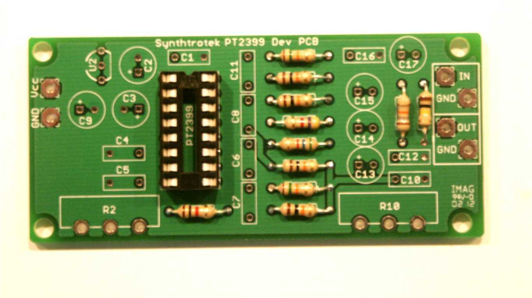
AP Phys 1 Unit 11.5 Notes - Resistor Circuits

11.5 - Resistor Circuits



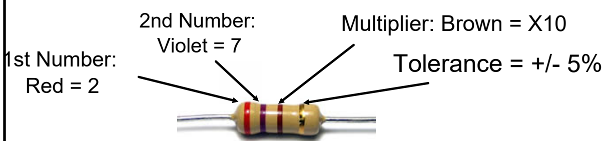
Resistor Codes

Resistors have a printed resistance that at-a-glance tells what its resistance value is (see Resources 8).

The first and second bands (read from closest band end of resistor) are two numbers.

The third band is a multiplier.

The fourth is a +/- tolerance band.



Resistance = 270 +/- 13.5 Ω

Resistor Code Examples

What are the values of the following resistors?

1.  10 megaohms

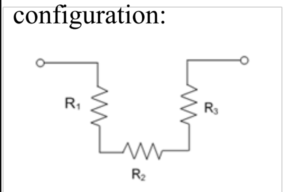
brown-black-blue-gold

2.  360 ohms

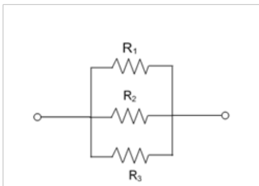
orange-blue-brown-gold

Resistor Circuits

Resistors can be arranged in serial or parallel configuration:



Series: current has only one path

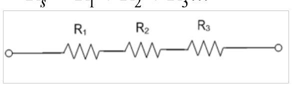


Parallel: current has multiple possible paths

Calculating Series Resistance

Series resistance (R_s) calculation:

$$R_s = R_1 + R_2 + R_3 \ldots$$

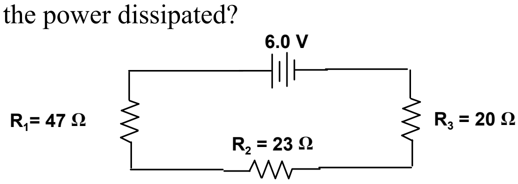


Resistance is additive - current travels through more obstacles.

$R_s = \sum_i R_i$ AP Equation	R = Resistance i = individual

3. Series Example

What is the resistance of the circuit?
What's the power dissipated?



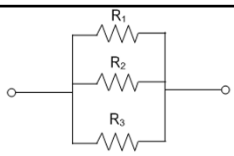
$$R_S = R_1 + R_2 + R_3 + \ldots$$

$$R_S = 47\Omega + 23\Omega + 20\Omega = \boxed{90\Omega}$$

Power: $P = \frac{V^2}{R} = \frac{(6.0V)^2}{90\Omega} = \boxed{0.40W}$

AP Phys 1 Unit 11.5 Notes - Resistor Circuits

Calculating Parallel Resistance



There are more paths for current: overall resistance is less.

R_p is always less than the lowest resistor.

$$R_p = \left(R_1^{-1} + R_2^{-1} + R_3^{-1} + ...\right)^{-1}$$

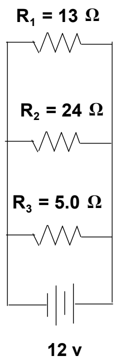
The 1/x button on your calculator is useful!

$\frac{1}{R_p} = \sum_i \frac{1}{R_i}$ AP Equation	R = Resistance i = individual

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} ...$
Not user friendly!

4. Parallel Example

Calculate the parallel resistance of the following circuit:



$$R_p = \left(R_1^{-1} + R_2^{-1} + R_3^{-1} + ...\right)^{-1}$$

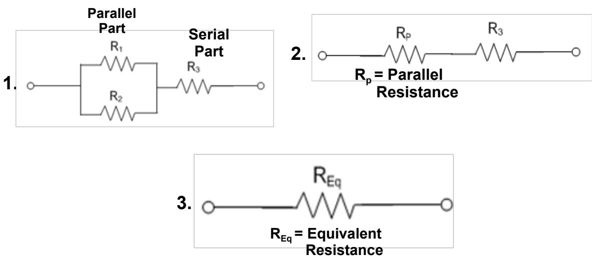
$$R_p = \left(13\Omega^{-1} + 24\Omega^{-1} + 5.0\Omega^{-1}\right)^{-1}$$

$$= \left(0.0769 + 0.0417 + 0.2\right)^{-1}$$

$$= 3.14\Omega$$

Mixed Circuits: Series & Parallel

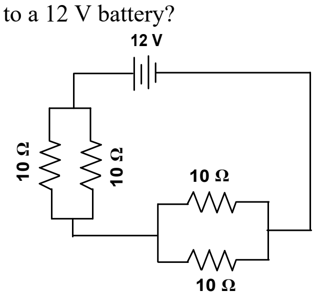
In a mixed circuit, sequentially reduce series/parallel sections, until the total resistance is reduced to one equivalent resistance (R_{eq}).



Mixed Example

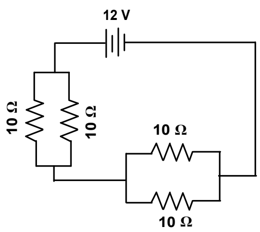
Consider this circuit:

5. What is the equivalent resistance in the circuit?
6. What current will flow through the circuit if the resistors are connected to a 12 V battery?



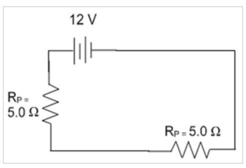
Mixed Example

5. First, solve the two parallel portions of the circuit.



$$R_p = \left(R_1^{-1} + R_2^{-1}\right)^{-1}$$

$$= \left(10\Omega^{-1} + 10\Omega^{-1}\right)^{-1} = 5\Omega$$

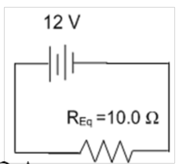


First Reduction

Mixed Example

5. Next, compute the equivalent resistance of the reduced circuit (it is now effectively a series circuit).

$$R_{eq} = 5.0\Omega + 5.0\Omega = 10.0\Omega$$



6. Total current? $V = IR$

$$I = \frac{V}{R} = \frac{12\,V}{10\,\Omega} = 1.2\,A$$

Homework

11.5 Problems.
Due: Next Class.