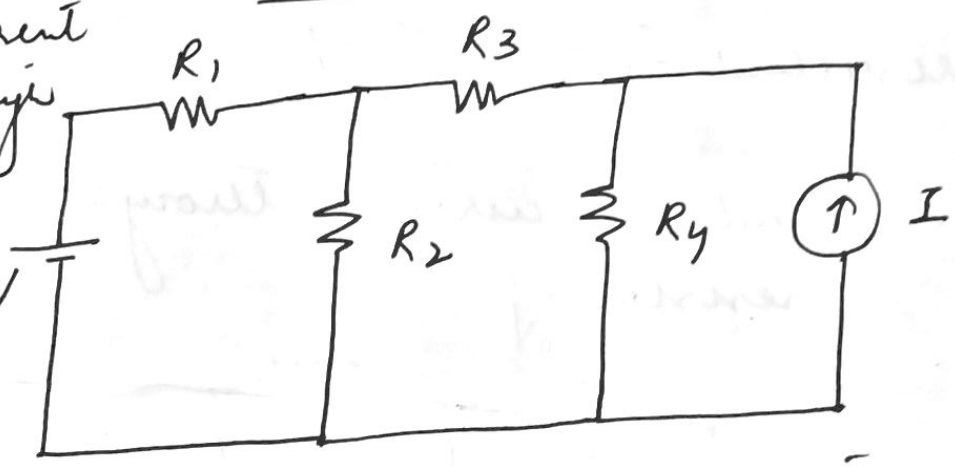
Superposition Theorem

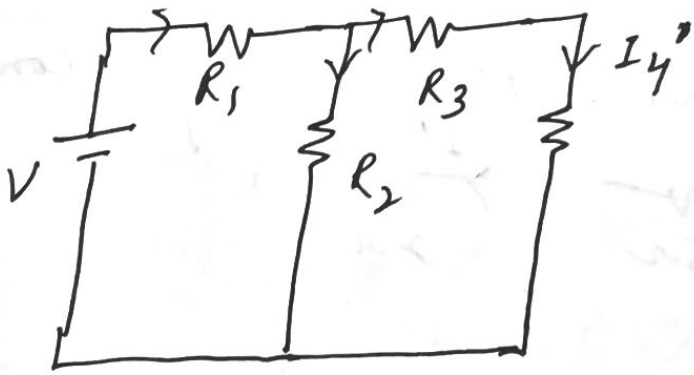
It states that in a linear network containing more than one independent source and dependent source, the resultant current in any element is the algebric sum of the currents that would be produced by each independent source acting alone

EXPLANATION

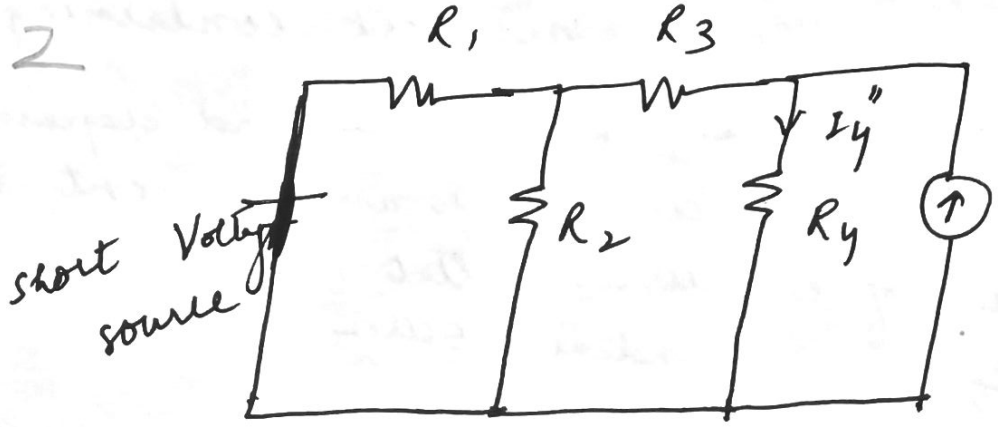
Find the current flowing through R_4



Step 1:- Considering current is flowing through R_4 due to source V [∵ Always open ckt current source & short ckt voltage source]

