Circuits

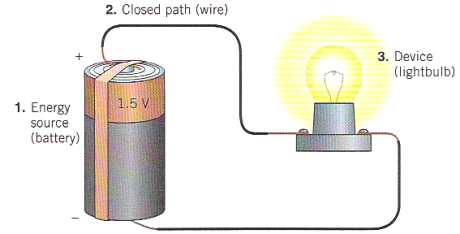
All electric circuits have three main parts

1.

2.

3.

If ANY part of the circuit is open, the device will not \_\_\_\_\_\_\_\_\_\_



Voltage: a \_\_\_\_\_\_\_ that pushes the current through the circuit.

Voltage is sometimes called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

In a battery, a series of chemical reactions occur in which electrons are transferred from one terminal to another. There is a \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_\_\_\_\_\_\_\_\_\_\_) between these terminals.

Voltage is measured in \_\_\_\_\_\_\_\_\_\_\_

Current: The actual \_\_\_\_\_\_\_\_\_\_\_\_ that is flowing through the wires of the circuit (\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

Current is defined as the rate at which \_\_\_\_\_\_\_\_\_ flows through a surface

Units are \_\_\_\_\_\_\_\_\_\_\_

Resistance: \_\_\_\_\_\_\_\_\_\_\_ that \_\_\_\_\_\_\_\_\_ the flow of current through the circuit

Resistance is provided by something that uses \_\_\_\_\_\_\_\_\_ in a circuit (a lightbulb)

Units of resistance are \_\_\_\_\_\_\_\_\_\_\_\_

Resistance is based on three things. Think of it like a \_\_\_\_\_\_\_\_.....

The \_\_\_\_\_\_\_\_\_ the wire is, the more resistance it has.

The \_\_\_\_\_\_\_\_\_ the cross sectional area, the \_\_\_\_\_\_ resistance it has.

\_\_\_\_\_\_\_\_\_\_\_\_ is a property of the material the wire is made out of. (ρ)

Ex.

How much would resistance change if a wire was used with ½ the length and ½ the radius of another wire?

These three quantities are related using   
Ohm’s Law:

Power

Power is the \_\_\_\_\_\_\_\_\_\_\_ of doing \_\_\_\_\_\_\_\_\_\_\_\_. This is the same as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Energy is \_\_\_\_\_\_\_\_\_\_\_\_\_\_, current is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, therefore power = \_\_\_\_\_\_\_\_\_\_\_\_ \* \_\_\_\_\_\_\_\_\_\_\_\_\_

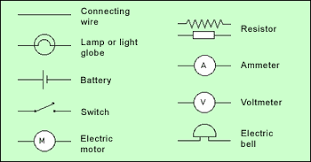
From the definition of power and Ohm’s Law we can come up with formulas for power.

Units are \_\_\_\_\_\_\_\_

Example: An electric heater emits 100 W when connected to a 120 V power line. What is the resistance in the heater?

Example: An electric fan has a resistance of 12 Ω and requires 0.75 A of current to function properly. What voltage is required to operate the fan?

Symbols you will see on circuit diagrams…….



There are **two** ways that we can attach devices to a circuit.

**(1) Series:** only \_\_\_\_\_ path for current to flow. Therefore current flows through \_\_\_\_\_\_\_ device. If one device burns out, current \_\_\_\_\_\_\_\_\_\_ flow and no devices receive current.

Adding devices in series \_\_\_\_\_\_\_\_\_\_\_\_ total resistance.

Ex. Draw a circuit with a battery connected to two resistors in series.

Since all resistors are part of the same loop, they each experience the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of current.

As current goes through the circuit, the charges must use energy to get through the resistors. All the resistors exist \_\_\_\_\_\_\_\_\_ the terminals of the battery which means they \_\_\_\_\_\_\_\_\_ the potential (voltage). As current moves through each resistor the voltage will drop.

Note: The terms “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” or “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” may be used to mean total.

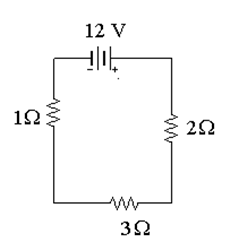
Example:

What is the total resistance?

What is the total current?

What is the current through each resistor?

What is the voltage drop across each resistor?



**(2) Parallel:** \_\_\_\_\_\_\_\_\_\_ pathways for current to flow. If one device burns out, the others will \_\_\_\_\_\_\_ receive current.

Adding devices in parallel \_\_\_\_\_\_\_\_\_\_\_\_ total resistance.

Ex. Draw a circuit with a battery connected with two resistors in parallel.

