MESH ANALYSIS

- Analysis using KVL to solve for the currents around each closed loop of the network and hence determine the currents through and voltages across each elements of the network

- Mesh analysis procedure

STEP 1

Assign a distinct current to each closed loop of the network

STEP 2

Apply KVL around each closed loop of the network

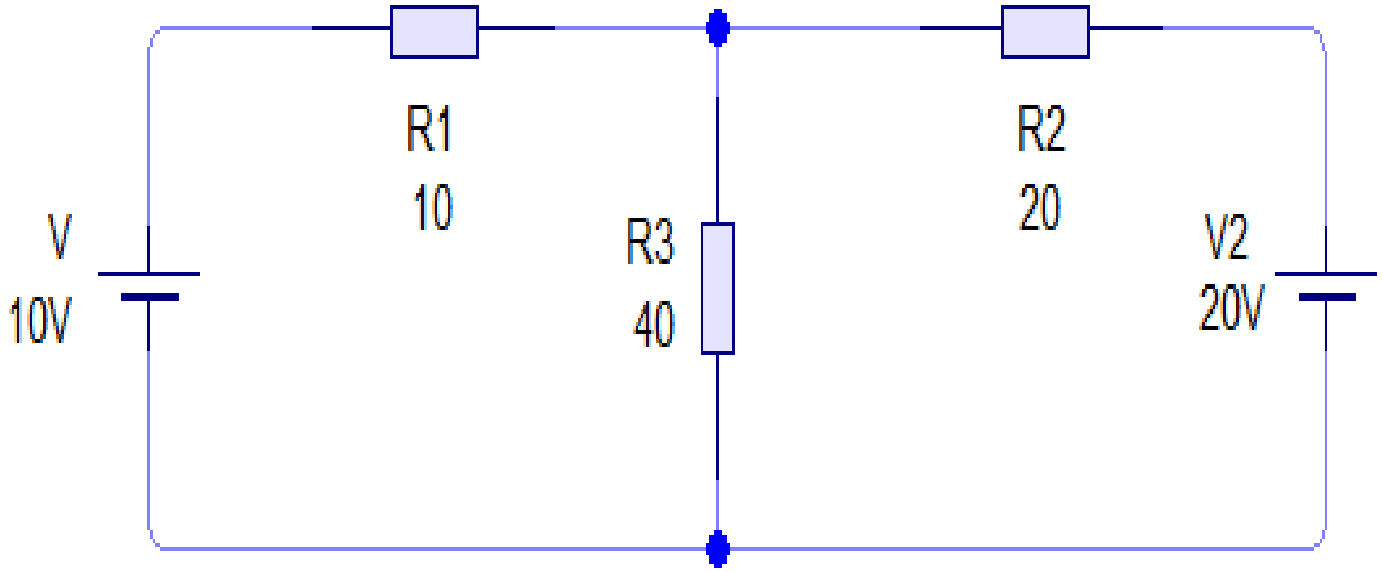
STEP 3

Solve the resulting simultaneous linear equation for the loop currents

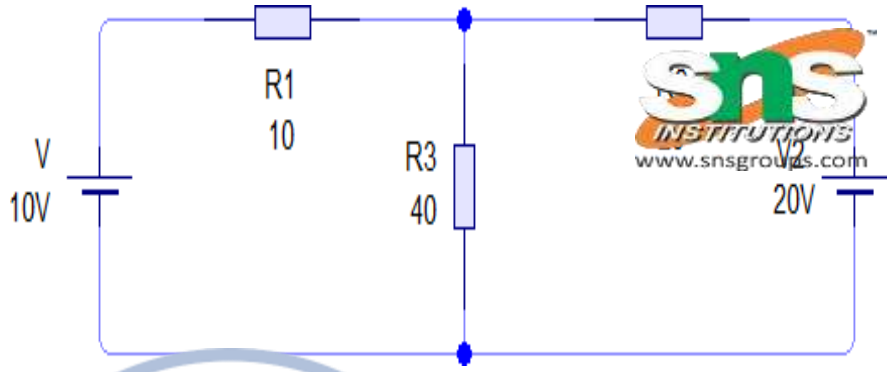
EXERCISE

- Exercise 1

Find the current flow through each resistor using mesh analysis for the circuit below