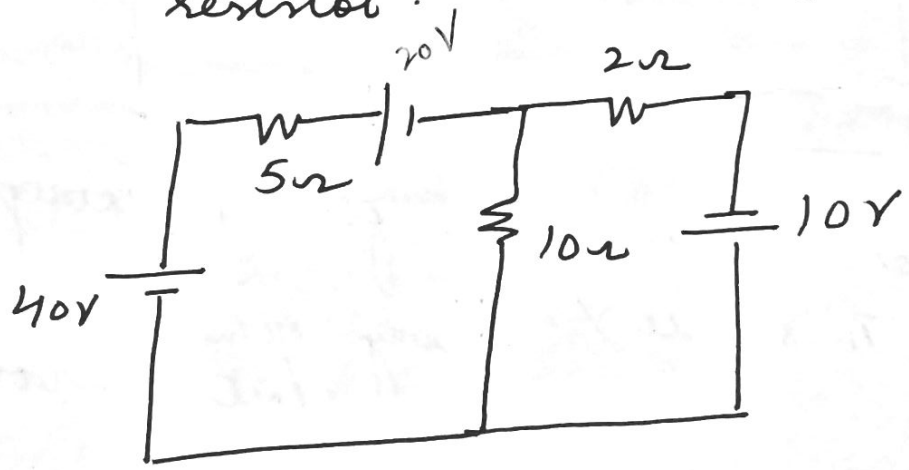


Step II :- Assuming the current flowing through R_4 is due to current source.

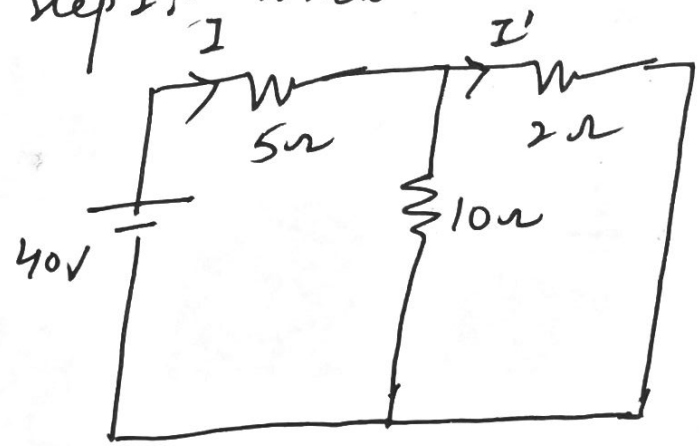


$\therefore$ resultant $I_4 = I_4' + I_4''$

Numerical 1 :- Find the current through 2Ω resistor.



