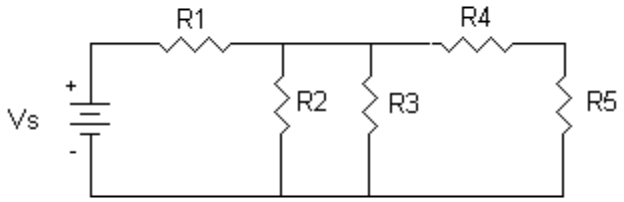
Circuit Example



If R1 = 24 Ω, R2 = 24 Ω, R3 = 12 Ω, R4 = 12 Ω, R5 = 12 Ω and Vs = 12 Volts, determine the circuit equivalent resistance (REQ) and the circuit current (I). Also calculate the branch currents through R2, R3, R4, and R5, and the voltage drops across R1, R2, R3, R4 and R5.

Alternative Solution

Calculate R23 (Parallel Resistance)

1/R23 = 1/R2 + 1/R3 = 1/24+ 1/12 = 1/24 + 2/24 = 3/24
R23 = 8 Ω

Calculate R45 (Series Resistance)

R45 = R4 + R5 = 12 + 12
R45 = 24 Ω

Calculate R2345 (Parallel Resistance)

1/R2345 = 1/R23 + 1/R45 = 1/8 + 1/24 = 3/24 + 1/24 = 4/24
Therefore, R2345 = 6 Ω

Calculate REQ (Series Resistance)

REQ = R1 + R2345 = 24 Ω + 6 Ω
REQ = 30 Ω

Calculated the circuit current. Use Ohm's Law $V = I \cdot R$
$12\ V = I \cdot 30\ \Omega$
Therefore, $I = 12/30$
$I = 0.4\ A$

Calculate the voltage drop across R1
$V1 = I \cdot R1 = 0.4\ A \cdot 24\ \Omega$
$V1 = 9.6\ V$

Using the Current Divider Rule calculate the current through R45
$I45 = (I \cdot R23)/(R23 + R45) = (0.4 \cdot 8)/(8 + 24) = 3.2/32$
$I45 = 0.1\ A$, note: $I45 = I4 = I5$ (both resistors are in series)

Calculate the voltage drop across R45
The voltage drop across $R45 = I45 \cdot R45 = 0.1 \cdot 24$
$V45 = 2.4\ V$

Determine the voltage drops across R2 and R3
$V45 = V2 = V3 = 2.4\ V$ (All three resistors are in parallel)

Calculate the current through R2
$I2 = V2 / R2 = 2.4\ V / 24\ \Omega$
$I2 = 0.1\ A$

Calculate the current through R3
$I3 = V3 / R3 = 2.4\ V / 12\ \Omega$
$I3 = 0.2\ A$

Finally, calculate the voltage drops across R4 and R5
$V4 = I4 \cdot R4 = 0.1\ A \cdot 12\ \Omega$
$V4 = 1.2\ V$

$V5 = I5 \cdot R5 = 0.1\ A \cdot 12\ \Omega$
$V5 = 1.2\ V$