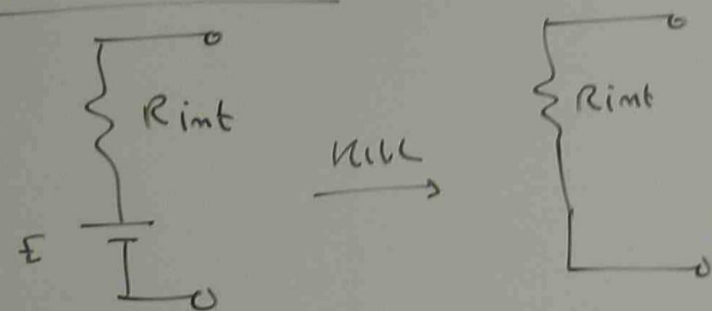
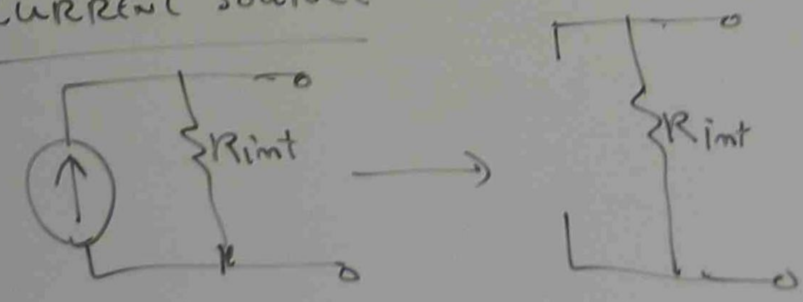
SUPER POSITION THEOREM

ALTERNATIVELY KILL THE THE SOURE. FIND THE CURRENT FLOWS IN BRANCHES AND ALGEBRICALLY ADD THE CURRENTS.

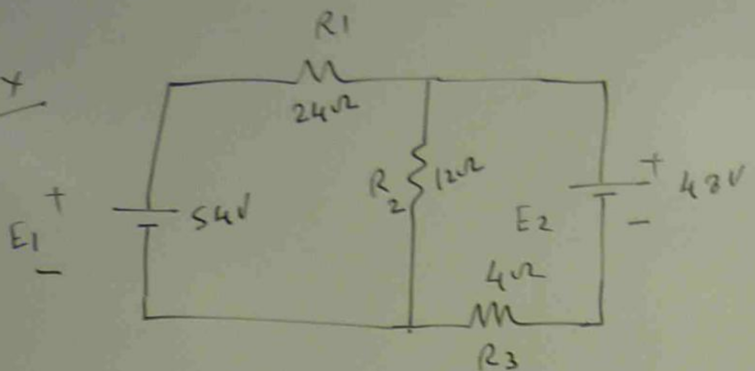
VOLTAGE SOURCE



CURRENT SOURCE

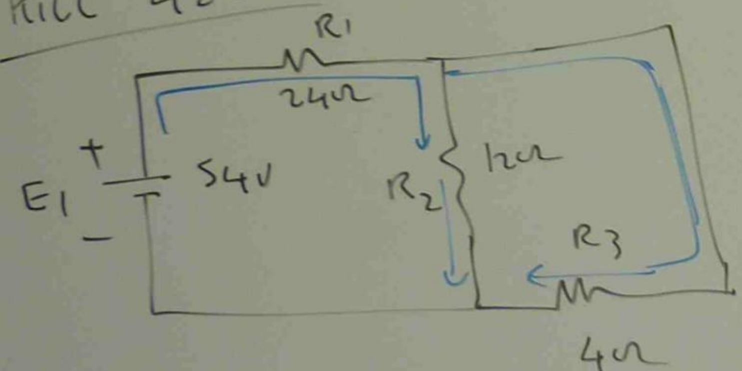


EX



USE SUPERPOSITION THEOREM AND DETERMINE THE CURRENT THROUGH THE 4Ω RESISTOR.

