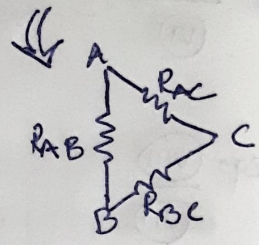












$R_{\Delta} = R_A R_B + R_B R_C + R_C R_A$

$= (12.5)(15) + (15)(5) + (5)(12.5)$

$= 322.5$

So, $R_{AC} = \frac{322.5}{15} = 21.5\ \Omega$

$R_{BC} = \frac{322.5}{12.5} = 25.8\ \Omega$

$R_{AB} = \frac{322.5}{5} = 64.5\ \Omega$

Superposition theorem: In any linear Bilateral network containing two or more independent sources, the resultant current or voltage in any branch is the algebraic sum of currents or voltages caused by each independent sources acting alone with all other independent sources being replaced by their respective internal resistances.

internal res. of ideal current source = ∞ (open circuit)

" " " " voltage source = 0 (short circuit)

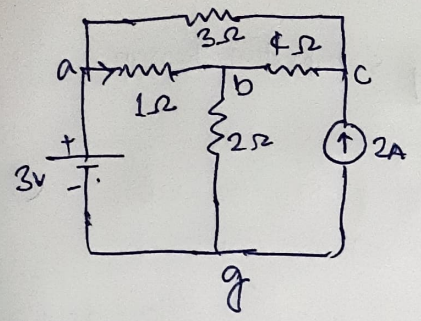
How to solve:

Step 1: Turn off all independent source except one, then find the output.

Step 2: Repeat step 1 for each independent sources.

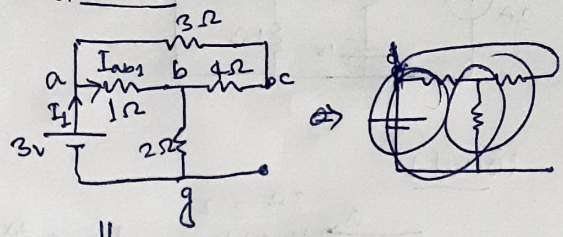
Step 3: Add Algebraically all the contribution of independent sources.

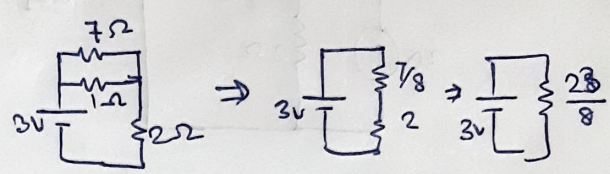
Q



Calculate I_{ab} and V_{gc}.

Soln: Circuit 1:





$16-18 = -2$

$$\boxed{\frac{1}{7}+\frac{1}{1} = \frac{1+7}{7} = \frac{7}{8} \rightarrow R_{eq}}$$

$$I = \frac{V}{R} = \frac{3\times 8}{23}$$

$$\boxed{I_1 = \frac{24}{23}}$$

$$I_{ac_1} = I_1 \times \frac{1}{8}$$

$$I_{ac_1} = \frac{3}{23}$$

$$I_{ab_1} = \frac{I_1 \times 7}{8}$$

$$I_{ab_1} = \frac{\cancel{24}^{3}}{23} \times \frac{7}{\cancel{8}}$$

$$\boxed{I_{ab_1} = \frac{21}{23}\ A}$$

$$V_{cg_1} = V_{cb_1} + V_{bg_1}$$

$$= (4)\left(\frac{3}{23}\right) + (2)\left(\frac{24}{23}\right)$$

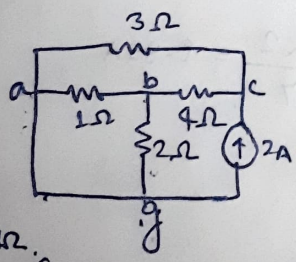
$$\Rightarrow \frac{12+48}{23} = \frac{60}{23}\ V$$