Solution :- Step I :- When 40V is acting alone



$$R = 5 + 10 \| 2$$

$$= 5 + \frac{10 \times 2}{10 + 2}$$

$$= 5 + \frac{20}{12}$$

$$= 5 + 1.67$$

or

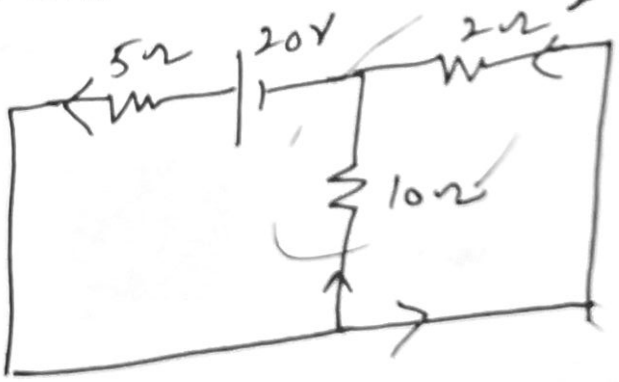
$$I = \frac{40}{5 + 1.67} = 6\ A$$

By current division Rule

$$I' = 6 \times \frac{10}{10 + 2}$$

$$= 5\ A\ (\rightarrow)$$

Step II :- When 20V source is acting alone

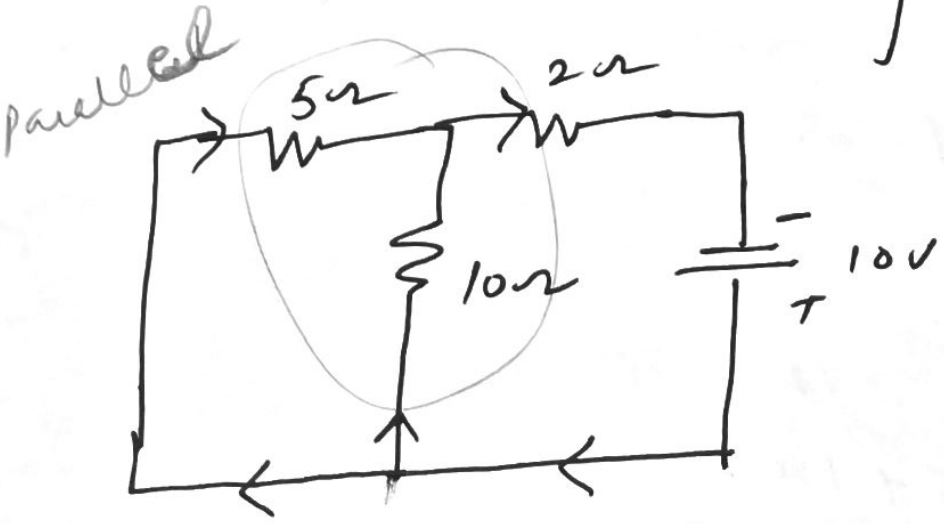


$$I = \frac{20}{5 + 1.67} = 3\ A$$

By current division Rule

$$I'' = 3 \times \frac{10}{10 + 2} = 2.5\ A\ (\leftarrow)$$

Step III :- When the 10V source is acting alone



$$I''' = \frac{10}{3.33 + 2} = 1.88\,A\ (\rightarrow)$$

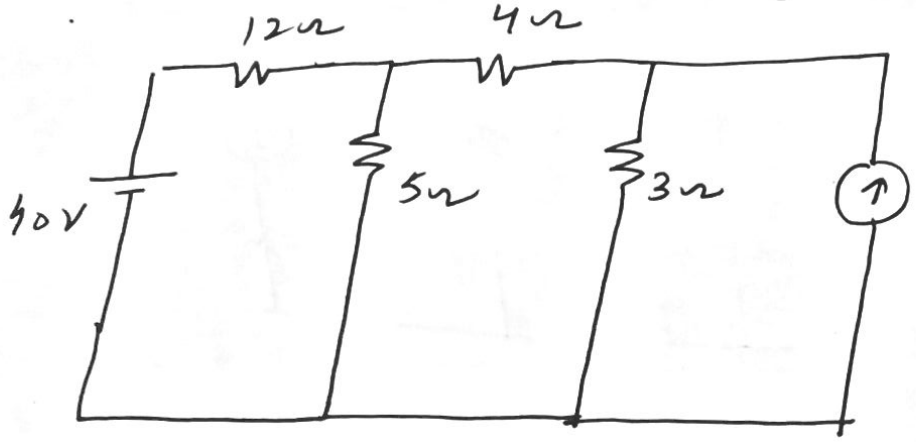
Step IV :- By superposition theorem