KILL 48V



$$R_T = R_1 + \frac{R_2 R_3}{R_2 + R_3} = 24 + \frac{12 \times 4}{12 + 4}$$

$$= 24 + \frac{48}{16} = 27\Omega$$

$$I_T = \frac{E1}{R_T} = \frac{54}{27} = 2 \text{ Amp}$$

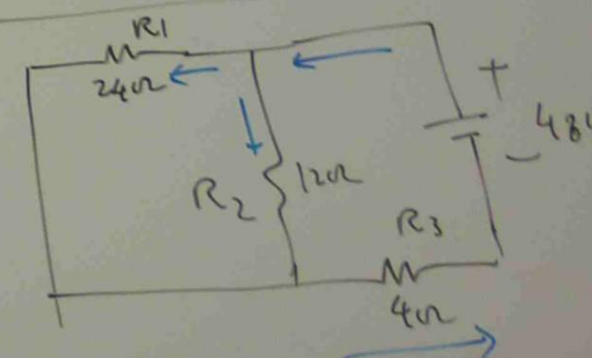
$$I'_{R_3}(4\Omega) = I_T \times \frac{R_2}{R_2 + R_3}$$

$$= 2 \times \frac{12}{12+4}$$

$$= 2 \times \frac{12}{16}$$

$$I'_{R_3} = 1.5\text{A}$$

KILL 54V



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

$$= 4 + \frac{24 \times 12}{24 + 12}$$

$$= 4 + \frac{24 \times 12}{36}$$

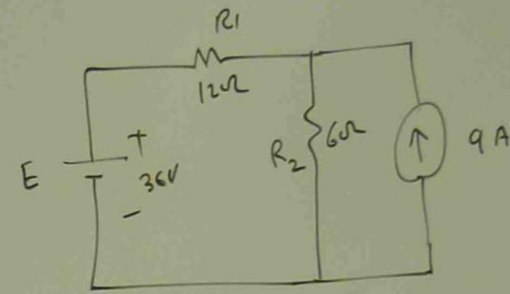
$$= 4 + 8 = 12\Omega$$

$$I''_{R_3} = \frac{E_2}{R_T} = \frac{48}{12} = 4A \;\rightarrow$$

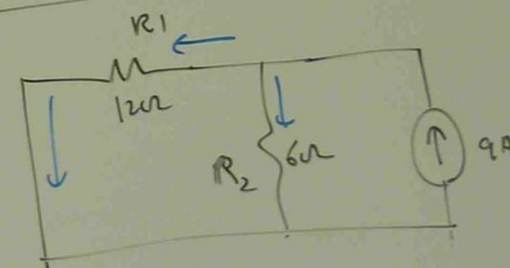
$$I_{R_3} = I''_{R_3} - I'_{R_3}$$

$$= 4 - 1.5 = 2.5A \;\rightarrow$$

Ex USING SUPERPOSITION, FIND THE CURRENT THROUGH 6Ω RESISTOR OF THE GIVEN NETWORK.