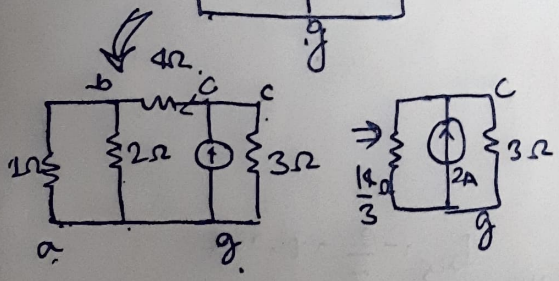
$$V_{cg} = V_{cg_1} + V_{cg_2}$$

$$= \frac{144}{23}$$

Circuit 2:

I_{ab_2} & V_{cg_2} = ?





$$I_L = \frac{2\times 3}{3+\frac{14}{3}} = \frac{18}{23}\ A$$

$$I_R = 2 - \frac{18}{23} = \frac{28}{23}\ A$$

$$I_{ab_2} = \frac{18}{23} \times \frac{2}{3}$$

$$= \frac{36}{46} = \frac{12}{23}\ A$$

$$V_{cg_2} = \left(\frac{28}{23}\right)(3)$$

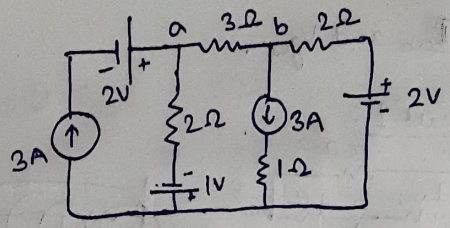
$$= \frac{84}{23}\ V$$

$$I_{ab_2} = \frac{-12}{23}\ A$$

So $I_{ab} = I_{ab_1} + I_{ab_2} = \frac{21}{23} - \frac{12}{23} = \frac{9}{23}\ A$

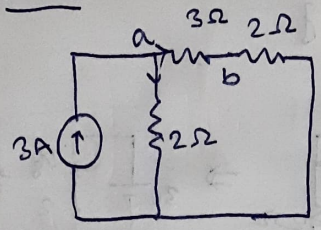
$= 0.39\ A$

Date
21/03/23



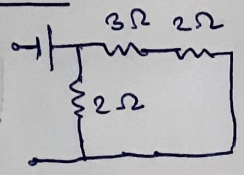
find I_{ab} by superposition theorem

Sol^n: circuit-1:



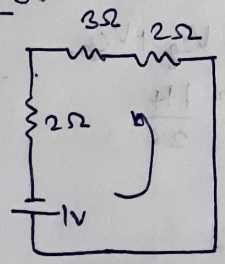
$I_{ab_1} = \frac{3\times2}{7} = 0.85\ A$

circuit 2:



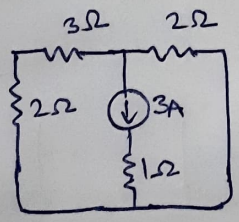
$I_{ab_2} = 0$

circuit 3:



$I_{ab_3} = -\frac{1}{7}\ A$

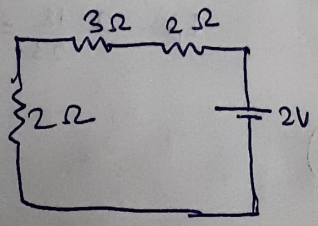
circuit 4:



$I_{ab_4} = \frac{3\times2}{7} = 0.85\ A$

~~So, $I_{ab} = I_{ab_1} + I_{ab_2} + I_{ab_3}$~~

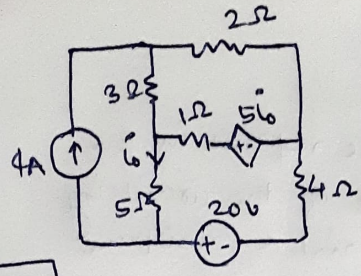
circuit 5:



$I_{ab_5} = -\frac{2}{7} = -0.28\ A$

So, $I_{ab} = I_{ab_1} + I_{ab_2} + I_{ab_3} + I_{ab_4} + I_{ab_5} = 0.85 + 0 - 0.14 + 0.85 - 0.28$

Q

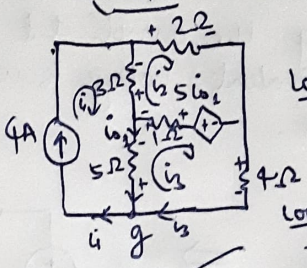


find i_o.

