భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
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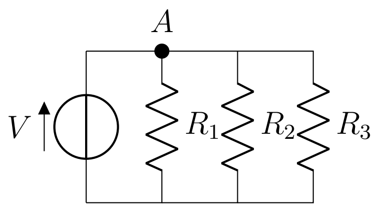
Verification of KCL and KVL

1 Aim

To verify Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL) in the given circuit

2 Circuit Diagram

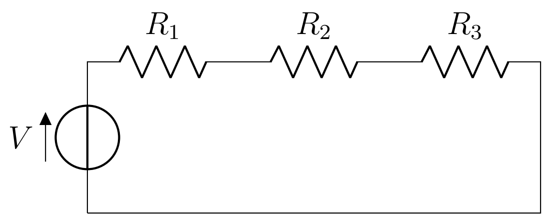
2.1 KCL:



where

$$\text{V} = 5\text{V} \tag{1}$$
$$R_1 = 100\Omega \tag{2}$$
$$R_2 = 220\Omega \tag{3}$$
$$R_2 = 180\Omega \tag{4}$$

2.2 KVL:



where

$$\text{V} = 5\text{V} \tag{5}$$
$$R_1 = 100\Omega \tag{6}$$
$$R_2 = 220\Omega \tag{7}$$
$$R_2 = 180\Omega \tag{8}$$

3 Theory

KCL:
At any node in an electrical circuit, the net current is zero.
KVL:
In closed path of an electrical circuit the net potential around the closed path is zero.

4 Theoretical calculations:

4.1 For verifying KCL:

Applying KCL at node A:
To find I,

$$I = I_1 + I_2 + I_3 \tag{9}$$

$$R_{\text{eq}} = \left(\frac{1}{100} + \frac{1}{180} + \frac{1}{220}\right)^{-1} \tag{10}$$

$$R_{\text{eq}} = 49.74\,\Omega \tag{11}$$

$$I = \frac{V}{R_{\text{eq}}} \tag{12}$$

$$I = \frac{5}{49.74} \tag{13}$$

$$I = 0.1\,\text{A} \tag{14}$$

To find I_1, I_2, I_3 using current division rule:

$$I_1 = \frac{100 \cdot \text{I}}{100 + 220 + 180} = 0.02\,\text{A} \tag{15}$$

$$I_2 = \frac{220 \cdot \text{I}}{100 + 220 + 180} = 0.044\,\text{A} \tag{16}$$

$$I_3 = \frac{180 \cdot \text{I}}{100 + 220 + 180} = 0.036\,\text{A} \tag{17}$$

4.2 For verifying KVL:

Assume current's direction to be clockwise
Applying KVL in loop:
Assume the current to be I,

$$-V + I \cdot R_1 + I \cdot R_2 + I \cdot R_3 = 0 \tag{18}$$

$$-5 + I \cdot 100 + I \cdot 220 + I \cdot 180 = 0 \tag{19}$$

On solving, we get

$$I = 0.01\,\text{A} \tag{20}$$

so,

$$\begin{aligned}
V_1 &= I \cdot R_1 = 0.01\,\mathrm{A} \cdot 100\,\Omega = 1\,\mathrm{V} \\
V_2 &= I \cdot R_2 = 0.01\,\mathrm{A} \cdot 220\,\Omega = 2.2\,\mathrm{V} \\
V_1 &= I \cdot R_3 = 0.01\,\mathrm{A} \cdot 180\,\Omega = 1.8\,\mathrm{V}
\end{aligned}$$

5 Observation

5.1 For KCL:

	theoretical	**practical**
I(A)	0.1A	0.09A
I_1(A)	0.02A	0.019A
I_2(A)	0.044A	0.045A
I_3(A)	0.036A	0.037A

5.2 For KVL:

	theoretical	**practical**
V_1(V)	1V	1.2V
V_2(V)	2.2V	2.1V
V_3(V)	1.8V	1.7V
V(V)	0.1V	0.1V

6 Result

For KCL, total input current is equal to total output current at node A.
For KVL, the net potential in a loop is zero