KILL 36V SOURCE

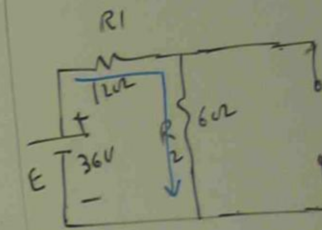


$$I'_{R_2} = I_T \times \frac{R_1}{R_1 + R_2}$$

$$= 9 \times \frac{12}{12+6}$$

$$= 9 \times \frac{12}{18} = 6A \downarrow$$

KILL 9A SOURCE



$$I''_{R_2} = \frac{E}{R_1 + R_2}$$

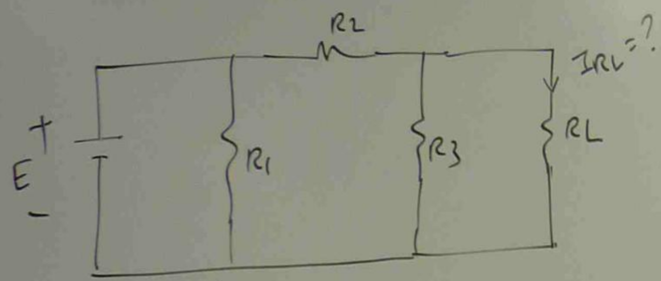
$$= \frac{36}{12+6}$$

$$= \frac{36}{18} = 2A \downarrow$$

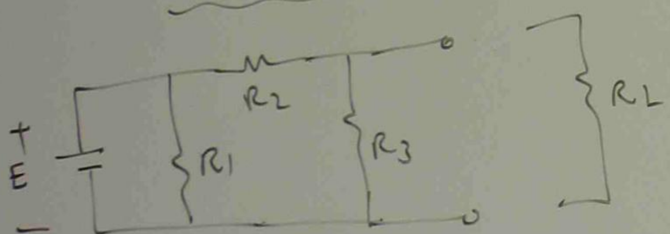
$$I_{R_2} = I'_{R_2} + I''_{R_2}$$

$$= 6 + 2 = 8A \downarrow$$

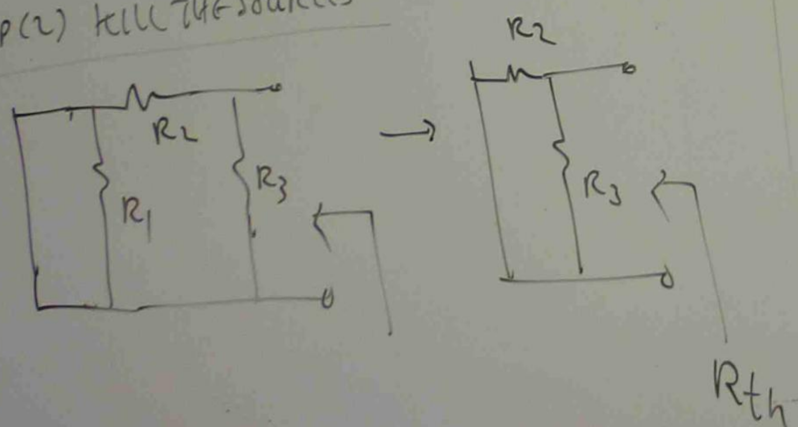
THEVENIN'S THEOREM



STEP(1) REMOVE THE BRANCH IN WHICH THE CURRENT NEEDS TO BE CALCULATED



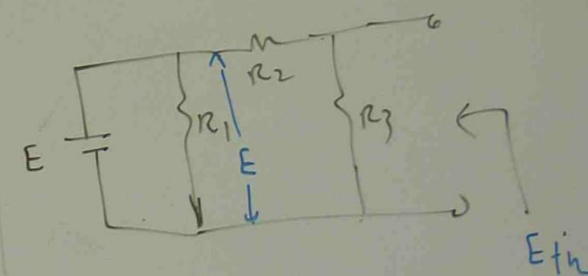
STEP(2) KILL THE SOURCES



STEP(3) DETERMINE THE RESISTANCE ACROSS TERMINAL

$$R_{th} = R_2 \| R_3 = \frac{R_2 R_3}{R_2 + R_3}$$

STEP(4) RECONNECT THE SOURCES, FIND THE VOLTAGE ACROSS TERMINAL

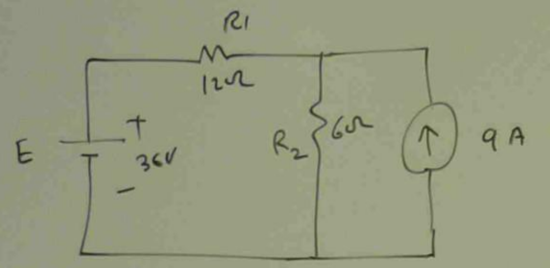


$$E_{th} = E \times \frac{R_3}{R_2 + R_3}$$

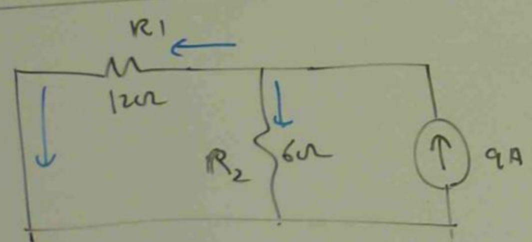
STEP(5)

$$I_{RL} = \frac{E_{th}}{R_{th} + R_L} = \frac{\frac{E R_3}{R_2 + R_3}}{\frac{R_2 R_3}{R_2 + R_3} + R_L}$$

Ex USING SUPERPOSITION, FIND THE CURRENT THROUGH 6Ω RESISTOR OF THE GIVEN NETWORK.



