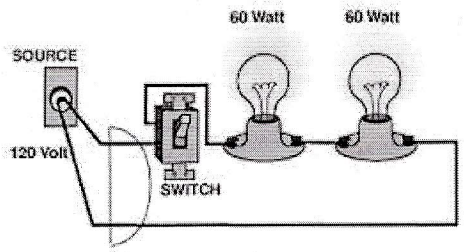
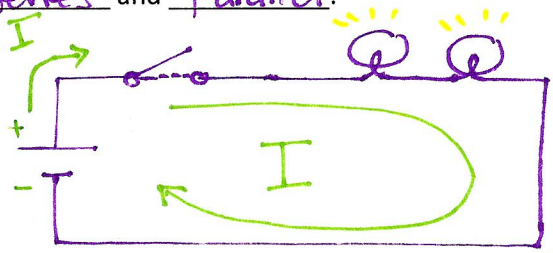
Electricity: Current, Resistance and Power: Ohms Law

Name: _____ Period: _____ Date: _____

Electric Circuit

A circuit is an unbroken loop of conductive material that allows electrons to flow through continuously without beginning or end. There are two types of circuits: Series and Parallel.





The diagram above shows a simple electric circuit. The direction of the conventional current is from the Positive terminal. Schematics are used when drawing or diagramming an electric circuit, and it is important to be able to interpret and draw them fully understand the topic. Here are some of the most frequently reencountered electric devices.

WIRE	LAMP INCANDESCENT
BATTERY	RESISTORS
GROUND	SWITCH
AMMETER	VOLTMETER

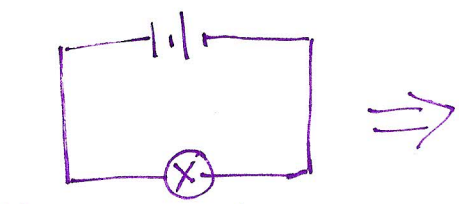
Voltmeters and ammeters are devices used to measure the electrical characteristics of parts of a circuit. The tricky part is wiring them into a circuit so that they don't have much of an effect on the circuit.

Ammeter

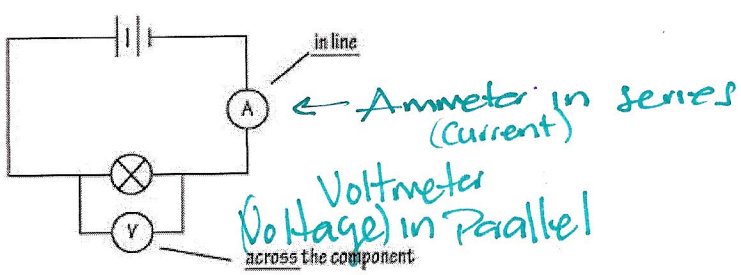
An ammeter is a device that measures the Current, I. It is connected as a "series connection" and it maintains the singular nature of the current.

Voltmeter

A volt meter is a device that measures the potential difference, or Voltage, V between two points. Unlike an ammeter, the voltmeter cannot be placed within a circuit since it would be connected to only one point. It is attached in a "parallel connection", creating a second circuit through which only a small of current flows to operate the voltmeter.

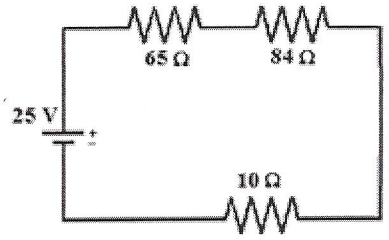


How to connect Ammeter & Voltmeter?



Series circuit

A series circuit consists of two or more resistors sequentially placed within one circuit. Here is an example of a circuit connected in series. Notice how there is only one pathway for the current to flow.



In an electric circuit, adding more resistors in series decreases the current (same with voltage) by increasing the resistance of the circuit.