In a parallel circuit, there are multiple loops. So the current \_\_\_\_\_\_\_\_ up among the loops with individual loops \_\_\_\_\_\_\_\_\_\_ to the total current.

Parallel circuits will all have some position where the current splits and comes back together. We call these \_\_\_\_\_\_\_\_\_\_\_\_. The current going \_\_\_\_ to a junction will always equal the current going \_\_\_\_\_ of a junction. This is true or else electrons will build up at points, which is impossible because they repel each other.

Notice that the JUNCTIONS touch both the POSTIVE and NEGATIVE terminals of the battery. That means they have the \_\_\_\_\_\_\_\_ potential difference down EACH individual branch of the parallel circuit. This means that the individual voltages drops are \_\_\_\_\_\_\_\_\_\_\_

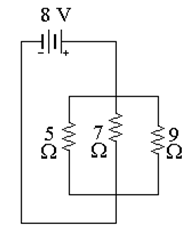
Example:

What is the total resistance?

What is the total current?

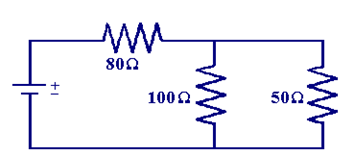
What is the voltage across each resistor?

What is the current drop across each resistor?

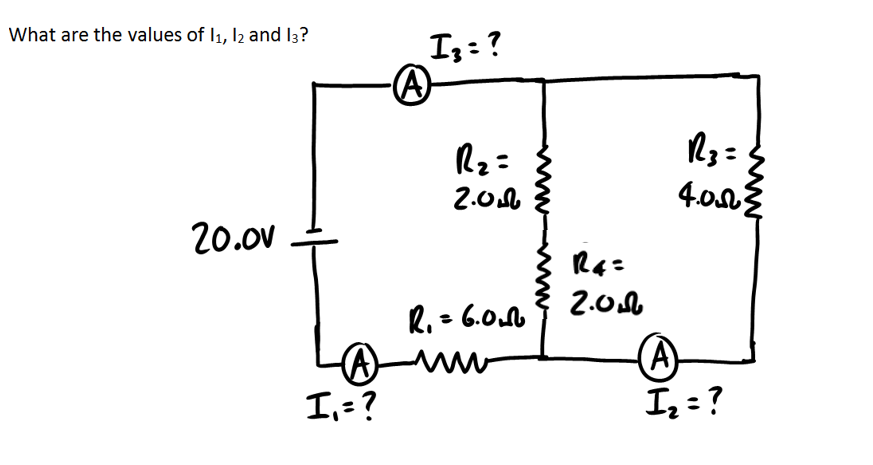


Let’s recap:

|  |  |  |
| --- | --- | --- |
| Value | Series | Parallel |
|  |  |  |
|  |  |  |
|  |  |  |

Example: Compound (Complex) circuit

12 V



Measuring Voltage and Current

We measure the voltage in a circuit using a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the current in a circuit using a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

You want them to \_\_\_\_\_\_\_\_\_\_\_\_ without \_\_\_\_\_\_\_\_\_\_\_\_\_ the circuit

We need to connect these two devices in different ways.

A \_\_\_\_\_\_\_\_\_\_\_must be connected in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This is because a voltmeter measures the voltage drop \_\_\_\_\_\_\_\_\_\_\_\_\_\_ a device. This way you can measure the change on either side of the device.

A voltmeter must have a very \_\_\_\_\_\_\_\_ resistance. That way when current comes to the junction, almost \_\_\_\_\_\_ of it will flow through the voltmeter and it will measure the voltage without affecting the circuit.

An \_\_\_\_\_\_\_\_\_\_\_\_ must be connected in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This is because an ammeter measures the current \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a circuit.

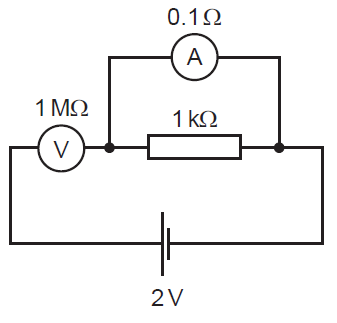
An ammeter must have very **\_\_\_\_\_\_\_\_** resistance, therefore when current flows through it, it will not be impeded and the ammeter can measure without affecting the circuit

Example:

Example

What would happen if a voltmeter was connected in series?

What would happen if an ammeter was connected in parallel?



Example: Brightness of a lightbulb

A lightbulb is rated at 100W in the US, where the standard wall outlet is 120 V. If this bulb were plugged in in Europe, where the standard wall outlet is 240V, how much brighter would it be?