KILL 36V SOURCE

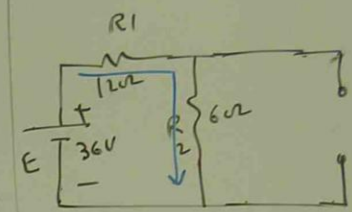


$$I'_{R_2} = I_T \times \frac{R_1}{R_1 + R_2}$$

$$= 9 \times \frac{12}{12+6}$$

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

KILL 9A SOURCE



$$I''_{R_2} = \frac{E}{R_1 + R_2}$$

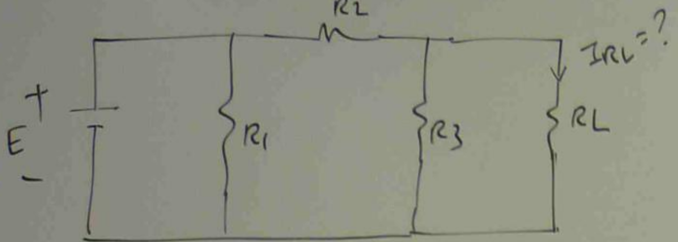
$$= \frac{36}{12+6}$$

$$= \frac{36}{18} = 2A$$

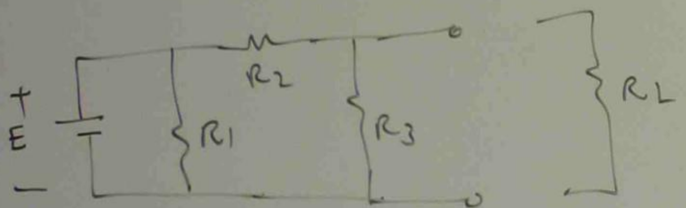
$$I_{R_2} = I'_{R_2} + I''_{R_2}$$

$$= 6 + 2 = 8A$$

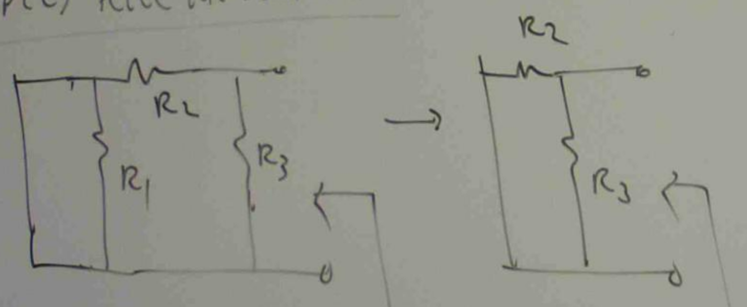
THEVENIN'S THEOREM



STEP(1) REMOVE THE BRANCH IN WHICH THE CURRENT NEEDS TO BE CALCULATED



STEP(2) KILL THE SOURCES

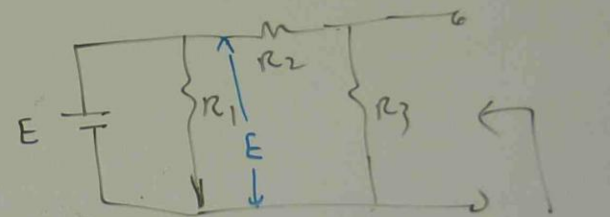


R_{th}

STEP(3) DETERMINE THE RESISTANCE ACROSS TERMINAL

$$R_{th} = R_2 \| R_3 = \frac{R_2 R_3}{R_2 + R_3}$$

STEP(4) RECONNECT THE SOURCES, FIND THE VOLTAGE ACROSS TERMINAL



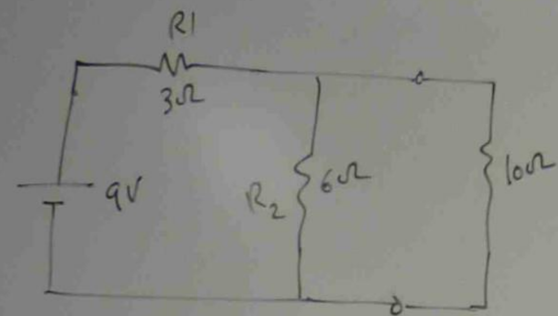
E_{th}

$$E_{th} = E \times \frac{R_3}{R_2 + R_3}$$

STEP(5)

