Electric circuits

“An electric circuit is a closed-loop or continuous pathway that allows electric current to flow from a voltage source, through various electrical components, and back to the source. The uninterrupted flow of electric charge creates a complete circuit, enabling the components within the circuit to perform their intended functions. There are several fundamental components that make up an electric circuit: a voltage source, a conducting path, a switch, a load and other electrical components, Figure 1.

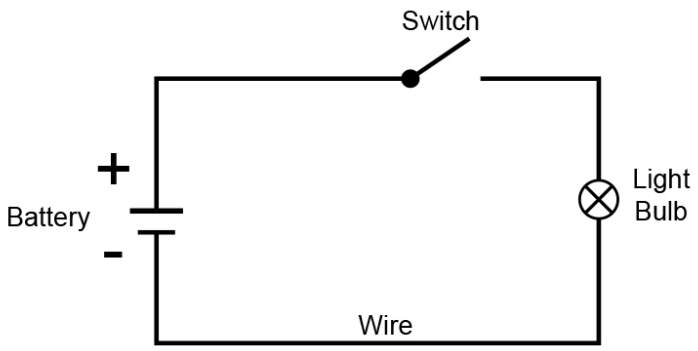


Figure 1: Simple electrical circuit

The voltage source, such as a battery or a power supply, provides the electrical energy required for the circuit to function. It creates an electric potential difference across the circuit, which drives the flow of electric current. The electrical current flows through conductors (usually wires) made of materials with low electrical resistance like copper. Switches are used to control the flow of electric current within the circuit, allowing it to be turned on or off as needed. A load is a device or component that consumes electrical energy within the circuit, converting it into another form of energy, such as light, heat, or motion. Electric lamps, air conditioners, motors are examples of loads.

There are various types of electric circuits including open circuit, closed circuit, short circuit, series circuit and parallel circuit. An open circuit has a physical break in the conduction path where current drops to zero and resistance becomes infinite. In contrary, in closed circuits the path is not broken that is there is a continuity in the connection. In a short circuit an unintentional low resistance connection between two or more points in a circuit occurs. Since current increases as the resistance drops (given by Ohm's law), this will result in a large amount of current flowing through the "short." This higher current, if it is greater than the wire gauge can safely handle, has the potential to burn the current path due to high temperatures, and could cause a fire.

In a series circuit, components are connected end-to-end in a single path, so the current flows through each component in turn. If one component fails, the entire circuit stops working. On the other hand, in a parallel circuit, components are connected in multiple paths, allowing the current to flow through more than one path simultaneously. If one component fails, the other paths can still function.

Passive components, including resistors, inductors, and capacitors, play essential roles in circuits, influencing current flow, storing energy, and affecting electrical system behavior. Passive means the component's behavior changes little with voltage or current fluctuations. Other components, known as actives, have a non-linear reaction to voltage and current. Diodes, transistors, and thermionic valves are examples of active components.

The resistor is a passive electrical component that creates resistance in the flow of electric current. In almost all electrical networks and electronic circuits resistors can be found. The resistance is measured in ohms (Ω). An ohm is the resistance that occurs when a current of one ampere (A) passes through a resistor with a one volt (V) drop across its terminals. Resistors are used for many purposes. A few examples include limiting electric current, voltage division and heat generation.

The Capacitor is a passive two-terminal device which can store energy. Capacitor stores energy in its electric field. Structurally, a capacitor consists of a pair of conducting plates separated by a layer of insulator (or dielectric). The plates maybe made of aluminum foil while the dielectric maybe air, ceramic, paper, mica. Capacitors with different physical characteristics store different amounts of charge for the same applied voltage V across their plates. The capacitance C, measured in farads (F), of a capacitor is defined as the ratio of the maximum charge Q that can be stored in a capacitor to the applied voltage V across its plates. Capacitors have applications ranging from filtering static from radio reception to energy storage in heart defibrillators.

An inductor is a passive component that is used in most power electronic circuits to store energy in the form of magnetic energy when electricity is applied to it. It consists of two terminals and an insulated wire coil that either loops around air or surrounds a core material that enhances the magnetic field. One of the key properties of an inductor is that it impedes or opposes any change in the amount of current flowing through it. Whenever the current across the inductor changes, it either acquires charge or loses the charge in order to equalize the current passing through it. An inductor is described by its distinctive nature of inductance L, which is measured in henry (H) and defined as the ratio of the voltage to the rate of change of current. Inductance is a result of the induced magnetic field on the coil."

Part 1: Text comprehension

Exercise 1: Find words in the text corresponding to the definitions below.

1. A conductive path over which an electric charge may flow.
2. The movement of electrons in a conductor measured in Amperes.
3. An equation explaining the relationship between current, voltage, and resistance.
4. A condition where the current flow through a conductor is interrupted by a missing or damaged component.
5. A passive electrical component that opposes sudden changes in current.
6. Device for making, breaking, or changing the connections in an electric current.

7. A measure of the opposition to current flow in an electrical circuit.
8. A condition in an electrical circuit where the electrical current flows through an unintended, shorter pathway instead of following the circuit.
9. A circuit that has two or more paths for current to flow through.
10. The ability of a component or circuit to collect and store energy in the form of an electrical charge.
11. The pressure from an electrical circuit's power source that pushes charged electrons (current) through a conducting loop.
12. An electrical component of a circuit that consumes electric power.
13. An electrical component that limits or regulates the flow of electrical current in an electronic circuit.
14. A circuit in which all circuit elements are arranged in a single path.
15. The ability to store energy in the form of a magnetic field.
16. A two-terminal electrical device that can store energy in the form of an electric charge.