❑ EXERCISE 1



❖ SOLUTION

- Assign a distinct current to each closed loop of the network

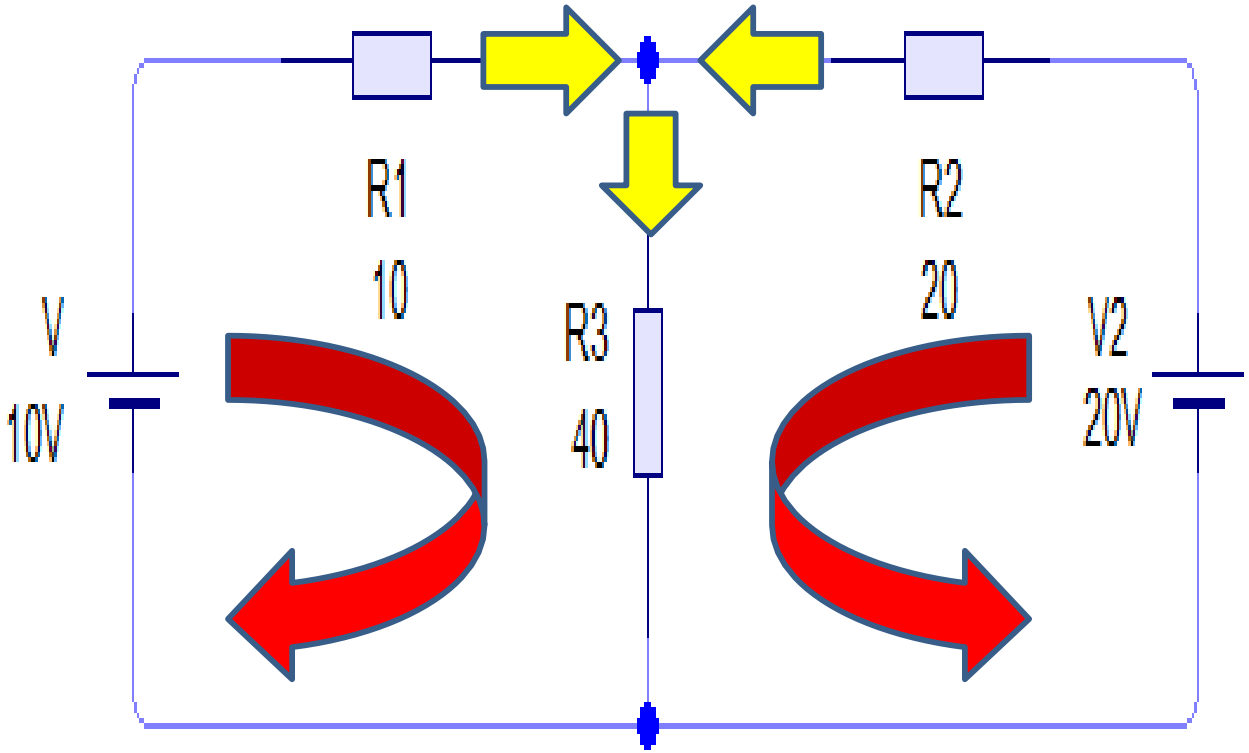
STEP 1

- Apply KVL around each closed loop of the network

STEP 2

- Solve the resulting simultaneous linear equation for the loop currents

STEP 3



STEP 1

$Loop1:$

$$I_1R_1+I_1R_3+I_2R_3=V_1$$

$$10I_1+40I_1+40I_2=10$$

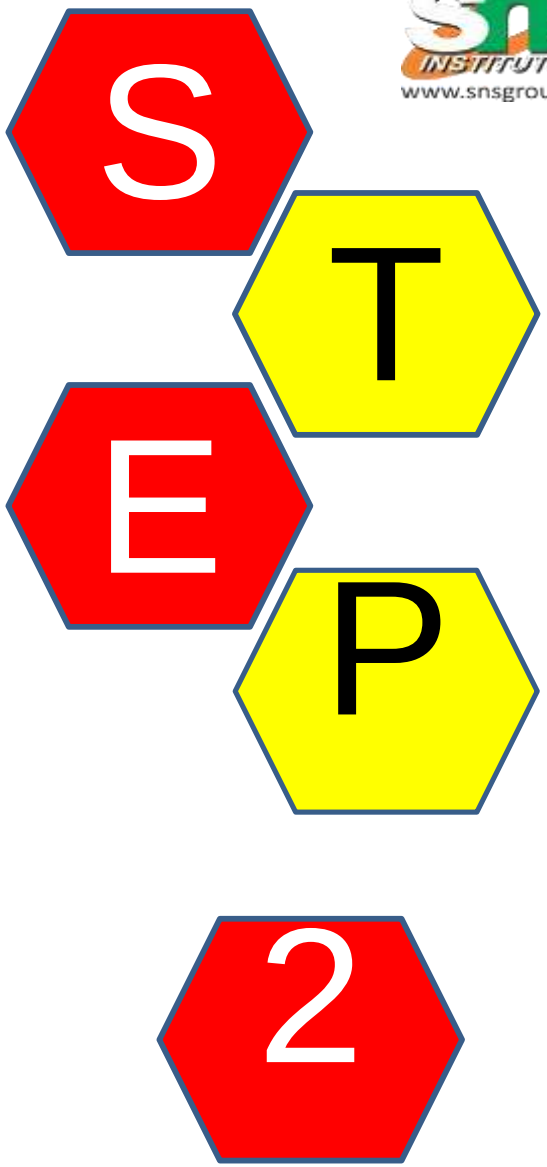
$$50I_1+40I_2=10---equation1$$

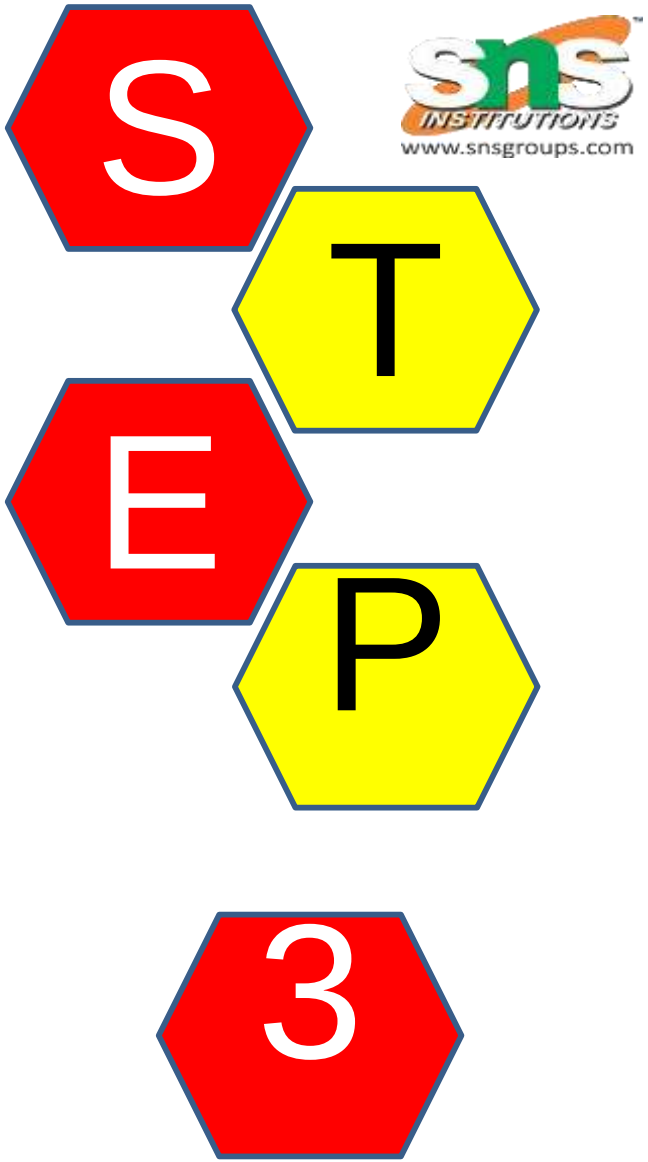
$Loop2:$

$$I_2R_2+I_2R_3+I_1R_3=V_2$$

$$20I_2+40I_2+40I_1=20$$

$$40I_1+60I_2=20---equation2$$





Solve equation 1 and equation 2 using Matrix

$$50I_1 + 40I_2 = 10$$

$$40I_1 + 60I_2 = 20$$

$$Matrix form:$$

$$\begin{bmatrix} 50 & 40 \\ 40 & 60 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 10 \\ 20 \end{bmatrix}$$

$$\Delta = \begin{vmatrix} 50 & 40 \\ 40 & 60 \end{vmatrix} = 3000 - 1600 = 1400$$

$$\Delta I_1 = \begin{vmatrix} 10 & 40 \\ 20 & 60 \end{vmatrix} = 600 - 800 = -200$$

$$\Delta I_2 = \begin{vmatrix} 50 & 10 \\ 40 & 20 \end{vmatrix} = 1000 - 400 = 600$$

$$I_1 = \frac{\Delta I_1}{\Delta} = \frac{-200}{1400} = -0.143A$$

$$I_2 = \frac{\Delta I_2}{\Delta} = \frac{600}{1400} = 0.429A$$

$$From KCL:$$

$$I_3 = I_1 + I_2 = -0.143A + 0.429A = 0.286A$$