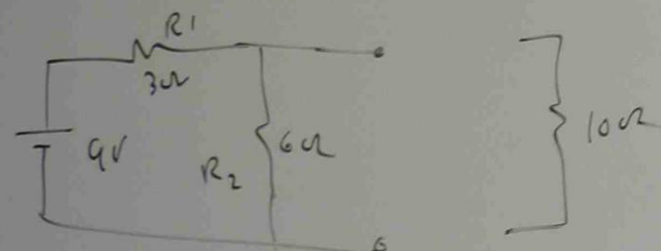
$$I_{R_L} = \frac{E_{th}}{R_{th} + R_L} = \frac{\frac{E R_3}{R_2 + R_3}}{\frac{R_2 R_3}{R_2 + R_3} + R_L}$$

Ex

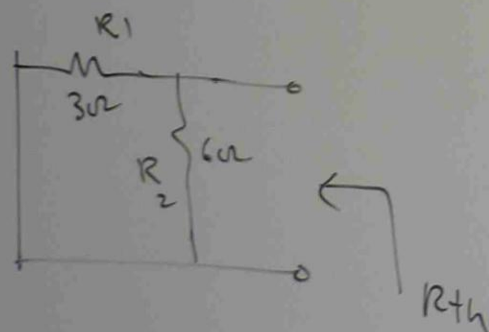


FIND THE CURRENT THROUGH 10Ω RESISTOR BY USING THEVENIN'S THEOREM.

