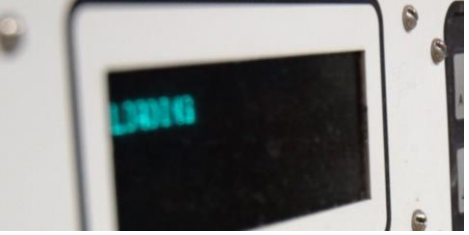



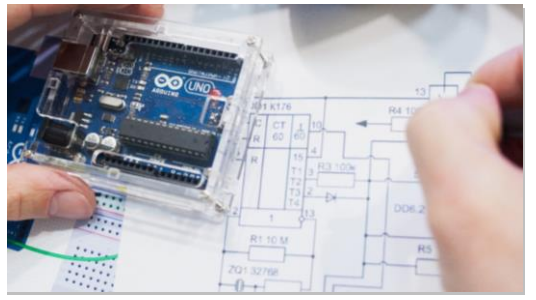

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pathways to engineering technology employment

Series and Parallel Circuits

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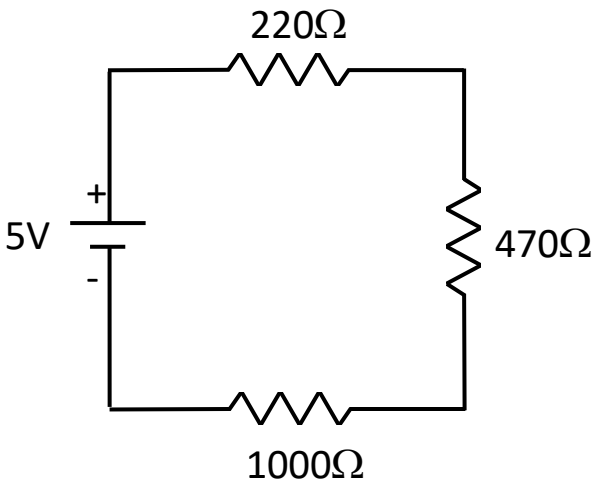
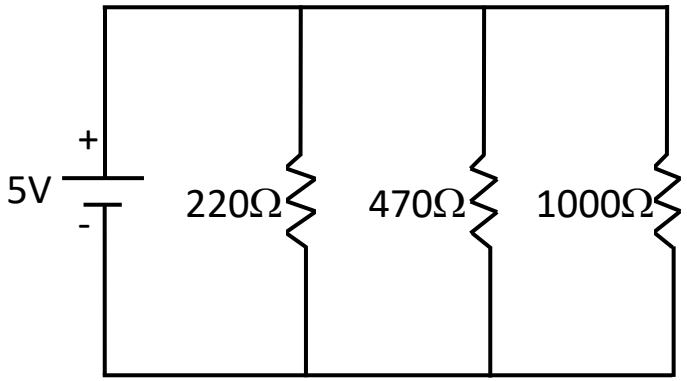
Different Ways of Combining Resistors



