Loop 2: (FADEF):

$$+10(z) + 1(x-y-6) - 2y = 0$$

$$10z + x - y - 6 - 2y = 0$$

$$x - 3y + 10z = 6 \rightarrow (2)$$

Loop 3: (ECGHE)

$$-1(x-y-6) - 3(x-y-z-6) - 4x + 24 = 0$$

$$-x + y + 6 - 3x + 3y + 3z + 18 - 4x + 24 = 0$$

$$-8x + 4y + 3z = -48 \rightarrow (3)$$

Solving (1) (2) & (3);

$$\boxed{\begin{aligned} x &= 4.102\,A \\ y &= -3.214\,A \\ z &= -0.774\,A \end{aligned}}$$

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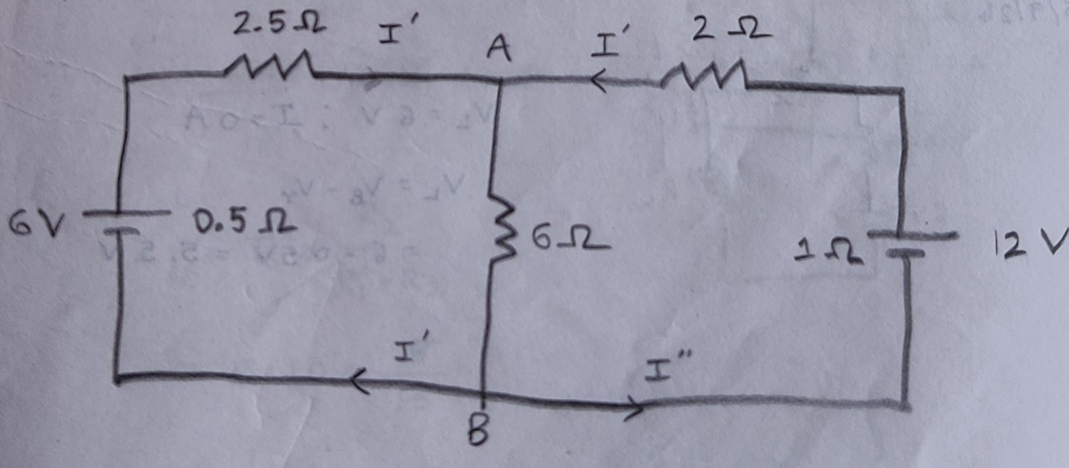
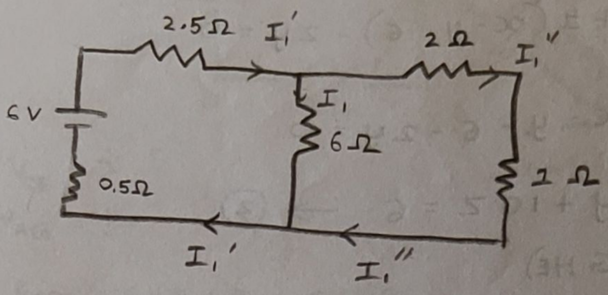
4 SUPERPOSITION THEOREM:

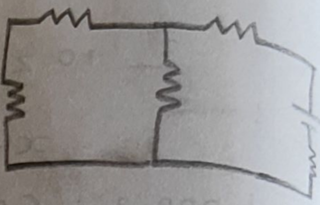
* Circuit should have more than one loop and more than one emf.

Steps:



Theorem of Superposition Principle :

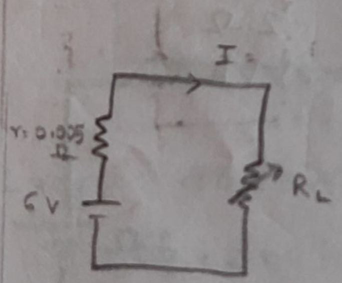




SUPERPOSITION PRINCIPLE :

* According to this theorem, if there are 'n' number of emf acting simultaneously in any linear bilateral network, then each emf acts independently of the other (i.e) as if the other emf does not exist. The value of current in any conductor is the algebraic sum of the currents due to each emf. Similarly, voltage across any conductor is the algebraic sum of the voltages which each emf would have produced while acting alone.