I



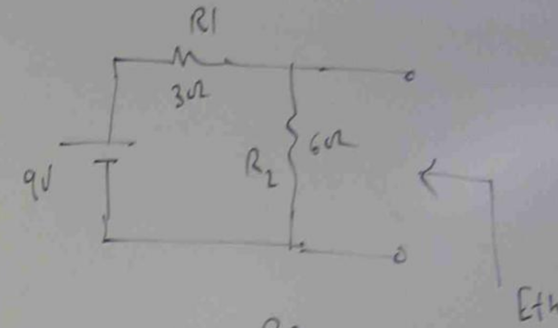
II



III

$$R_{th} = \frac{3 \times 6}{3+6} = \frac{18}{9} = 2\Omega$$

IV



$$E_{th} = 9V \times \frac{R_2}{R_1+R_2}$$

$$= 9 \times \frac{6}{3+6}$$

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

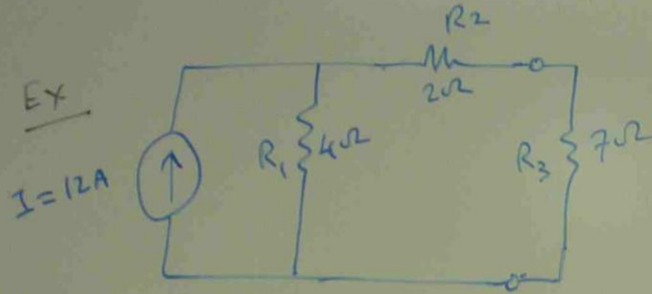
V

$$I_{10\Omega} = \frac{E_{th}}{10\Omega + R_{th}}$$

$$= \frac{6}{10+2}$$

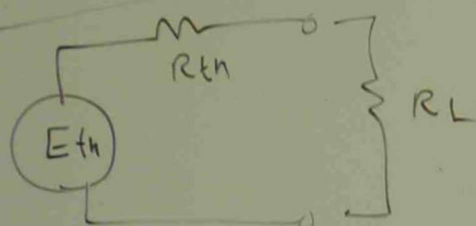
$$= \frac{6}{12} = 0.5\ A$$

EX



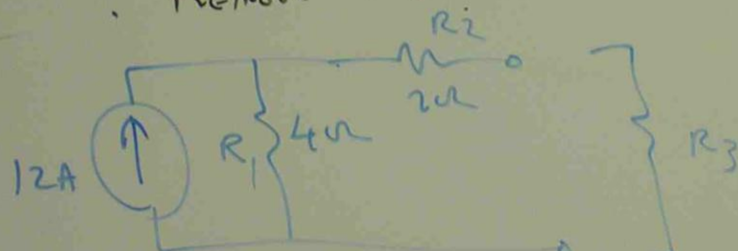
FIND THEVENIN'S EQUIVALENT CIRCUIT ACROSS R3

THEVENIN'S EQUIVALENT

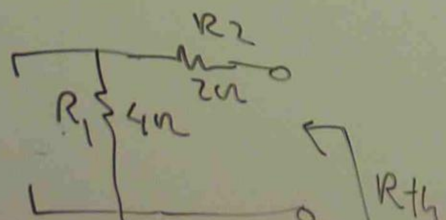


. Remove R3

I

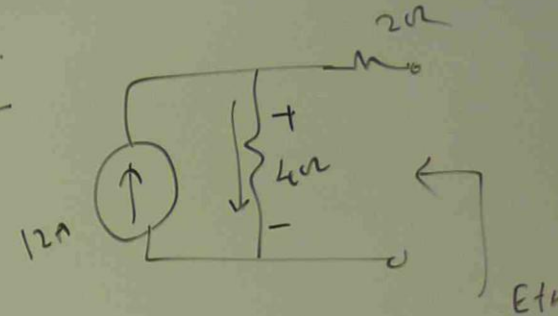


II



III $R_{th} = R_1 + R_2 = 4 + 2 = 6\Omega$

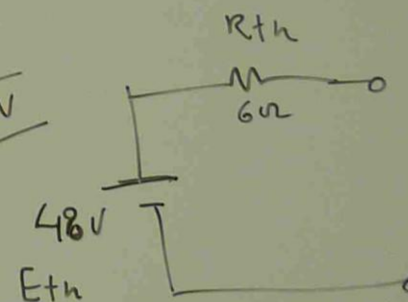
IV



$V_{4\Omega} = 12 \times 4 = 48V$

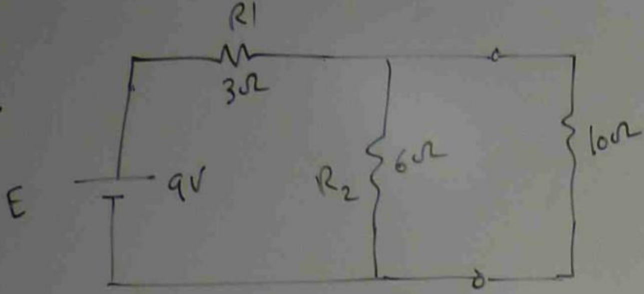
$V_{4\Omega} = E_{th} = 48V$

V



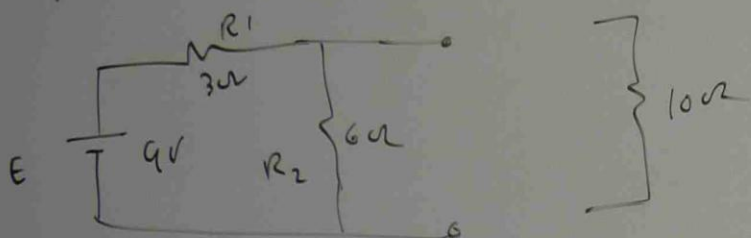
THEVENIN'S EQUIVALENT.

Ex

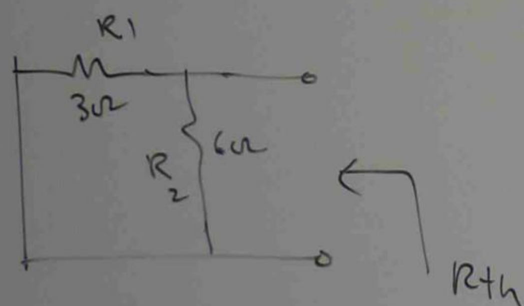


FIND THE CURRENT THROUGH 10Ω RESISTOR BY USING THEVENIN'S THEOREM.