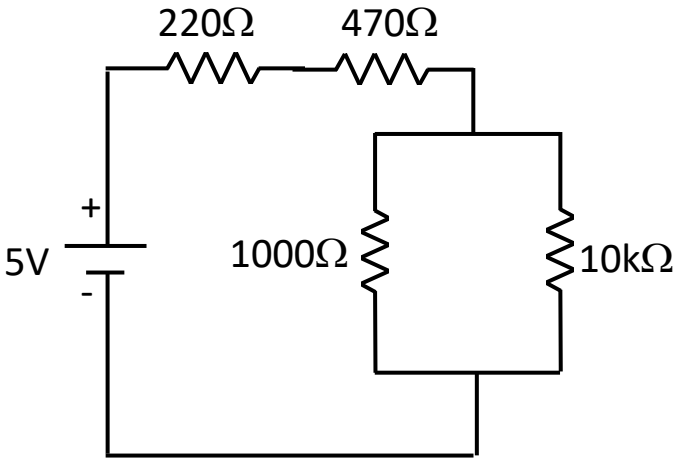
Series

Electrons flow in sequence through the resistors



Parallel

Electrons divide to pass through each resistor

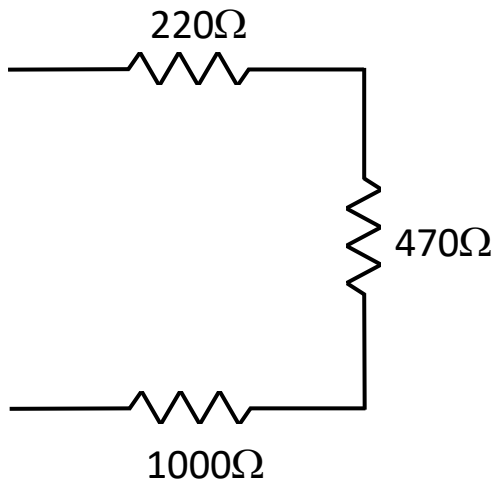


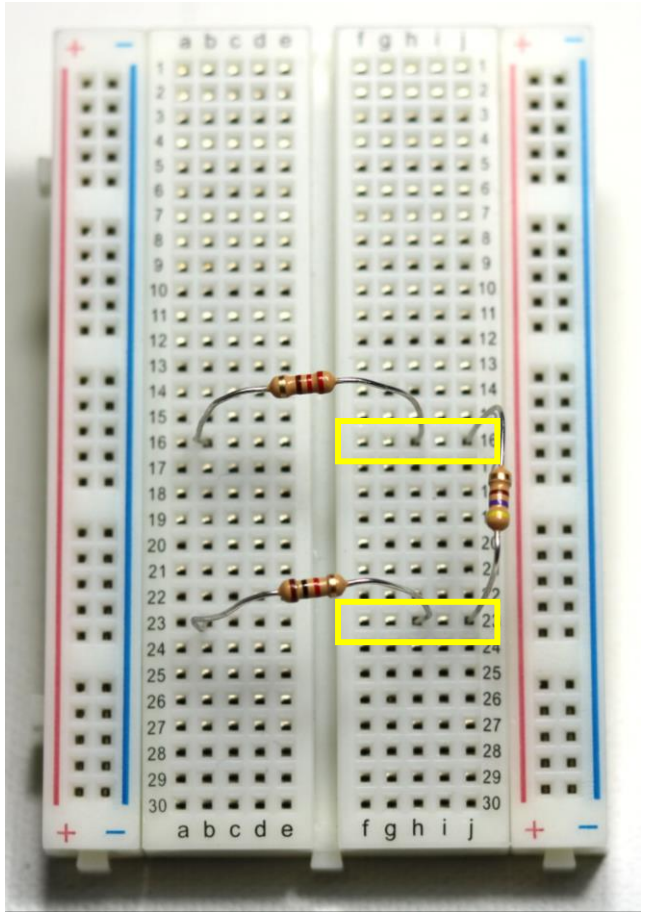
Series and Parallel

For analysis, multiple resistors must often be combined as a single equivalent resistance.

Series Resistors

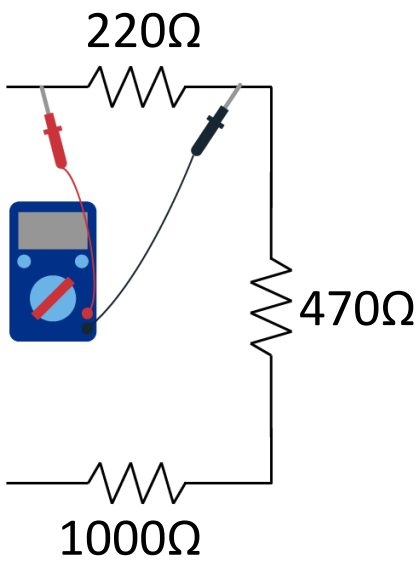
- Find three resistors: 220Ω, 470Ω, & 1000Ω
- Place them in series on the breadboard with two jumper wires