Exercise 2: Find in the text words that are closest in meaning to the following.

Numerous:	Continuous:
Act:	Essential:
Obtain:	Unique:

Exercise 3: Find in the text words that are opposite in meaning to the following.

Active:	Unimportant:
Stability:	Supports:
Accidental:	Produce:

Exercise 4: Find what the underlined pronouns in the following sentences refer to.

1. Switches are used to control the flow of electric current within the circuit, allowing <u>it</u> to be turned on or off as needed.
2. A load is a device or component that consumes electrical energy within the circuit, converting <u>it</u> into another form of energy.
3. Whenever the current across the inductor changes, <u>it</u> either acquires charge or loses the charge in order to equalize the current passing through it.

Exercise 5: State whether the following statements are true or false and quote from the text to justify your answer.

1. Electric load is an electrical component that converts electrical energy into heat only.

2. The location of a break in a circuit is irrelevant to its inability to sustain continuous charge flow.

3. An electric circuit that allows a current to travel along an unexpected path is known as a complex circuit.

4. The resistance of an electric circuit is a measure of the overall amount of hindrance to the flow of charge through the circuit.

5. Parallel circuits are characterized by the fact that there are multiple pathways by which charge can travel from the + terminal to the - terminal.

6. A conductor is a substance that electric current hardly passes through.

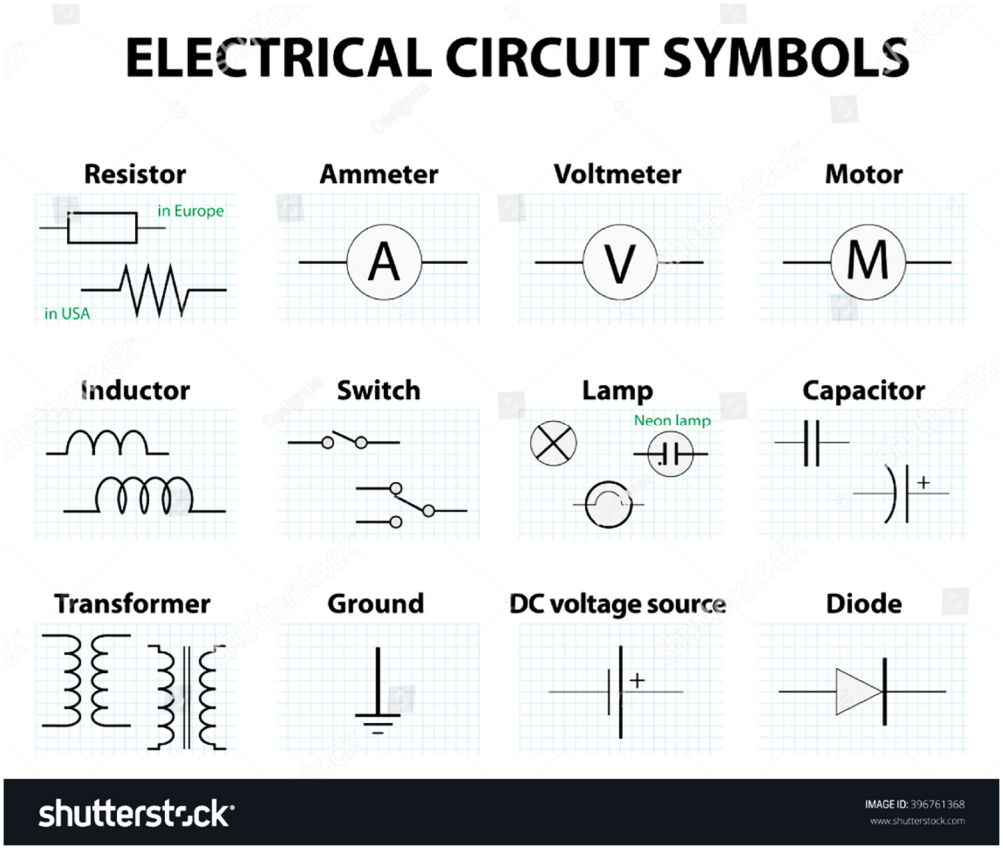
7. Capacitors can be used to filter unwanted electronic noise.

Exercise 6: Respond to the following:

- Why are lamps in a household circuit connected in parallel?

- Based on the information provided in text write the equations of resistance and capacitance.

- Based on the information provided in text and the electrical circuits symbols below draw the following:
  (a) Open circuit (b) closed circuit and (c) short circuit each consisting of a battery and a lamp.
  (d) A circuit consisting of a battery connected in series with resistor 1 and in parallel with resistor 2 and resistor 3, respectively.
  (e) A circuit consisting of a battery in series with a resistor, capacitor and inductor.


ELECTRICAL CIRCUIT SYMBOLS
Resistor
in Europe
in USA
Ammeter
A
Voltmeter
V
Motor
M
Inductor
Switch
Lamp
Neon lamp
Capacitor
Transformer
Ground
DC voltage source
Diode
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