I



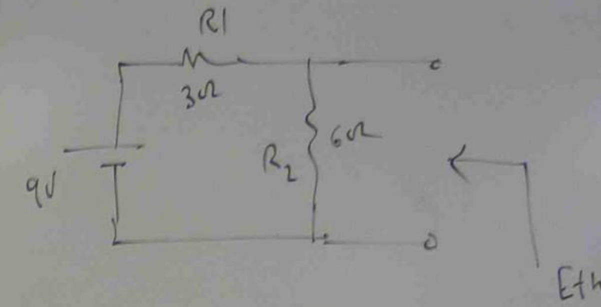
II



III

$$R_{th} = \frac{3\times 6}{3+6} = \frac{18}{9} = 2\Omega$$

IV



$$E_{th} = 9V \times \frac{R_2}{R_1+R_2}$$

$$= 9 \times \frac{6}{3+6}$$

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

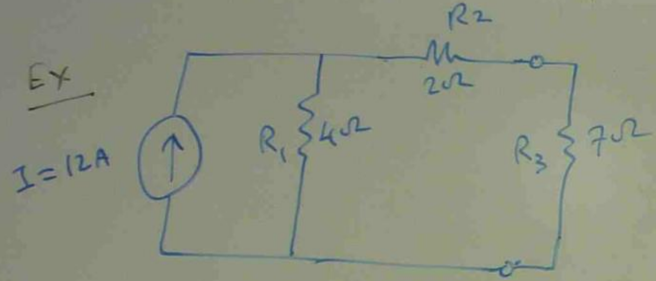
V

$$I_{10\Omega} = \frac{E_{th}}{10\Omega + R_{th}}$$

$$= \frac{6}{10+2}$$

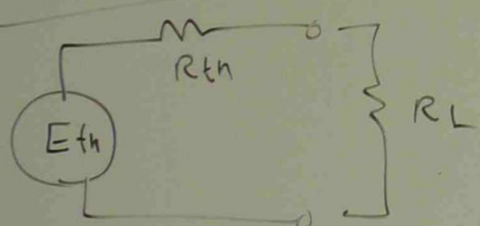
$$= \frac{6}{12} = 0.5\ A$$

EX



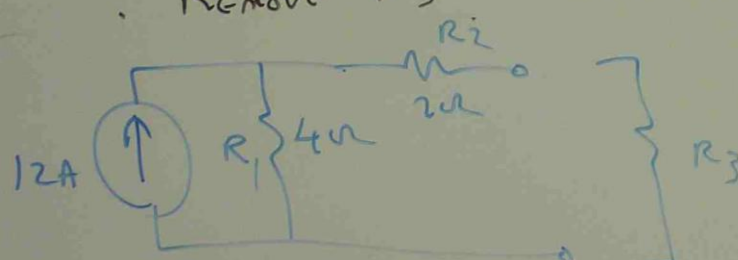
FIND THEVENIN'S EQUIVALENT CIRCUIT ACROSS R3

THEVENIN'S EQUIVALENT

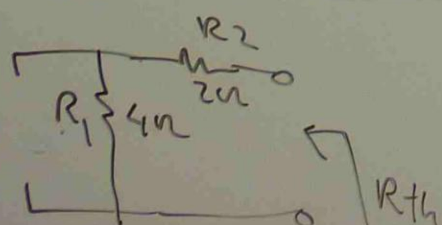


REMOVE R3

I



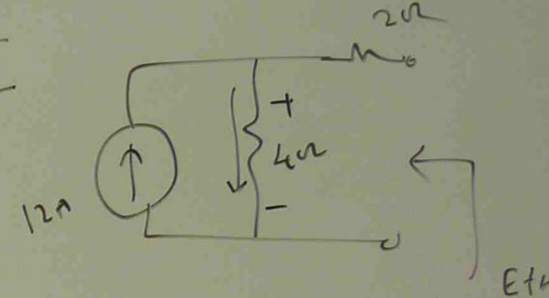
II



III

$R_{th} = R_1 + R_2 = 4 + 2 = 6\Omega$

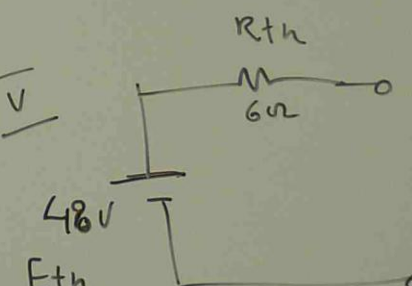
IV