$\boxed{i_{o_1} = \frac{52}{17} A}$ Ans

Soln

Circuit 1:



Loop1

$i_1 = 4A$

Loop2

$-3(i_2 - i_1) - 2(i_2) + 5i_{o_1} - (i_2 - i_3) = 0$

Loop3:

$-5(i_3 - i_1) - (i_3 - i_2) - 5i_{o_1} - 4i_3 = 0$

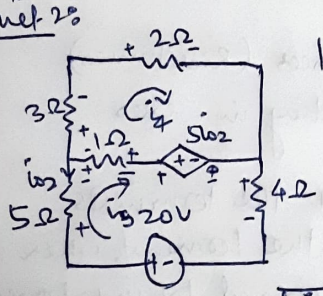
$-3i_2 + 12 - 2i_2 + 5(4 - i_3) - i_2 + i_3 = 0$

At Node g:

$i_{o_1} + i_3 = i_4$

$i_{o_1} + i_3 = 4$

Circuit 2:



$\boxed{i_{o_2} = -i_5}$

Loop4:

$(-3)(i_4) - 2(i_4) + 5i_{o_2} - (i_4 - i_5) = 0$

$-3i_4 - 2i_4 + 5i_{o_2} - i_4 + i_5 = 0$

Loop5:

$(-5)(i_5) - 1(i_5 - i_4) - 5i_{o_2} - (4)(i_5) + 20 = 0$

$-5i_5 - i_5 + i_4 - 5i_{o_2} - 4i_5 + 20 = 0$

$-\cancel{5i_5} - i_5 + i_4 + \cancel{5i_5} - 4i_5 + 20 = 0$

$20 = 5i_5 - i_4$

$-3i_4 - 2i_4 - 5i_5 - i_4 + i_5 = 0$

$6i_4 - 4i_5 = 0$

$i_{o_2} = \frac{-60}{17}$

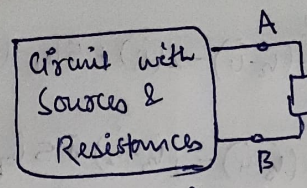
$i_o = i_{o_1} + i_{o_2}$

$= \frac{52}{17} - \frac{60}{17} = \frac{-8}{17} A$

Date
24/03/23

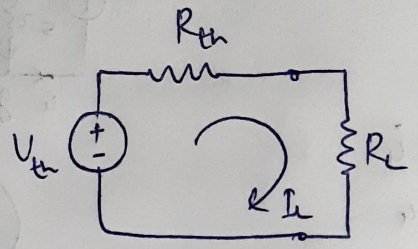
Thevenin's Theorem:

The theorem is useful to find the response in an element by replacing the complicated part of the circuit by a simple equivalent voltage source and a resistance in series with it.



(a) Original circuit

$\Rightarrow$



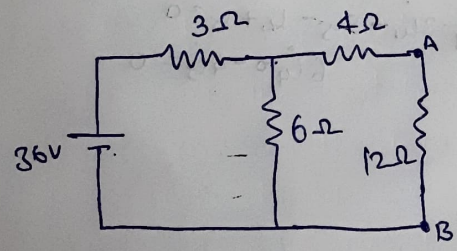
$$I_L = \frac{V_{th}}{R_{th} + R_L}$$

(b) Thevenin's equivalence circuit

→ Any 2 terminal network consisting of impedances (Resistances) and sources may be replaced by an emf acting in series with an impedance (Resistance).

→ The emf is the open circuited voltage at the terminals and the impedance (Resistance) is the impedance viewed at the terminals when all the sources in the network have been replaced by impedance (R) equal to their internal impedance (Resistance).