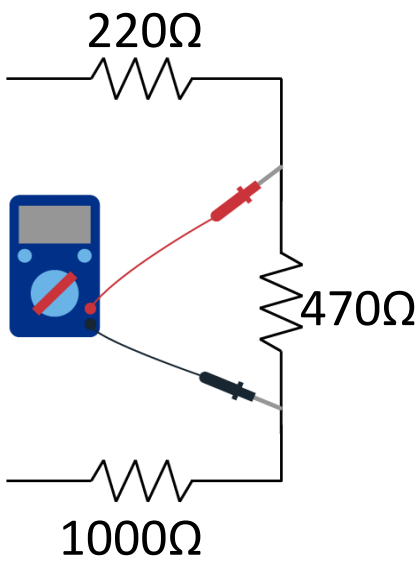


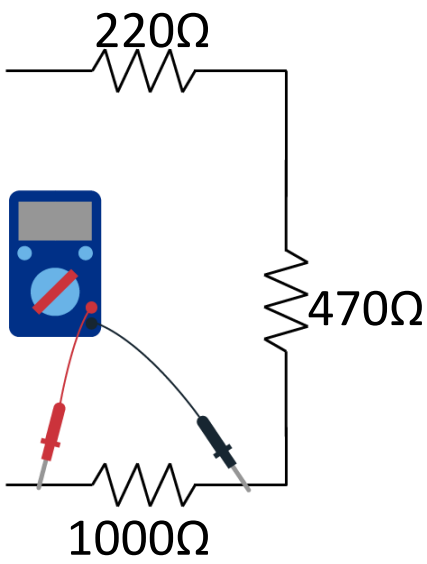


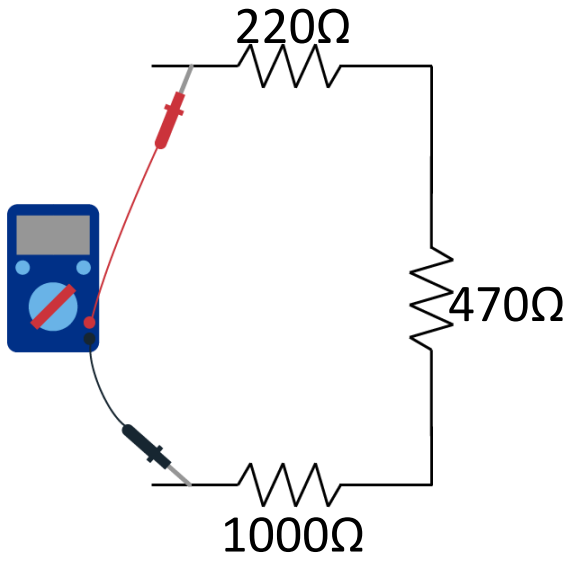
Do not plug resistors to power!

Measure Resistance Combinations









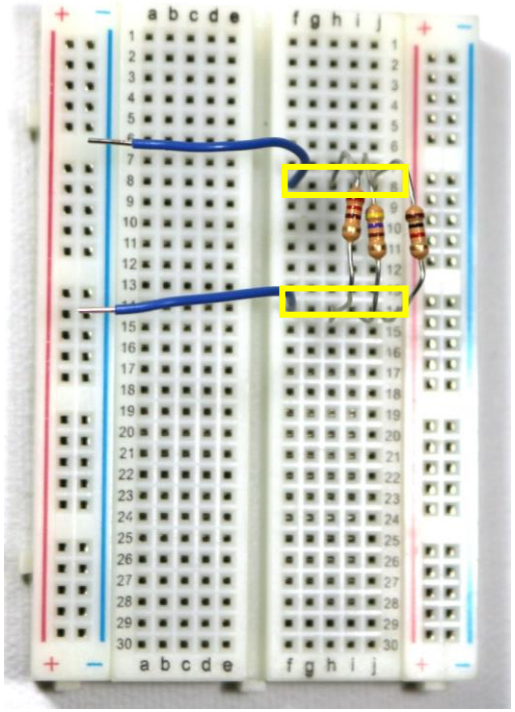
$$R_{eq} = 220\Omega + 470\Omega + 1000\Omega = 1690\Omega$$