$$I = I' + I'' + I'''$$

$$= 5 - 2.5 + 1.88$$

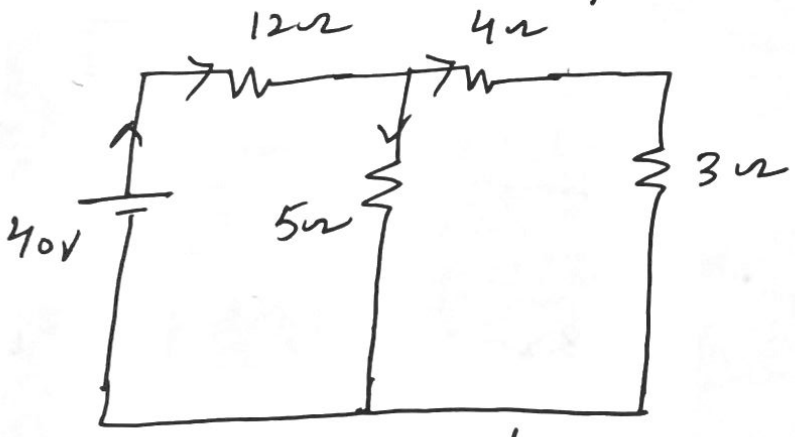
$$= 4.38\ A$$

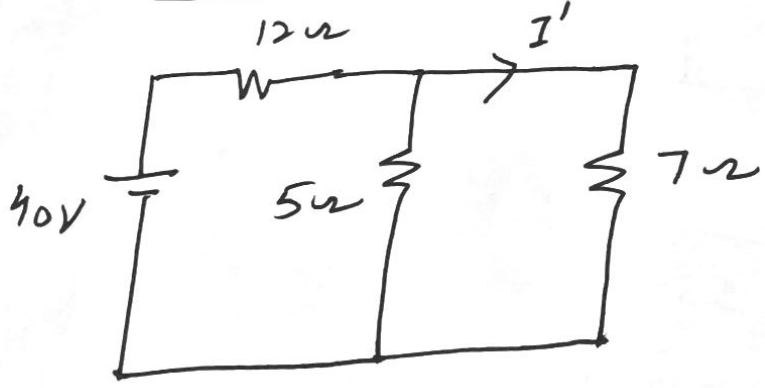
Numerical-2 :- Find the current through the 4Ω



Solution :-

Step I :- When 40V is acting alone



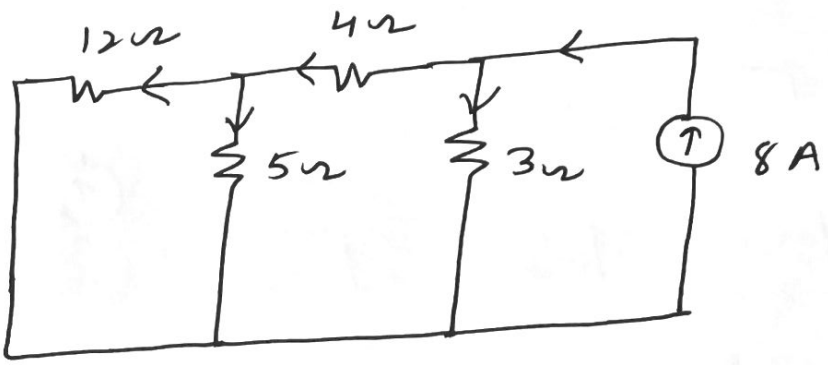


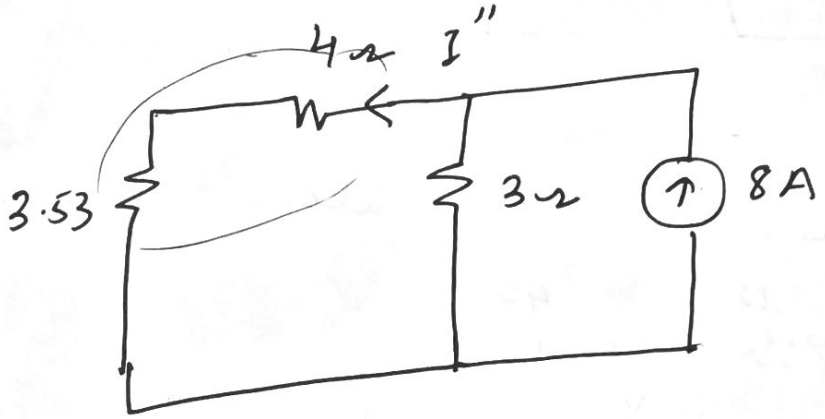
$$I = \frac{40}{12 + 2.92} = 2.68\,A$$

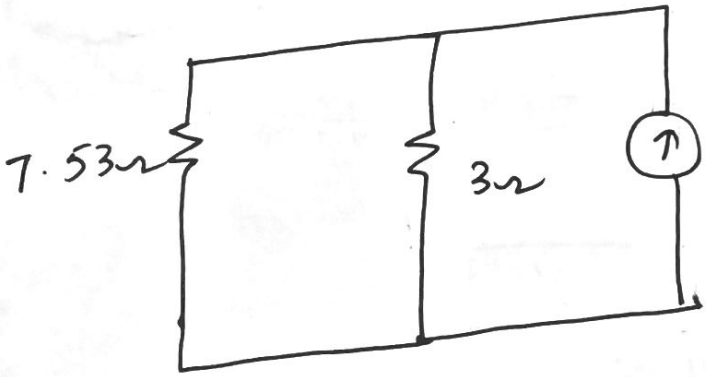
$$I' = \frac{5}{5+7} \times 2.68$$

$$= 1.12\,A\ (\rightarrow)$$

Step II :- When 8A source is acting alone







$$I'' = \frac{3}{7.53+3} \times 8$$

$$= 2.28\,A\ (\leftarrow)$$

Step III :- By superposition

$$I = I' + I''$$

$$= -1.12 + 2.28$$

$$= 1.16\,A\ (\leftarrow)$$