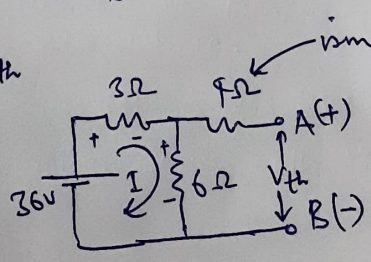
Q



Apply Thevenin theorem to find current flowing through the 12Ω Resistance

Soln: Step1: to find V_{th}

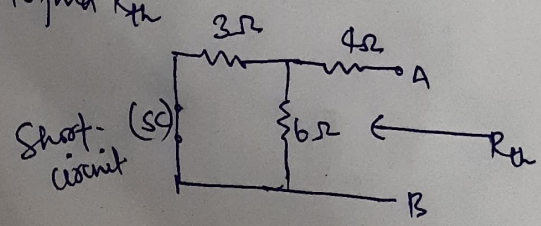
circuit 1:



isme koch current flow nahi kregi

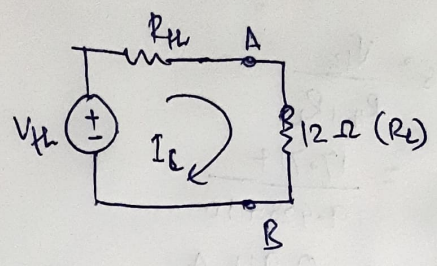
$I = \frac{36}{9} = 4A$, $V_{th} = 6 \times 4 = 24V$

Step2: to find R_{th}



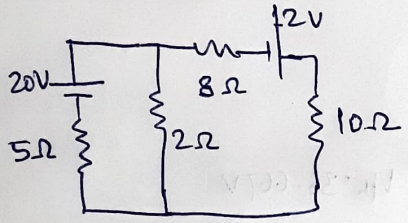
$R_{th} = [3 \| 6] + 4$
$= (2+4)\,\Omega$
$= 6\,\Omega$

Step3: Thevenin's Equivalence circuit

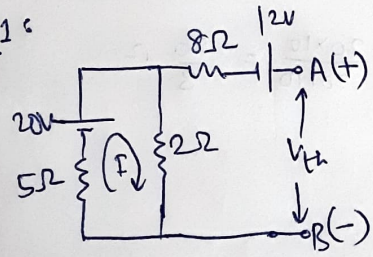


$$I_L = \frac{V_{th}}{R_{th}+R_L} \Rightarrow \frac{24}{6+12} = 1.33\ A$$

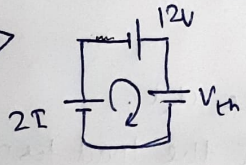
Q find the current in 10 Ω Resistance of the circuit using thevenin's theorem.



Soln: circuit 1:



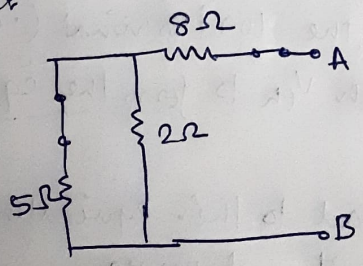
$$I = \frac{20}{7} = 2.857\ A$$



Apply KVL $2I + 12 - V_{th} = 0$

$V_{th} = 17.714$

circuit 2:



$$\frac{1}{5} + \frac{1}{2} = \frac{1}{R_p}$$

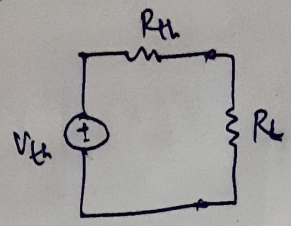
$$\frac{2+5}{10} = \frac{1}{R_p}$$

$$R_p = \frac{10}{7}$$

So, $R_{AB} = \frac{10}{7} + 8 \Rightarrow \frac{66}{7}$

$= 9.42\ \Omega$

circuit 3:

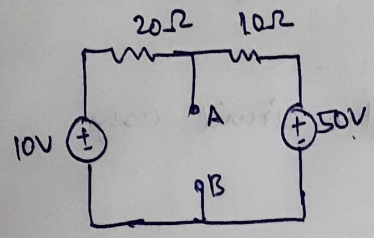


$$I_s = \frac{V_{th}}{R_{th}+R_L}$$

$$= \frac{17.714}{9.428+10}$$

$$= 0.911\ A$$

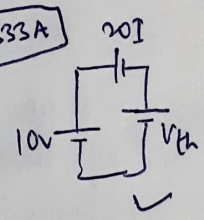
Q



find thevenin's equivalence

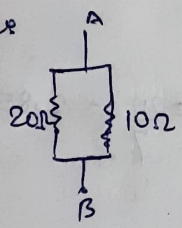
Sol^n circuit 1:

$\boxed{I = 1.333A}$



$V_{th} = 36.667V$

circuit 2:



$$R_{eq} = \frac{20\times10}{20+10} = \frac{20}{3}\ \Omega$$

Steps to solve Thevenin's Problem:

Step1: Locate the load Resistance R_L

Step2: Disconnect the load Res. R_L from the ckt.

Step3: Calculate open circuit voltage V_{th} at the load terminal.

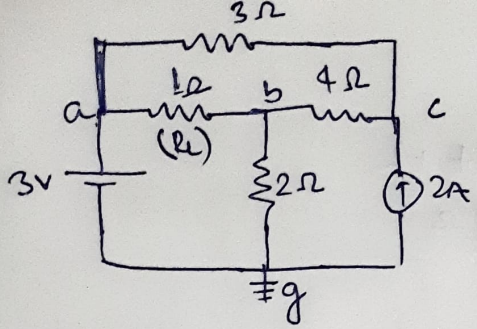
Step4: Redraw the circuit with each independent source replaced by its internal resistance.

Step5: Calculate the Resistance b/w the load terminal (ie R_{th})

Step6: Place R_{th} in series with V_{th} to form the equivalence circuit.

Step7: Reconnect the original load to this equivalence circuit to calculate voltage, current and power

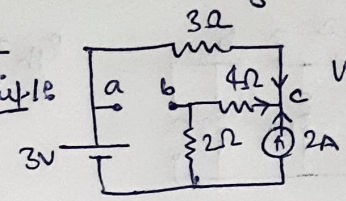
Q



find out I_{ab} & V_{cg} using thevenin's th.

8Ω

Circuit 1:



$V_{th} = V_{ab}$

At c node apply KCL:

$$\frac{(V_b - V_c)}{4} + 2 + \frac{(V_a - V_c)}{3} = 0$$

$$\frac{V_b - V_c}{4} + \frac{3 - V_c}{3} = -2$$

$$\frac{0 - V_c}{6} + \frac{3 - V_c}{3} = -2$$

$$\frac{-V_c + 6 - 2V_c}{6} = -12$$

$$-3V_c = -18$$

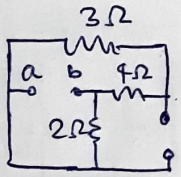
$$\boxed{V_c = 6}$$

$$I_{bc} = I_{gc} = \frac{0-6}{6} = -1A$$

$$V_b = 2 \times 1 = 2V$$

So, $V_{ab} = 3 - 2 = 1V = V_{th}$

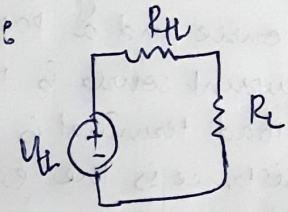
Circuit 2:



$$R_{th} = \frac{14}{9}\ \Omega$$

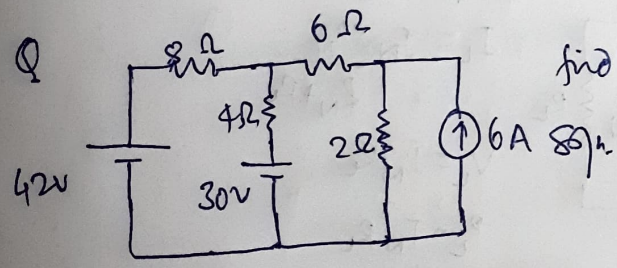
So, Equivalence circuit

Circuit 3:



$$\text{So, } I_L = \frac{1}{\frac{14}{9} + 1} = \frac{9}{23} = 0.39\ A$$

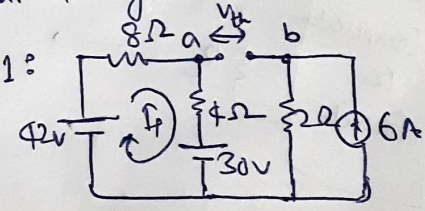
Q



find the current through 6Ω.

