Resistors in Series

A simple circuit consists of a 12 V battery and three 2000 Ω resistors connected in series.

Instead of using three separate 2K resistors, we could replace the three resistors with one single resistor having an equivalent resistance.

Resistors in Series

Equivalent Resistance for Resistors in Series \( R = R_1 + R_2 + \cdots \)

The equivalent resistance of resistors in series equals the sum of the individual resistances of the resistors.

Resistors in Series

Equivalent Resistance for Resistors in Series \( R = R_1 + R_2 + \cdots \)

The equivalent resistance of resistors in series equals the sum of the individual resistances of the resistors.
14.4(B) SIMPLE CIRCUITS

Resistors in Series

The equivalent resistance of resistors in series equals the sum of the individual resistances of the resistors.

\[ R_{eq} = R_1 + R_2 + R_3 + \ldots \]

\[ R_{eq} = 2000 \Omega + 2000 \Omega + 2000 \Omega \]

\[ R_{eq} = 6000 \Omega = 6 \text{k}\Omega \]

Resistors in Parallel

The reciprocal of the equivalent resistance is equal to the sum of the reciprocals of the individual resistances.

\[ \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots \]

\[ \frac{1}{R_{eq}} = \frac{1}{2000 \Omega} + \frac{1}{2000 \Omega} + \frac{1}{2000 \Omega} \]

\[ \frac{1}{R_{eq}} = 0.0015 \Omega \]

\[ R_{eq} = 667 \Omega \]

VIRP Tables

A simple and straightforward method for analyzing circuits involves creating a VIRP table for each circuit you encounter. A VIRP table describes the potential drop (V-voltage), current flow (I-current), resistance (R) and power dissipated (P-power) for each element in your circuit, as well as for the circuit as a whole.

Circuit Analysis Example

A 10-Ω, 15-Ω, and 5-Ω resistor are connected in a series circuit with a 90-V battery. Draw a schematic of the circuit and then complete a VIRP table for this circuit.
Summary: Series and Parallel Circuits

<table>
<thead>
<tr>
<th>SERIES</th>
<th>PARALLEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>One path for current to flow.</td>
<td>Multiple paths for current to flow.</td>
</tr>
</tbody>
</table>

\[
I_1 = I_2 = I_3 = \ldots \\
V = V_1 + V_2 + V_3 + \ldots \\
R_{eq} = R_1 + R_2 + R_3 + \ldots
\]

Circuit Analysis Example

A 120.0-Ω resistor, a 60.0-Ω resistor, and a 40.0-Ω resistor are connected in parallel and placed across a 12.0-V battery. Draw a schematic and then complete a VIRP table for this circuit.

Gustav Kirchhoff

GERMAN PHYSICIST (1854)

Kirchhoff's Current Law (Junction Rule)

“The sum of all current entering any point in a circuit has to equal the sum of all current leaving any point in a circuit.”

Kirchhoff's Voltage Law (Loop Rule)

“The sum of all the potential drops in any closed loop of a circuit has to equal zero.”
11. Complete a VIRP table for the circuit shown here.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>2.5 V</td>
<td>0.025 A</td>
<td>0.0625 W</td>
</tr>
<tr>
<td>R2</td>
<td>9.0 V</td>
<td>0.045 A</td>
<td>0.4 W</td>
</tr>
<tr>
<td>R3</td>
<td>7.5 V</td>
<td>0.025 A</td>
<td>0.19 W</td>
</tr>
<tr>
<td>Total</td>
<td>9.0 V</td>
<td>0.07 A</td>
<td>0.63 W</td>
</tr>
</tbody>
</table>

**PROBLEMS**

33-40