Super position theorem.

Superposition theorem allow us to analyze a circuit with multiple sources by considering the effect of each source separately.

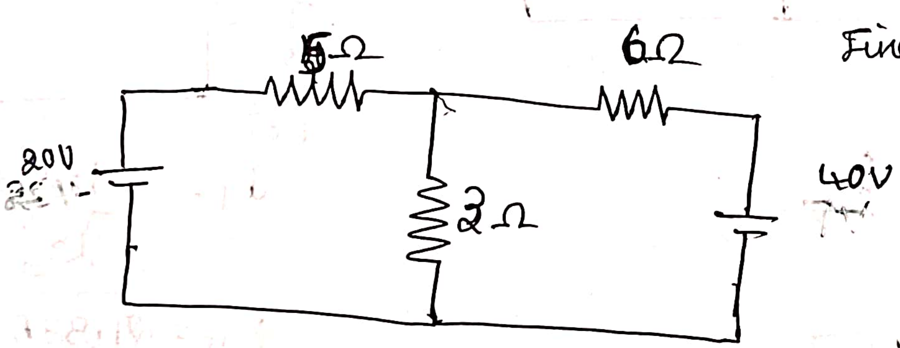
steps 1:- Find the number of independent sources

2:- Consider one source at a time, deactivate other sources. Find current & voltage across each element.

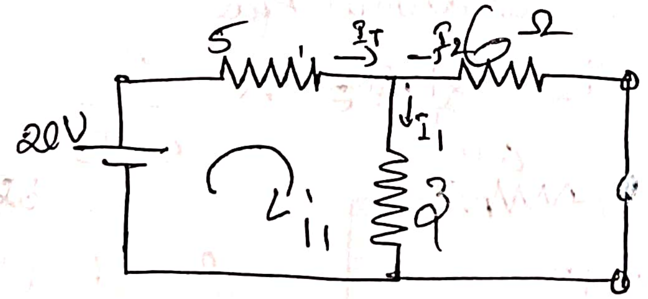
3. Repeat this for all the sources.

4. Add the current & voltages.

1) Find ct through 3 Ω resistor.



Let 20V is active



$28 - 4i_1 + 2(i_1 - i_2) = 0.$

$28 - 6i_1 + 2i_2 = 0$

$-6i_1 + 2i_2 = -28$ — ①.

$-2(i_2 - i_1) - i_1 = 0$

$-2i_2 + i_1 = 0$

$i_1 - 2i_2 = 0$ — ②.

② × 6 =

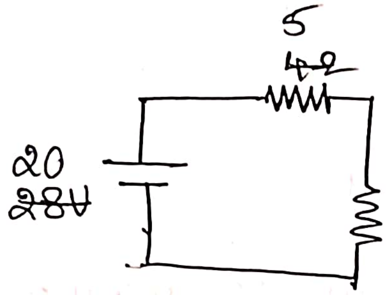
$6i_1 - 12i_2 = 0$ — ③

① + ③

$-10i_2 = -28$

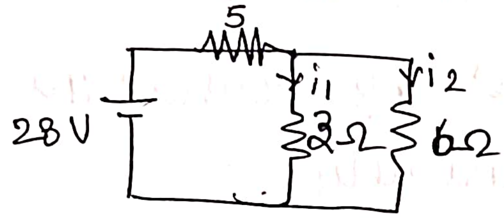
$\boxed{i_2 = 2.8\ A}$

43



$6 \parallel 3 = \frac{\cancel{6}\times\cancel{3}}{\cancel{9}} = 2\Omega$. $I_T = \frac{20}{7} = 2.857\,A$.

$\cancel{2 \parallel 1} = 1\Omega$.



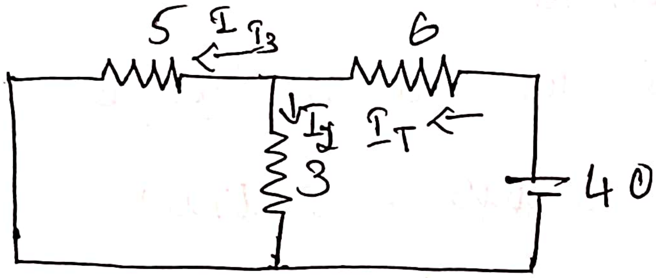
~~$i_2 = \frac{5 \cdot 6}{\cancel{28}} \times \frac{2}{2+1} = 3.73\,A$~~

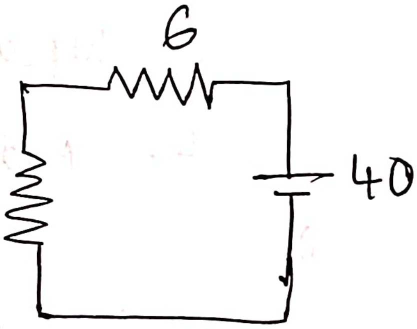
$i_1 = 2.85 \times \frac{6}{2+6} = 1.86\,A$

$= 2.85 \times \frac{\cancel{6}\,2}{\cancel{9}\,3}$

$\boxed{I_1 = 1.904\,A}$

2) To find I_2.

