Name: _____

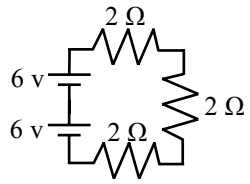
Period: _____

V, R, and I in Series Circuits

Total Voltage (V_T)

If the batteries are in series (in a line) then ***add them together*** to find the total voltage (V_T).

$$V_T = V_1 + V_2 + V_3 + ...$$

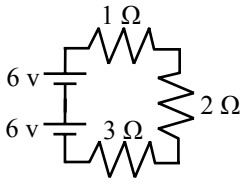


$V_T = 6\text{ v} + 6\text{ v} = 12\text{ v}$

Total Resistance (R_T)

If the resistors are in series then ***add them together*** to find the total resistance (R_T).

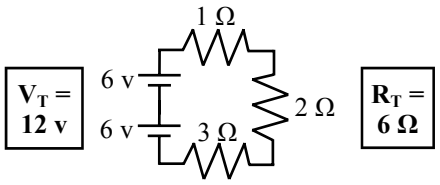
$$R_T = R_1 + R_2 + R_3 + ...$$



$R_T = 1\ \Omega + 2\ \Omega + 3\ \Omega = 6\ \Omega$

Total Current (I_T)

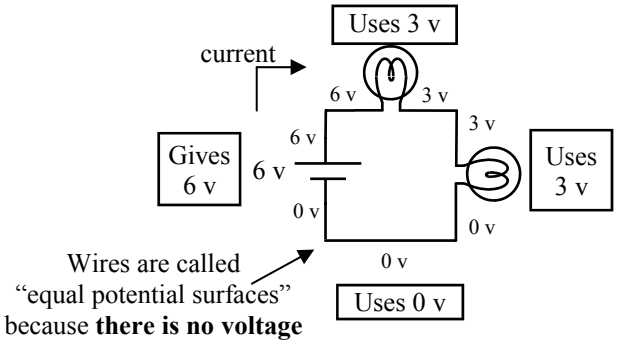
Use Ohm's Law to calculate the total current from V_T and R_T.



$$I = \frac{V}{R} = \frac{12\text{ v}}{6\ \Omega} = 2\text{A}$$

Voltage Drop

Each resistor in a series circuit "uses" part of the energy of the circuit, reducing the voltage. Eventually the voltage is back to zero at the negative side of the battery. Then the battery energizes the electrons again.



Wires are called "equal potential surfaces" because **there is no voltage drop across a wire** (R = 0, so V = 0).

A circuit uses up all the voltage given by the batteries. Batteries give voltage: circuits use voltage. The voltage at the negative end of the batteries is always zero!

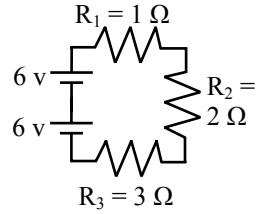
Voltage Across a Resistor

Calculating Voltage over a particular resistor:
1) find the total current;
2) use Ohm's Law for that resistor.

$V_{RX} = I_T R_X$, where R_X is a particular resistor.

$V_1 = I_T R_1 = (2\text{A})(1\Omega) =$ **2 v**

V_T = 12 v
R_T = 6 Ω
I_T = 2 A



$V_3 = I_T R_3 = (2\text{A})(2\Omega) =$ **4 v**

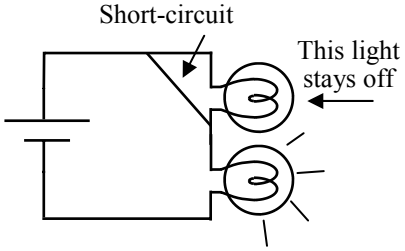
$V_3 = I_T R_3 = (2\text{A})(3\Omega) =$ **6 v**

Notice that each resistor uses up part of the voltage and that all of the individual voltage drops equal V_T.

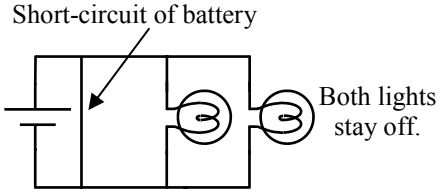
Short Circuits

Electricity always chooses the path of least resistance. Since wires have virtually no resistance, electricity will go thru a wire instead of a device or circuit. This causes a short-circuit.

A short-circuit is when a wire by-passes a device in a circuit.



Short-circuiting a device just by-passes it: it stays off. It is easier for the current to go thru the wire than the light bulb.

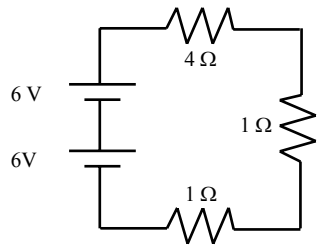


Short-circuiting a battery can be dangerous: it will drain the battery quickly and can lead to a melted wire or even a fire!

Name: _____

Period: _____

Find the following quantities:

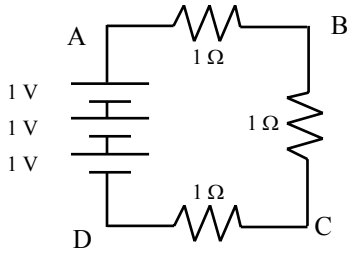


V_T =

R_T =

I_T =

Label the voltages at the letters.



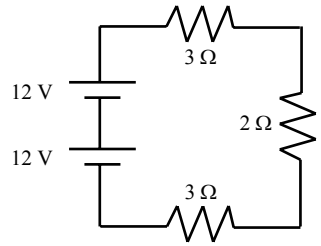
V at A =

V at B =

V at C =

V at D =

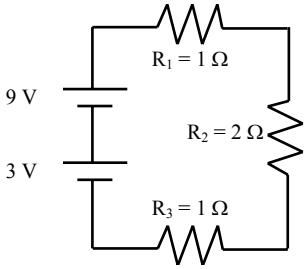
Find the following quantities:



V_T =

R_T =

I_T =



Series or parallel?

V_T = _____

R_T = _____

I_T = _____

V over R_1 = _____

V over R_2 = _____

Draw all circuits.

In the Lab

Circuit 1: battery; light bulb; green resistor; switch.

Notice how bright the light bulb is.

Rank the three resistors from lowest to highest:

Use an ohm meter to check for the actual resistances:

Green: _____ Red: _____; Blue: _____

Circuit 2: battery; light bulb; red resistor; switch.

Compare the brightness of the light bulb to circuit 1.

Which has more resistance the red or green resistor?

Circuit 3: battery; light bulb; blue resistor; switch.

Compare the brightness of the light bulb to circuit 1.

Which has more resistance the blue or red resistor?

Circuit 4: 2 batteries; 2 light bulbs; switch.

CAUTION!

It is important that you are exact in how you do this next step:

Short circuit one of the light bulb (NOT THE BATTERY).

What happens to that light bulb?