Electrical Current Flow

Electron Flow - From excess to deficient

Conventional Current Flow
- Internal to Source (Battery)
  - Negative to Positive
- External from Source (Battery)
  - Positive to Negative

Voltage Drop - Across a Resistor + to -

Negative Current - Assumed Direction Reversed

Electrical Theory

Ohm's Law
- I =V/R (DC)   I = V/Z (AC)

Series: $R_{eq} = R_1 + R_2 + R_3$

Parallel: $1/R_{eq} = 1/R_1 + 1/R_2 + 1/R_3$

Kirchoff's Law
- Sum of Loop Voltages = 0
- Sum of Node Currents = 0

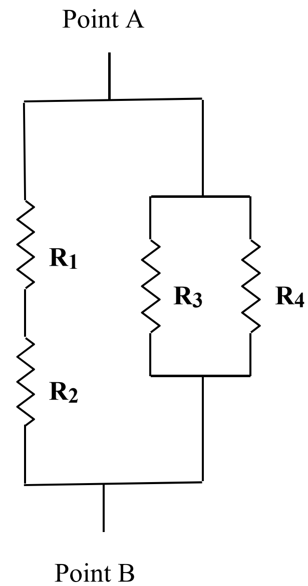
Joule's Law
- $P = IE = I^2R$ (I Squared R Loss)

Equivalent Circuits

Thevenin
- Two Terminal Resistor and Battery Circuit
  - Series Voltage Source and Equivalent Resistor
- Voltage Source = Open Circuit Voltage
- Equivalent Resistor = V / Short Circuit Current

Norton
- Two Terminal Resistor and Battery Circuit
  - Parallel Voltage Source and Equivalent Resistor
- Current Source = Short Circuit Current
- Equivalent Resistor = V / Short Circuit Current

Series and Parallel Resistor Example Problems



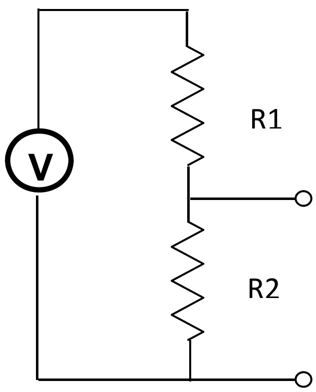
Given the configuration above, calculate the equivalent resistance from Point A to Point B.

R1 = 100 Ω   R2 = 300 Ω   R3 = 100 Ω   R4 = 400 Ω

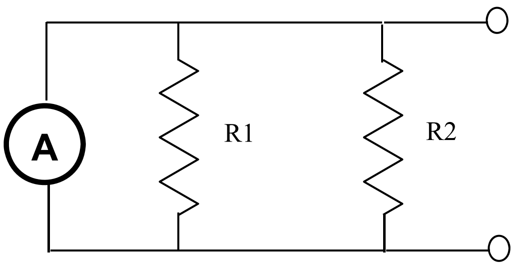
If the current through R4 is 100 mA;
What is the voltage across R2?
What is the current through R1?
What is the total current from Point A to Point B?

Equivalent Resistance from Point A to Point B	66.7 Ω
Voltage across R2	30 V
Current through R1	100 mA
Total current from Point A to Point B	600 mA

Simple Voltage and Current Dividers



$$V_{R_2} = V \frac{R_2}{R_1 + R_2}$$



$$I_{R_2} = I \frac{R_1}{R_1 + R_2}$$

Equivalent Circuits

Thevenin's Theorem

Any network of resistors and batteries having two output terminals, may be replaced by a series combination of a voltage source V_{eq} and a resistance R_{eq}.

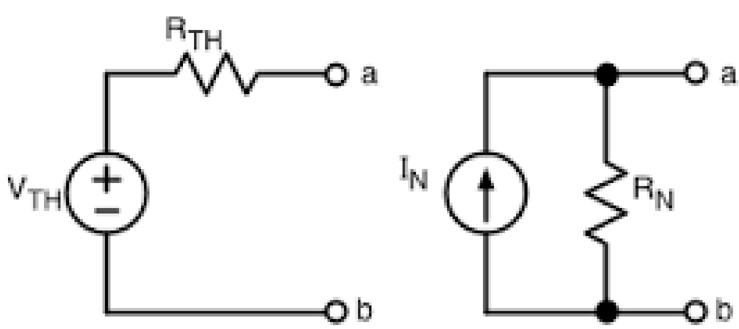
The equivalent emf V_{eq} is the potential at the output terminals when the output current is zero (open-circuit voltage).

The equivalent resistance R_{eq} is the ratio of the V_{eq} to the output current when R_{Load} is zero (short-circuit current).

Norton's Theorem

Any network of resistors and batteries having two output terminals, may be replaced by a parallel combination of a current source I_{eq} and a resistance R_{eq}.

The current source I_{eq} is the short-circuit current in the output terminals, and the resistance R_{eq} is the same as for Thevenin's Theorem.



http://hyperphysics.phy-astr.gsu.edu/hbase/electric/thevenin.html