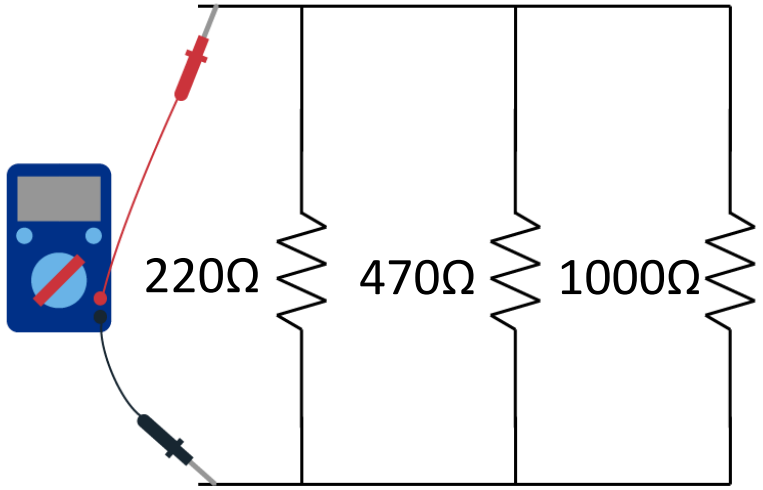
Generalizing the Equivalent Resistance:

$$R_{eq} = R_1 + R_2 + \cdots + R_n = \sum_{i=1}^{n} R_i$$

Measuring Resistance for Resistors in Parallel

Do not plug resistors to power!





$$R_{eq} = \frac{1}{\frac{1}{220\Omega} + \frac{1}{470\Omega} + \frac{1}{1000\Omega}} = 130.3\Omega$$

Now measure resistance across each individual resistor. What happens?

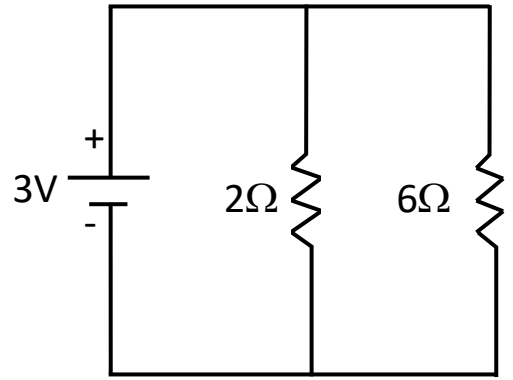
Generalizing the Equivalent Resistance:

$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}} = \frac{1}{\sum_{i=1}^{n} \frac{1}{R_i}}$$

Class Problem: Consider the circuit below.

a. What is the total current supplied to the resistors (current that leaves the power source)?

b. How much power is consumed by the resistors?



Solution:

a. $$R_{eq} = \frac{1}{\frac{1}{2\Omega} + \frac{1}{6\Omega}} = \frac{1}{\frac{3}{6} + \frac{1}{6}} = \frac{1}{\frac{4}{6}} = \frac{6}{4} = 1.5\Omega$$

$$V = I \cdot R \implies I = \frac{V}{R} = \frac{3V}{1.5\Omega} = 2A$$

b. $$P = I \cdot V = 3V \cdot 2A = 6W$$

Combined Series & Parallel Resistors

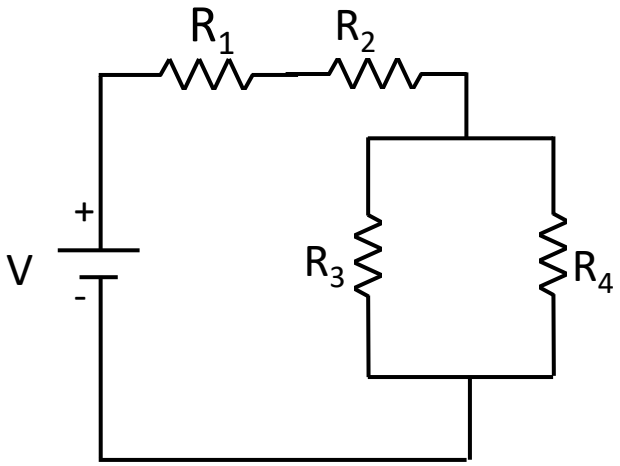
Procedure:

STEP 1: Combine adjacent series resistors in series.

