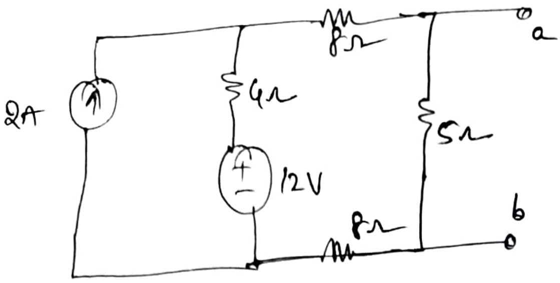
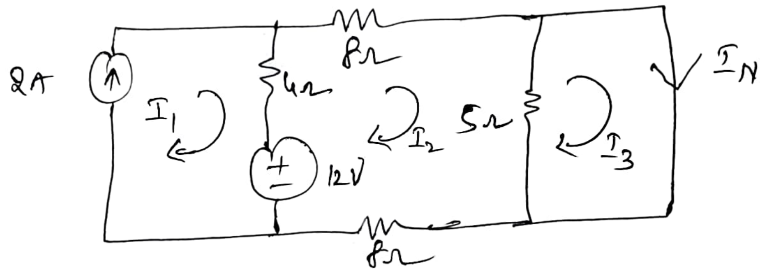
Nortons Theorem

(1)



To find I_N: Short circuit a, b



$I_1 = 2A$

$-12 + 4(I_2 - I_1) + 8I_2 + 5(I_2 - I_3) + 8I_2 = 0$

$-4I_1 + 25I_2 - 5I_3 = 12$

Substitute I_1; $-4(2) + 25I_2 - 5I_3 = 12$

$25I_2 - 5I_3 = 12 + 8 = 20$

$25I_2 - 5I_3 = 20$ —— (1)

$5(I_3 - I_2) = 0$

$I_3 = I_2$ —— (2)

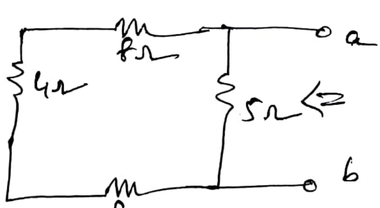
$25I_2 - 5I_2 = 20$

$20I_2 = 20 \Rightarrow I_2 = 1A$

$I_3 = 1A$

$I_N = 1A$

To find R_N:



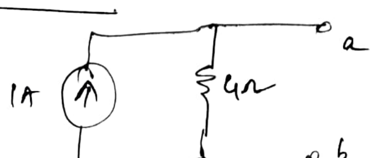
$4 + 8 + 8 = 20\Omega$

$5\Omega \parallel 20\Omega = \frac{100}{25}$

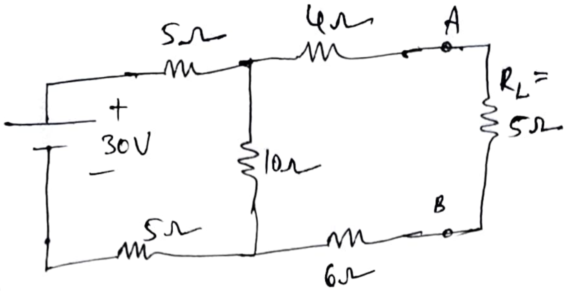
$= 4\Omega$

$R_N = 4\Omega$

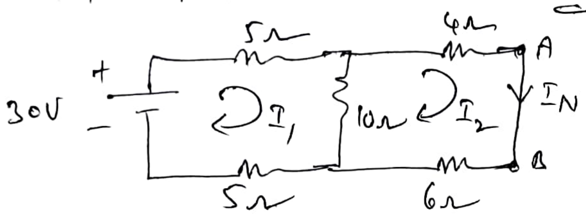
Norton eq circuit:



(2) Current in load resistor $I_{5\Omega} = ?$ Using Norton theorem



Open A, B; short circuit. to find I_N



$-30 + 5I_1 + 10(I_1 - I_2) + 5I_1 = 0$

$20I_1 - 10I_2 = 30$ — (1)

$10(I_2 - I_1) + 4I_2 + 6I_2 = 0$

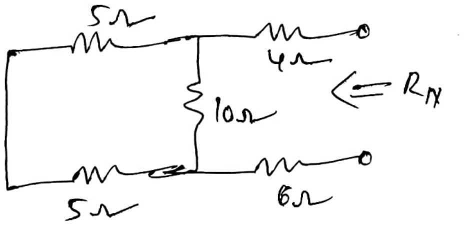
$-10I_1 + 20I_2 = 0$ — (2)

$I_1 = 2A$

$I_2 = 1A$

So, $I_N = I_2 = 1A$

Norton resistance: R_N

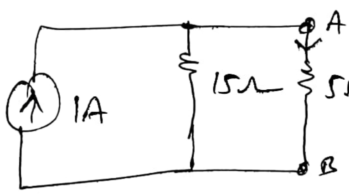


$5 + 5 = 10\Omega$

$10 \| 10 = \frac{100}{20} = 5\Omega$

$5 + 4 + 6 = 15\Omega$

Norton eq circuit:



$I_{AB} = I_{5\Omega} = 1 \times \frac{15}{15+5} = \frac{15}{20} = 0.75A.$