/9/24

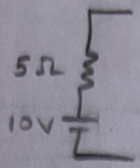


$V_L = 6\ V\ ;\ I = 0\ A$

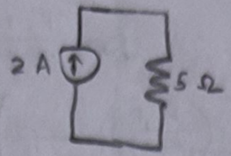
$V_L = V_B - V_r$

$= 6 - 0.5V = 5.5\ V$

Converting Voltage Source to Current Source or Vice-versa :



(series)



(Parallel)

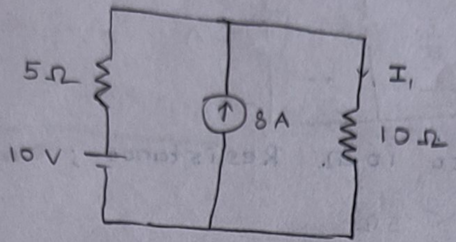
$V = IR$

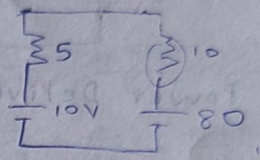
$I = \frac{V}{R} = \frac{10}{5} = 2\ A$

Example :

$I = \frac{15}{15}\ \frac{2}{3}$

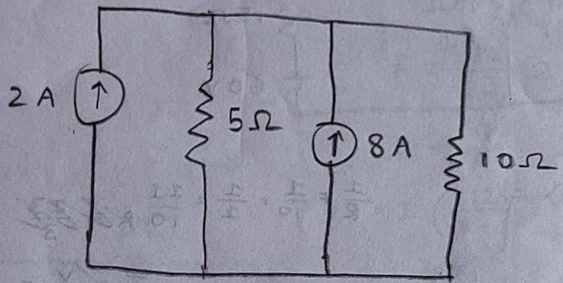
$I_1 = \frac{2}{3}$

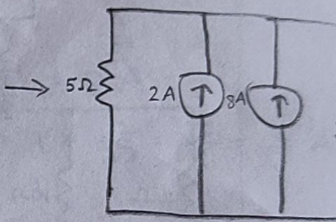


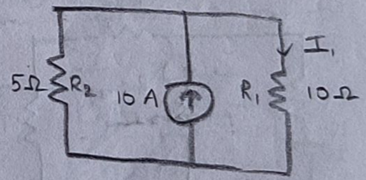


$I_2 = \frac{80}{15}$

$\frac{18}{3} = A$



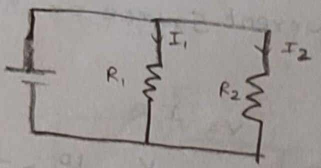




$$I_1 = I \times \frac{R_2}{R_1 + R_2}$$

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

$$= \frac{10}{3}\ A$$

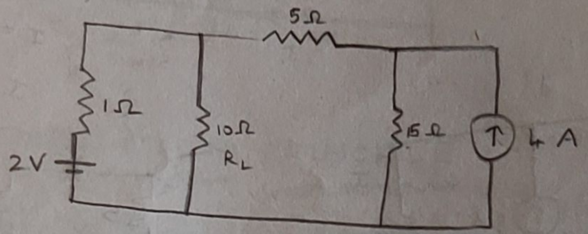


$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_1 + R_2}{R_1 R_2}$$

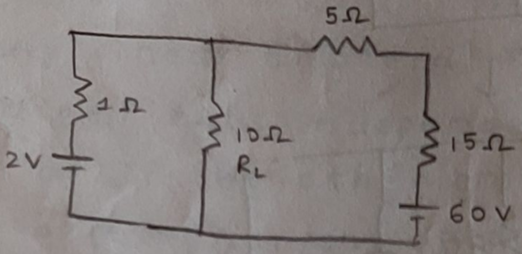
$$R = \frac{R_1 R_2}{R_1 + R_2}$$

$$I_1 \cancel{R_1} = I_1 \left(\frac{R_1 R_2}{R_1 + R_2}\right) \; ; \quad \boxed{I_1 = \frac{R_2}{R_1 + R_2}}$$

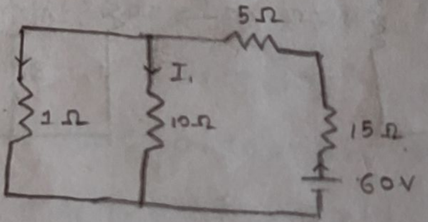
Q)



Power Delivered to 10 Ω Resistance ;



$$\begin{array}{r} 15 \\ \times 4 \\ \hline 60 \end{array}$$



$$\frac{1}{R} = \frac{1}{10} + \frac{1}{1} = \frac{11}{10} \quad \cancel{R = \frac{23}{3}}$$