8Ω

Circuit 1:



$$-8I_1 - 4I_1 - 30 + 42 = 0$$

$$12 = 12I_1$$

$$I_1 = 1A$$

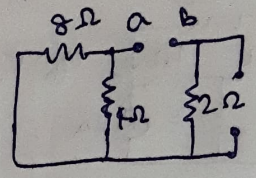
So, $V_a = 42 - 8$
$= 34V$

$V_b = 12V$

$V_{th} = V_a - V_b$

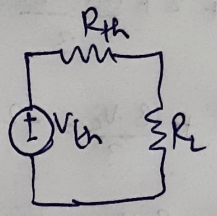
So $V_{th} = 34 - 12$
$= 22V$

Circuit 2:



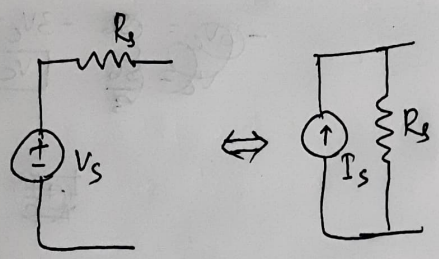
$R_{th} = 8 \| 4 + 2$
$= \frac{14}{3}\ \Omega$

Circuit 3:



$I_L = \frac{22}{\frac{14}{3} + 6} = \frac{66}{32}\ A$
$= 2.062\ A$

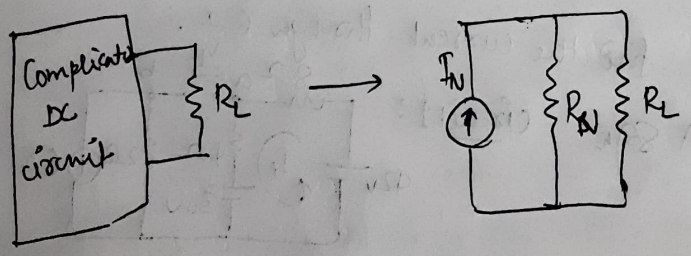
#



$I_S = \frac{V_S}{R_S}$

$V_S = I_S R_S$

→ Norton's Theorem: Any two output terminals of a linear active network containing independent sources may be replaced by an equivalent current source and a parallel resistance. The magnitude of current source is the current measured when the load terminal is short-circuit and the parallel resistance is the equivalent resistance of the circuit.

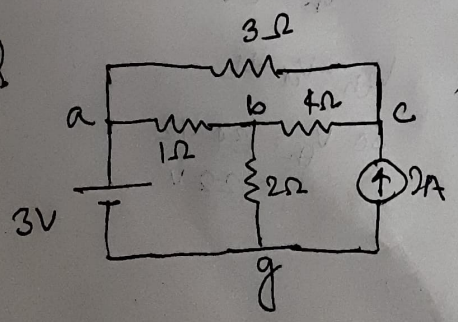


$I_L = \frac{I_N \times R_N}{R_N + R_L}$

$V_L = I_N R_L$

$P_L = I_N^2 R_L$

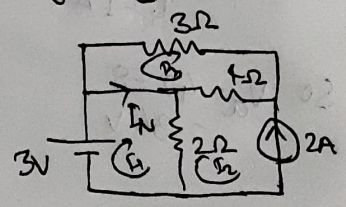
Q



find out I_{ab} by using N theorem:

Sol:

Circuit-1:



$I_2 = 2A$, $I_N = I_1 - I_3$

$3-2(I_1-I_2)=0$

$3-2I_1-4=0$

$I_1=-0.5A$

$-3I_3-4(I_3-I_2)=0$

$-3I_3-4I_3-4\times2=0$

$I_3=-\frac{8}{7}=-1.142A$

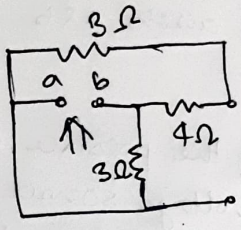
so, $I_N=I_1-I_3$

$=-0.5+1.142$

$=2.358$

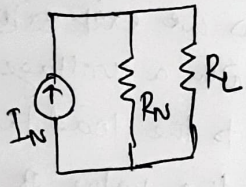
$I_N=\frac{9}{14}A$

Circuit 2:



