Cheatography

Electricity Cheat Sheet

by Phoebe Zhang (Phoebe12) via cheatography.com/30133/cs/15749/

Flow of Electrons

Electrons flow from the negative (-) terminal to the positive (+) terminal of a cell (e.g. a battery) Conventional current is positive charge flowing from the positive (+) terminal to the negative (-) terminal]

Current

It measures electron movement through space and time.

Current = how much charge (coulombs, [packets of electrons]) passes through a point in a circuit in an amount of time.

This is also known as the rate of flow through an electric circuit, like a heart rate (beats per minute).

As electrons 'enter' a component in the circuit, the same number of electrons 'leave' the component

Ammeters

In a circuit, an ammeter must be connected in series. We do this because we want to know what rate the electrons (coulombs) are moving through that point in the circuit.

To connect an ammeter correctly, you need to break the circuit (stop flow, not smash-break).

Red (+) and black (-) terminals

Ammeters have almost no resistance, allowing as much current to pass through as possible for an accurate reading without disturbing the current too much.

There are different scales to read.

Resistance

Resistance is measured in Ohms.

As conductors allow electricity to flow through a circuit, and insulators do not, resistance is circuit components slowing down or making it harder for electrical current to flow through a circuit.

Each circuit component has some resistance, slowing down the current slightly. Sometimes an actual component called a resistor is added and it will have a number of ohms. That number will mean how difficult or easy it is for the current to flow through.

A thin wire will have more resistance than a thick wire.

We know that a voltmeter would slow down the current altogether, and an ammeter would slow it down VERY slightly, an almost insignificant amount.

Voltmeters need to withstand stored energy (to measure how much energy is going in and coming out of a component such as a light globe). So, they are stronger than ammeters and resist the current a lot more while an ammeter just wouldn't be able to handle much at all. Re-read the slide on ammeters if this makes no sense.

Calculating current

The size of an electric current shows the rate of flow of electric charge. You can calculate the size of a current using this equation:

current in amps =	charge in coulombs
	time in seconds

Glossary

Load:

Converts electrical energy into another form e.g. light globe produces heat and light

Direction:

Glossary (cont)

Electrons move from negative to positive end of a power source (i.e. repelled and attracted)

Current:

Rate of flow of electrons (i.e. number of coulombs of electrons passing a point in a circuit per second)

Voltage:

Energy electrons gain from a power source and lose as they move around an electrical circuit

Notes:

1 Coulomb (Q)/1 second (s) =	1 Amp (A)
1 Joule (J)/1 Coulomb (Q) =	1 Volt (V)

Measuring and Calculating Current

Measured by an ammeter, in amperes, or amps for short.

I = Current in Amperes

Q = Quantity of Charge in coulombs

t = time in seconds

I = Q(c)/t (s)

For mA to A: Simply divide mA by 1000.

Eg: 450 mA = 0.45A

For A to mA: Simply multiply A by 1000.

Eg: 0.45A x 1000 = 450mA or move 3 decimal points to the left.

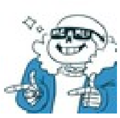
Example: If 5 coulombs of charge pass point X in 2 seconds, what is the current?

Resistance

The measure of the difficulty of passing an electrical current through a conductor.

Different parts of the circuit (wires, globes, resistors, etc.) have different levels of resistance.

Calculate the reciprocal of the total resistance in parallel circuits by adding their **reciprocals**.



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Summary

Assuming all globes have the same resistance: in a series circuit, the current is the same at every point because it flows in one loop around from one battery terminal back to the other battery terminal. The globes should light up at the same brightness.

In a parallel circuit, the current splits as it turns at each junction, or corner. It divides and is shared among all components. The globes should also light up equally.

Ohm’s Law

Ohm’s law shows us that there is a relationship between current, voltage and resistance.

Current is proportional to Voltage –More voltage = more current flowing through.

Current is disproportionate to Resistance – More resistance = less current flowing through.

The equation for finding out the Voltage, Current and Resistance is I = V/R, or V=IR. That is, Voltage equals Current x Resistance.

Calculating energy transferred

Work out the energy transferred using this equation:

energy = current x voltage x time

E = I × V × t where:

E is the energy transferred in joules, J

I is the current in amperes, A

V is the potential differences in volts, V

t is the time in seconds, s

Charge is current multiplied by time so this equation can also be written as:

E = V × Q where:

E is the energy transferred in joules, J

V is the potential difference in volts, V

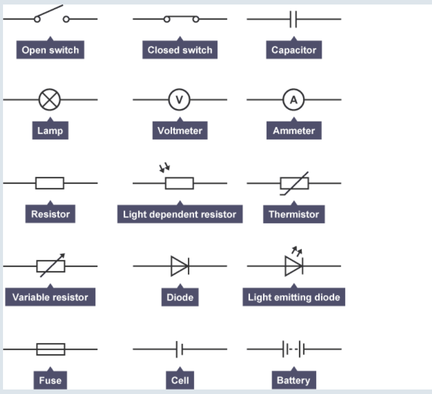
Q is the charge in coulombs, C

Resistors

Resistors can be used to protect other components (such as an LED) from damage by too much current.

Resistance is also useful in things like transistor radios and TV sets.

Symbols



Voltage

Definition: a measure of how much energy electrons gain from a power source or lose as it moves around a circuit through a load

The power source (eg: a battery) provides the electrons with the energy that is stored inside the power source.

energy gained = energy “lost”. The energy is used in the load component (eg. Filament inside the globe).

The power supply and load should match in volts.

Voltage is measured in volts (V)

The number of volts is equal to how much energy per coulomb (packet of electrons) is taken through the circuit from the power supply to the components for use.

Equation is V =	energy (j)
	electrons (c)

Watch batteries, AA and AAA batteries are usually 1.5V

Voltmeters

You attach a voltmeter to find out how much energy (the doughnuts represent energy in the earlier animation) goes into a component and out the other.

You attach the voltmeter parallel to the component you are testing and not in series. This means you do not need to break the circuit to measure volts.

Voltmeters are designed so that they do not significantly affect the amount of the current passing through the circuit component.

Voltmeters have a lot of resistance. If you connected it in series, it would probably stop the current from going through which isn’t useful or fun.

Series and Parallel

The components in electrical circuits can be connected in series or in parallel.

Components that are connected one after another on the same loop of the circuit are connected in series. The current that flows through each component connected in series is the same.

The sum of all the potential differences across the components in a series circuit is equal to the total potential difference across the power supply.

Components that are connected on separate loops are connected in parallel. The current is shared between each component connected in parallel. The total amount of current flowing into the junction, or split, is equal to the total current flowing out. The current is described as being conserved.

For a parallel circuit the current from the electrical supply is greater than the current in each branch. The sum of all the current in every branch is equal to the current from the electrical supply.

Potential energy = voltage.

Simple Circuits & Symbols

Every circuit must have:
1. Power supply e.g. a battery
2. Load/s: that converts electrical energy into another form of energy e.g. light bulb
3. Conducting path e.g. connecting wires

Series vs Parallel

	Series	Parallel
Arrangement	A single path – components joined side by side	Separate paths – 1 (or more) component in each branch
Current	SAME for every component	DIVIDES and SHARED among all components
Voltage	SHARED amongst every component	SAME for every component
Advantage	Adding more power devices increases voltage	Break in circuit won’t affect other components
Disadvantage	Break in circuit affects all other components	Breaks in circuits can go undetected