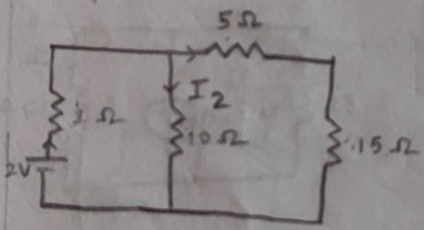
$$R = \frac{10}{11} + 20$$

$$\cancel{I_1 = I = \frac{V}{R} = \frac{60}{\frac{23}{3}} = \frac{180}{23}}$$

$$\cancel{I_1 = I \times \left(\frac{R}{R_1 + R_2}\right) = \frac{180}{23} \times \frac{20}{30}}$$

$$R = \frac{10}{11} + 20 = \frac{10 + 220}{11} = \frac{230}{11} \qquad I = \frac{V}{R}$$

$$I_2 = \frac{60}{230} \times \frac{1}{11} = 0.26\ A$$



$$\frac{1}{R} = \frac{1}{10} + \frac{1}{20} = \frac{20 + 10}{200} = \frac{30}{200} = \frac{3}{20}$$

$$R = \frac{20}{3} + 1 = \frac{20 + 3}{3} = \frac{23}{3}$$

$$I_1 = I \left(\frac{R_2}{R_1 + R_2}\right) \qquad I = \frac{V}{R} = \frac{2}{1}$$

$$= \cancel{\frac{23}{3} \times \frac{20}{30}} \qquad = 0.17$$

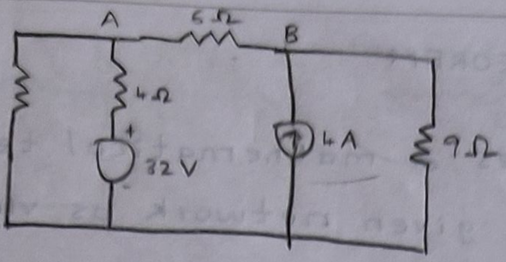
$$= \frac{6}{23} \times \frac{20}{30} = \frac{4}{23} = 0.17$$

Using Superposition Principle ;

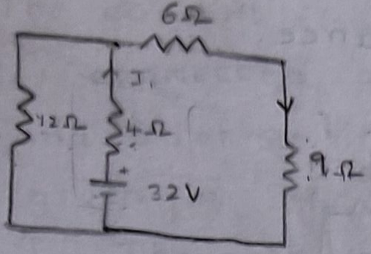
$$I = I_1 + I_2$$
$$= 0.26 + 0.17$$
$$= 0.43\ A$$

$$P = I^2 R$$
$$= (0.43)^2 \times 10$$
$$= 0.184 \times 10$$
$$= 1.84\ W$$

Q)



Power dissipated through 9 Ω.



$R_1 = 9 + 6 = 15\,\Omega$

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$\cancel{\frac{1}{15} + \frac{1}{4} = \frac{4+15}{60} = \frac{19}{60}}$

$\cancel{R = \frac{60}{19}}$ $\frac{1}{15} + \frac{1}{12} = \frac{12+15}{180}$

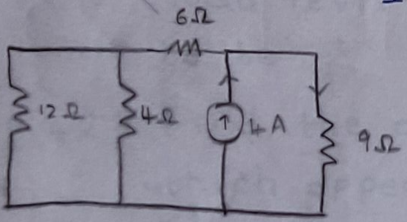
$= \frac{17}{180}$

$R = \frac{\cancel{180}^{60}}{\cancel{27}_{9}} + 4 = \frac{60+36}{9} = \frac{96}{9}$

$R = \frac{32}{3}\,\Omega$

$I = \frac{V}{R} = \frac{32}{\frac{32}{3}} = 3\,A$

$I_1 = I\left(\frac{12}{15+12}\right) = \cancel{3} \times \frac{12}{\cancel{27}} = \frac{12}{9} = \frac{4}{3}\,A$



$\cancel{\frac{1}{R} = \frac{1}{12} + \frac{1}{10} = \frac{10+12}{120} = \frac{22}{120}}$

$\cancel{R = \frac{120}{22} + 9}$

$\cancel{\frac{1}{R} = \frac{22}{120} + \frac{1}{9}}$

$\cancel{\frac{1}{R} = \frac{22}{12}}$

$\frac{1}{R_1} = \frac{1}{12} + \frac{1}{4} = \frac{4+12}{48} = \frac{16}{48} = \frac{4}{12} = \frac{1}{3}$

$R_1 = 3$

$R = R_1 + R_2 = 3 + 6 = 9\,\Omega$

$I_2 = I\left(\frac{R_1}{R_1 + R_2}\right) = 4\left(\frac{9}{9+9}\right) = 4\left(\frac{9}{18}\right) = 2\,A$

Using Superposition Principle : $I = I_1 + I_2$

$I = \frac{4}{3} + 2 = \frac{4+6}{3} =$

Power dissipated $= I^2 R$

$= \left(\frac{10}{3}\right)^2 \times 9 = \frac{100}{\cancel{9}} \times \cancel{9} = 100\,W$