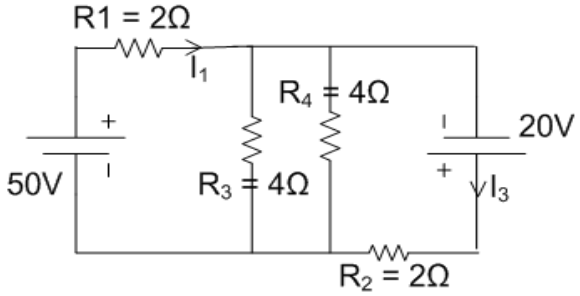
Q. Consider the circuit below.

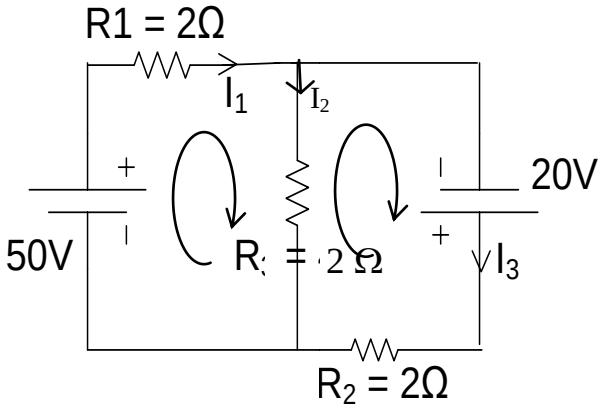


a) Reduce the circuit to a two loop circuit and redraw the circuit showing the directions of the currents I_1, I_2 and I_3. (Take I_2 to flow through the central section of the circuit).

As the resistances R_3 and R_4 are connected in parallel (ends to ends) their equivalent resistance is given by

$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{4*4}{4+4} = 2\Omega$$

Hence the circuit reduces to



b) Using two clockwise traverse loops for the left and right sections of the circuit, calculate the values of the currents through each of the resistors.

Using the junction rule (total incoming current at a junction equal to total outgoing current) for the top common point of the two loops we have

$I_1 = I_2 + I_3$ ---------- (1)

Applying loop rule $\left(\sum E = \sum R*I\right)$ to the left loop of the circuit we get

$50 = 2\ I_1 + 2\ I_2$

Or $I_1 + I_2 = 25$ ---------- (2)

And for the right loop we have

$20 = 2\ I_3 - 2\ I_2$

Or $I_3 - I_2 = 10$

Substituting I_3 from equation 1 in 2 we have

$I_1 - 2I_2 = 10$ ---------- (3)

Subtracting equation 3 from 2 we have

$3\ I_2 = 15$

Or **$I_2 = 5$ A**

And from equation 3

$I_1 = 10 + 2\ I_2 =$ **20 A**

And from equation 1 we get

$I_3 = I_1 - I_2 = 20 - 5 =$ **15 A.**

c) Calculate the power dissipated in each of the resistors.

Power dissipated in R_1

$P_1 = I_1^2 * R_1 = 20^2 * 2 =$ **800 W**

In R $P = R * I_2^2 = 2 * 25 =$ **50 W** (25W in each of the original 4Ω)

And in R_2

$P_2 = R_2 * I_3^2 = 2 * 225 =$ **450 W**.