$V_{4\Omega} = 12 \times 4 = 48V$

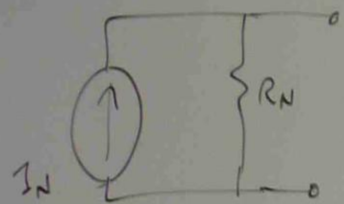
$V_{4\Omega} = E_{th} = 48V$

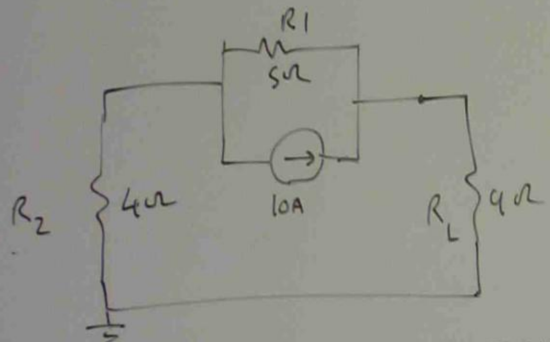
V



THEVENIN'S EQUIVALENT.

NORTON THEOREM

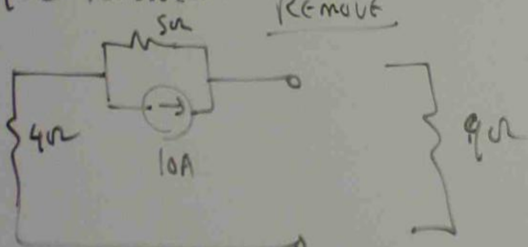




FIND THE NORTON EQUIVALENT CIRCUIT EXTERNAL TO 9Ω RESISTOR

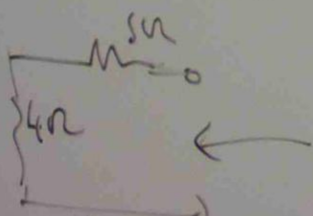
I

REMOVE

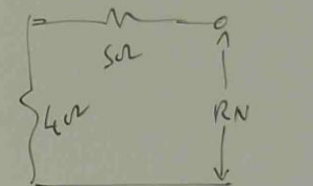


KILL THE SOURCE

II



III FIND THE EQUIVALENT RESISTANCE ACROSS TERMINAL

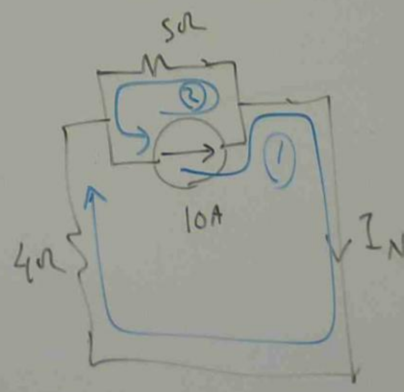


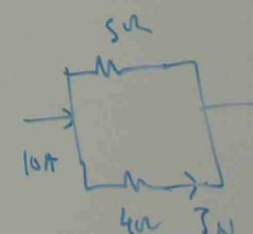
$R_N = 4 + 5 = 9\Omega$

IV FIND NORTON CURRENT

RECONNECT THE SOURCE

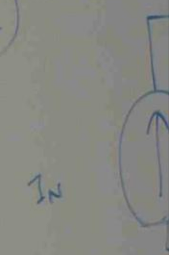
SHORT CIRCUIT THE TERMINAL





$I_N = 10 \times \frac{5}{5+4} = \frac{50}{9} = 5.55\,A$

V



NOR