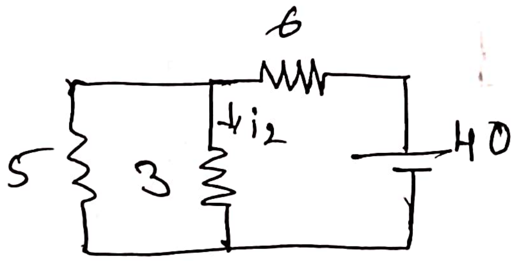




$= \frac{5\times3}{8} = \frac{15}{8} = 1.87$

$i_T = \frac{\cancel{40}}{\cancel{9}} \cdot \frac{40}{1.87+6}$

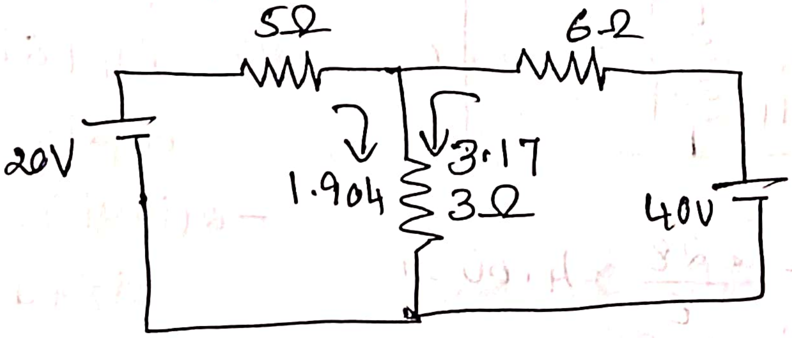
$\boxed{i_T = 5.08\,A}$



ct divider Rule

$i_2 = 5.08 \times \frac{5}{5+3} = 3.17\,A$.

3)

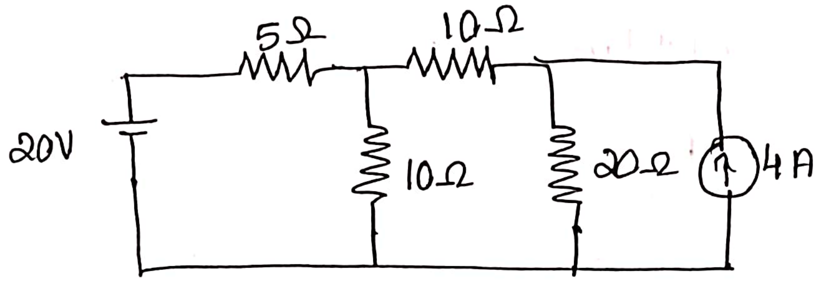


$\therefore$ ct through 3Ω is

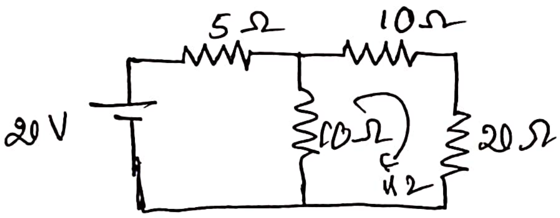
$1.904 + 3.17$

$= 5.074\,A$

Find the current flowing through 20Ω resistor.



Step 1:- deactivate 4A.



$20 - 5i_1 - 10(i_1 - i_2) = 0$

$20 - 5i_1 - 10i_1 + 10i_2 = 0$

$20 - 15i_1 + 10i_2 = 0$

$-15i_1 + 10i_2 = -20 \quad — (1)$

$-10(i_2 - i_1) - 10i_2 - 20i_2 = 0.$

$-10i_2 + 10i_1 - 10i_2 - 20i_2 = 0$

$10i_1 - 40i_2 = 0 \quad — (2).$

$(1) \times 4 = -60i_1 + 40i_2 = -80 — (3)$

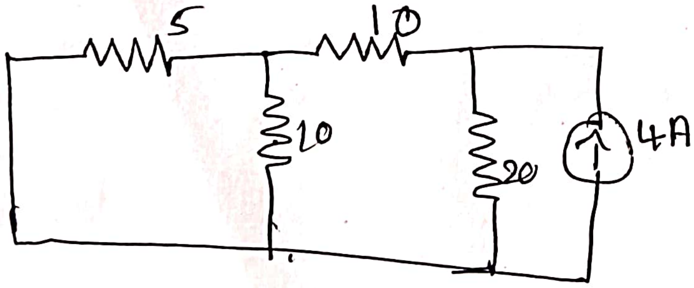
$(2) + (3) = \quad 50i_1 = -80 \Rightarrow i_1 = -1.6$