The following applies in Series Circuit:

In resistors R_1, R_2, and R_3, we have currents I_1, I_2 and I_3. Each of these three currents is equal to each other current and to the circuit current I:

$$I=I_1=I_2=I_3$$

However, the voltage across each resistor is less than the source voltage V. If the 3 resistors in the example were equal, each voltage would be equal to one-third of the total source voltage.

$$V=V_1+V_2+V_3$$

To find the total resistance in the circuit, the resistors are added when connected in series. The total resistance of the circuit increases as the sum of all the resistances. This explains why the current decreases as more resistors are added.

$$R=R_1+R_2+R_3$$

Example: For the circuit shown above, find:

a. Total resistance of the circuit

b. The voltage drop for each resistor

a) Series

STEP 1: Find total resistance in circuit

$R_T=R_1+R_2+R_3$

$R_T=65\Omega+84\Omega+10\Omega$

$R_T=159\Omega$

b) STEP 1: Find current in the circuit

$V=IR$

$I=\frac{V}{R}=\frac{25V}{159}=0.16A$

STEP 2: Find voltage drop for each resista

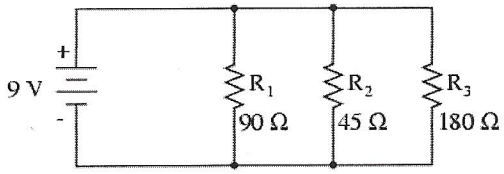
$V_1=IR_1=(0.16A)(65\Omega)=10.4V$

$V_2=IR_2=(0.16A)(84\Omega)=13.44V$

$V_3=IR_3=(0.16A)(10\Omega)=1.6V$

Parallel Circuits

A parallel circuit consists of two or more resistors connected across each other to a common point of potential difference. An example of a parallel circuit is shown below.



In a parallel circuit, a branch point is reached in which the current I is split into I_1, I_2 and I_3. Since each resistor is connected directly to the battery, **each resistor has the same voltage drop. In parallel, the current is shared!**

Another feature of the parallel is the availability of an alternative path. While each branch current is less than the total circuit I, the effect of adding resistors in parallel is to increase the effective circuit current by decreasing the circuit resistance R.

The following applies in Parallel Circuit:

As seen in the example, if we have 3 resistors R_1, R_2 and R_3 with currents I_1, I_2 and I_3, the voltages V_1, V_2 and V_3 would be equal to the source voltage V.

$V=V_1=V_2=V_3$

Ammeters placed in the circuit would reveal that the circuit current I is equal to the sum of the branch currents I_1, I_2 and I_3.

$I=I_1+I_2+I_3$

To find the total resistance in a parallel circuit, we use:

$$\frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$$

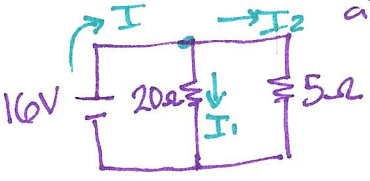
The total resistance is determined reciprocally, which in effect reduces the total resistance of the circuit as more resistors are added in parallel. For Example, if $R_1=10\Omega$ and $R_2=10\Omega$, the total resistance would be $R=5\Omega$ (in parallel).

Example 2: A 20Ω resistor and a 5Ω resistor are connected in parallel. If a 16V battery is used, calculate:

a. The equivalent resistance of the circuit

b. Current of the circuit

c. Current flowing through each resistor



a) To find equivalent resistance

$\frac{1}{R_T}=\frac{1}{20}+\frac{1}{5}$

$\frac{1}{R_T}=\frac{1+4}{20}$

$\frac{1}{R_T}=\frac{5}{20}$

$R_T=\frac{20}{5}=4\Omega$

b) To find current in circuit

OHM'S LAW

$V=IR$

$I=\frac{V}{R_T}=\frac{16V}{4\Omega}=4A$

c) To find current in each resister

$I=\frac{V}{R_1}=\frac{16V}{20\Omega}=0.8A$

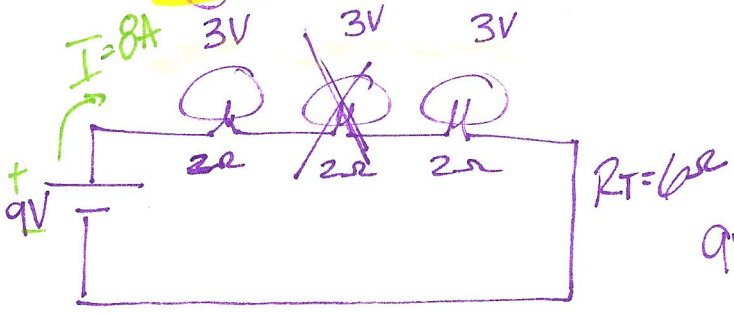
+

$I=\frac{V}{R_2}=\frac{16V}{5\Omega}=3.2A$

$4A$

CIRCUITS

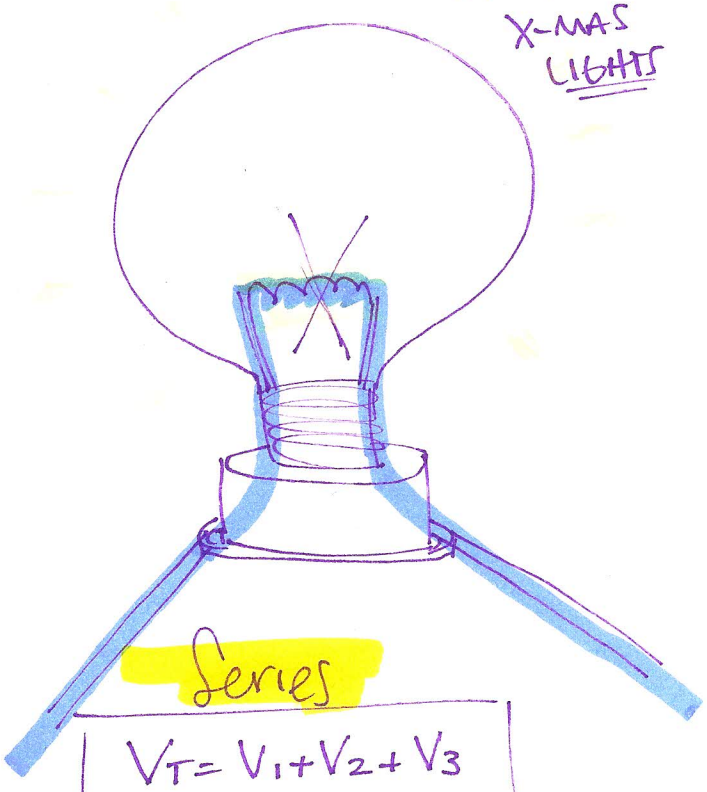
Series



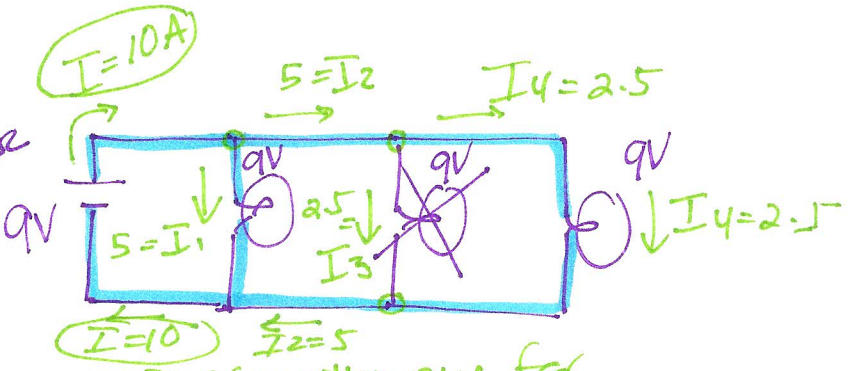
1 pathway for current to flow

- If 1 doesn't work, none will work

Example: X-MAS LIGHTS



Parallel



- Diff pathways for current to flow
- If 1 doesn't work, the rest STILL WORK

Parallel

$$V_T = V_1 = V_2 = V_3$$

$$I_T = I_1 + I_2 + I_3$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Series

$$V_T = V_1 + V_2 + V_3$$

$$I_T = I_1 = I_2 = I_3$$

$$R_T = R_1 + R_2 + R_3$$