$R_N=\frac{14}{9}\Omega$

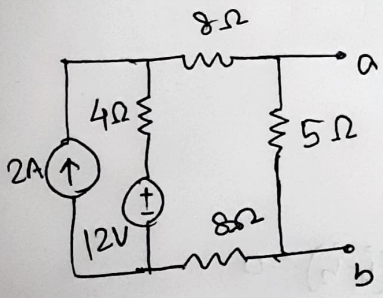
Circuit 3:



$I_{ab}=\frac{9}{14}\times\frac{\frac{14}{9}}{\frac{14}{9}+1}$

$I_{ab}=0.39$

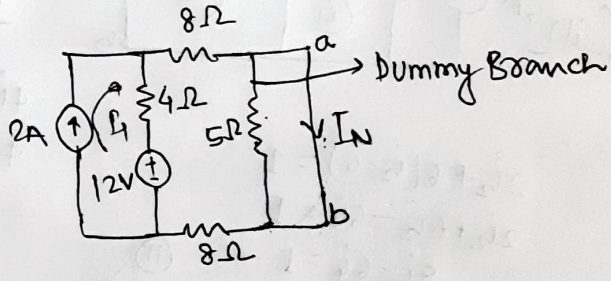
Q



find out Norton's equivalence circuit, across a&b.

Soln:

Circuit 1:



$-8I_N-8I_N+12-4(I_N-I_1)=0$

$-16I_N+12-4I_N+4I_1=0$

$12+4I_1=20I_N$

$12+4I_1=5(10+4I_1)$

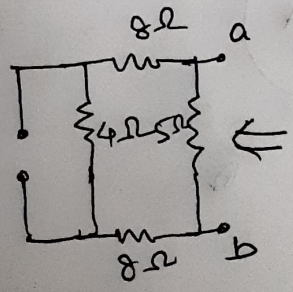
$12+4I_1=50+20I_1$

$2A-4(I_1-I_N)-12=0$

$2-4I_1+4I_N=12$

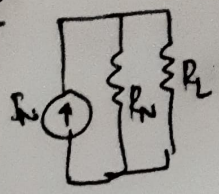
$I_N=\left(\frac{10+4I_1}{4}\right)$

Circuit 2:



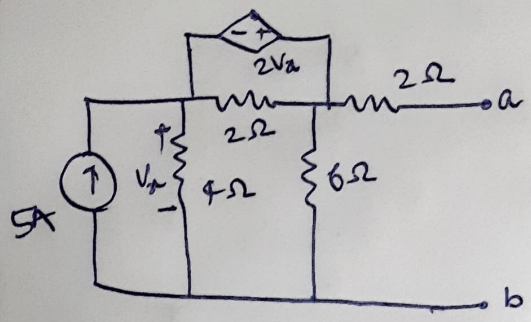
$R_N=4\Omega$

Circuit 3:



Dated 28/3/23

Q



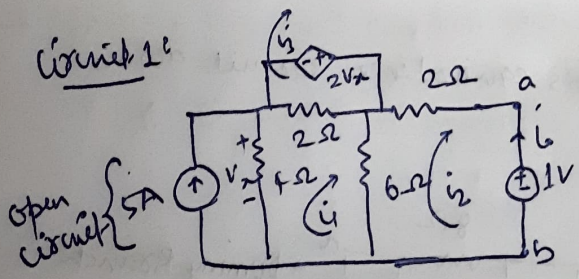
Q find the thevenin's equivalence resistance across a & b

Sol:

Because of the presence of the dependent voltage source. we cannot directly calculate the equivalence resistance of the circuit. so we exit the network with a voltage source connected to the load terminals. we can put the value of voltage source as 1V to ease our calculation.

our goal is to find the current through the terminal.