$(10)(-1.6) - 40i_2 = 0.$

$-16 = 40i_2.$

$\boxed{i_2 = -0.4A}$

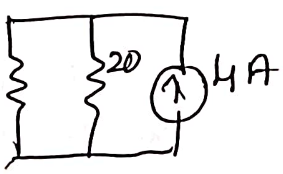
ct through 20Ω is $0.4A$.



$\frac{10 \times 5}{15} + 10$

$= \frac{50}{15} + 10$

$= 13.33.$



$I_{20\Omega} = 4 \times \frac{13.33}{13.3 + 20} = 1.6A$

(iv)

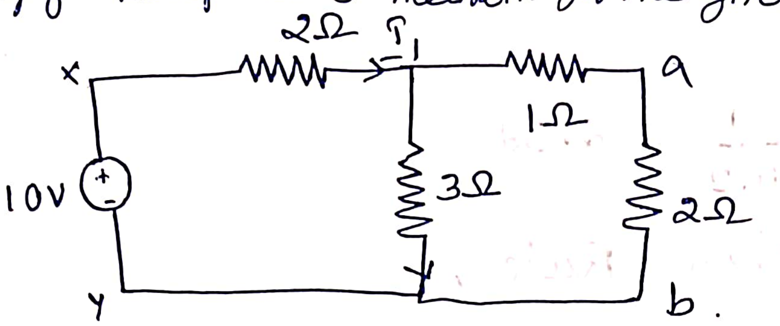
Total ct flowing through 20Ω is

$$= 0.4 + 1.6$$

$$\boxed{I_{20\Omega} = 2A}$$

(46) verify Reciprocity Theorem for the given ckt

Reciprocity Theorem



$$R_{eq} = \cancel{(2 \parallel 1)} = \cancel{\frac{2\times 1}{2+1}} = \cancel{\frac{2}{3}}$$

$$= (2+1) \parallel 3 = \frac{3\times 3}{3+3} = \frac{9}{6} = \frac{3}{2}$$

$$= \frac{3}{2} + 2 = \frac{7}{2} = 3.5\Omega$$

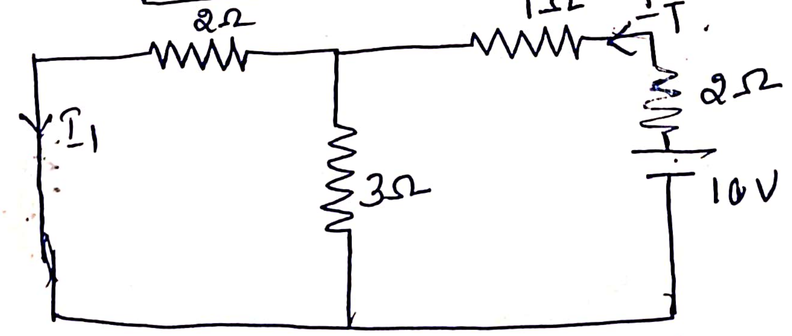
$$\therefore \quad I_T = \frac{V}{R_{eq}} = \frac{10}{3.5}$$

$$\boxed{I_T = 2.85\,A}$$

$$I_2 = I_T \times \frac{3}{(2+1)+3}$$

$$= I_T \times \frac{3}{6} = 2.85 \times \frac{1}{2}.$$

$$\boxed{I_2 = 1.43\,A} \quad \text{—— ①}$$



$$R_{eq} = \left[(2 \parallel 3)+1\right] + 2 = 4.2\Omega$$

$$I_T = \frac{10}{4.2} = 2.38$$

By ct. division Rule,

$$I_1 = I_T \times \frac{3}{5}$$

$$= 2.38 \times 0.6$$

$$\boxed{I_1 = 1.43\,A} \quad \text{——— (2)}$$

$\because$ $I_2 = I_1$ the Reciprocity theorem is proved.

Reciprocity Theorem: In a linear bi-lateral network with a single voltage source, the current through any branch of the network, due to the voltage source will be the same if the voltage source is moved to that branch and the current is measured at the original location of the source.