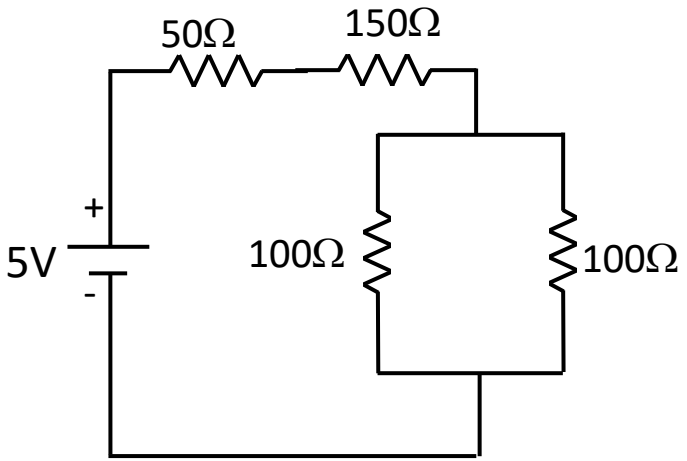
STEP 2: Compute the equivalent resistance of each "group" of parallel resistors.

STEP 3: Redraw the circuit with intermediate equivalent resistances.

STEP 4: Repeat steps 1, 2, and 3 until R_{eq} is found.

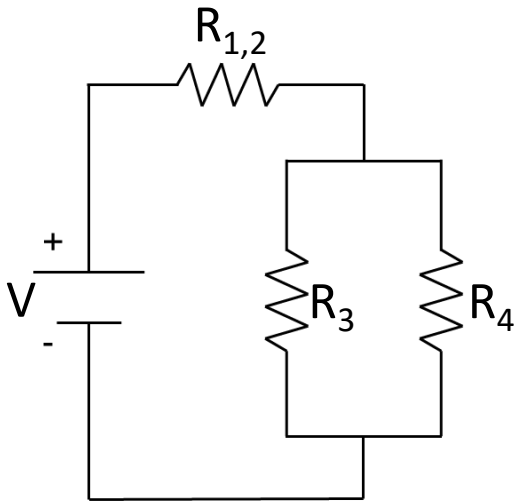


Find R_{eq} for the given circuit



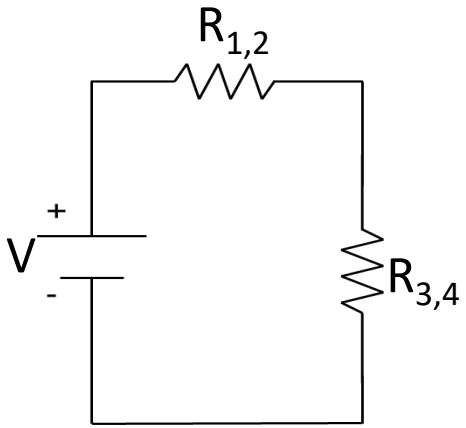
STEP 1:

$$R_{1,2} = 50\Omega + 150\Omega = 200\Omega$$



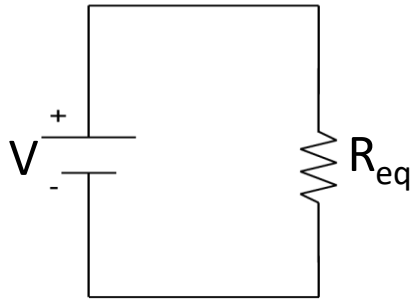
STEP 2 and 3:

$$R_{3,4} = \frac{1}{\frac{1}{100\Omega} + \frac{1}{100\Omega}} = 50\Omega$$



STEP 4:

$$R_{eq} = R_{1,2} + R_{3,4} = 200\Omega + 50\Omega = 250\Omega$$



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