Circuit 1:



$$\boxed{i_o = -i_2}$$

$V_x = 4i_1$

$4i_1 - 2(i_1 - i_3) - 6(i_1 - i_2) = 0$

$4i_1 - 2i_1 + 2i_3 - 6i_1 + 6i_2 = 0$

$-4i_1 + i_3 + 6i_2 = 0$ — (I)

$-4i_1 + 5i_1 + 6i_2 = 0$

$6i_1 + 8i_2 = 0$

$-6i_1 + 8i_2 = 0$

$44i_2 = 1$

$i_2 = \frac{1}{44}$

$2i_2 + 6(i_2 - i_1) = 1$

$2i_2 + 6i_2 - 6i_1 = 1$

$8i_2 - 6i_1 = 1$ — (II)

$-2(i_3 - i_1) + 2V_x = 0$

$-2i_3 + 2i_1 + 2V_x = 0$

$\boxed{i_3 = 5i_1}$ — (III)

$10i_1 = 2i_3$

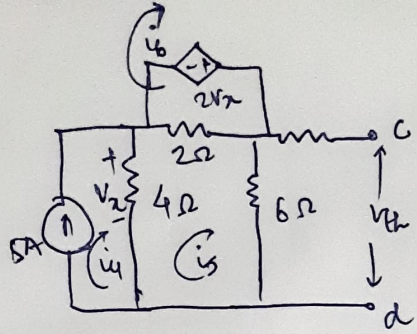
So, $i_o = -i_2$

$= \frac{1}{44}$ A

$i_o = -i_2 = \frac{1}{6}$ A

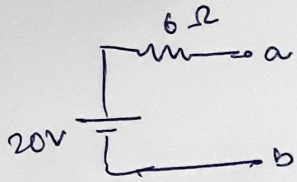
So, $R_{th} = \frac{V_o}{i_o} = \frac{1}{i_o} = 6\,\Omega$

circuit 2:

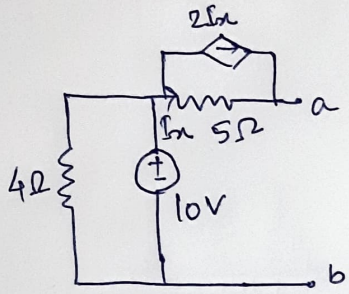


$V_{th} = 6i_5$
$= 20V$

So Equivalence circuit

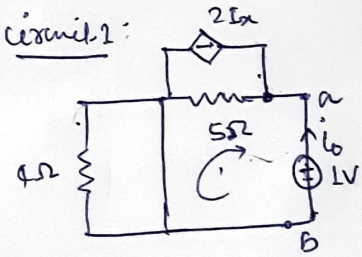


Q



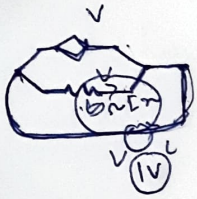
find out Norton's equivalence circuit between a & b

Sol: circuit 1:



$-5i_x - 1 = 0$
$i_x = -\frac{1}{5}$

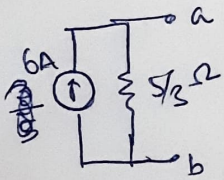
$2I_x + I_x + i_o = 0$
$i_o = +\frac{3}{5}A$

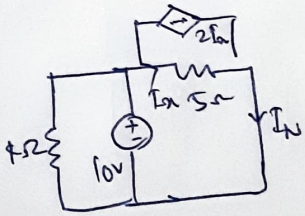


$5i_x = 1$
$i_x = \frac{1}{5}$

$R_N = \frac{1}{i_o}$
$= \frac{5}{3}\Omega$

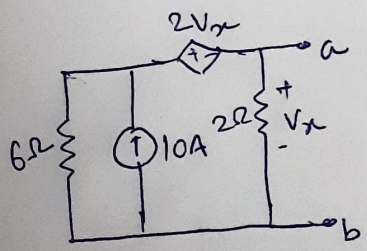
So Norton's equivalence circuit





$I_N = 3I_x$ $(I_x = 2A)$
$= 6A$

Q



a find out the Norton's equivalence circuit