Topics: Electrical quantities, Ohms law, simple DC circuit, Power, Meters

Electrical Quantity	**DC symbol**	**AC symbol**	**SI Unit**
Charge	Q	***q(t)***	Coulomb (C)
Current	I	***i(t)***	Ampere (A)
Voltage	**V**	***v(t)***	Volt (V)
Resistance	**R**	R	Ohm (Ω)
Power	**P**	P	Watt (W)

Charge:

Electrical charge is a fundamental property of a body, like its mass.
Smallest isolated charge is charge of electron (-) or proton(+),

1 Coulomb equivalent to charge on 6.25×10^{18} electrons

$$F \propto \frac{q_1 q_2}{r^2}$$

$$\text{proportionality constant} = \frac{1}{4\pi \in_0}$$

$\in_0 = 8.8542 \times 10^{-19} \text{C}^2 / \text{N} \cdot \text{m}^2$ permittivity of free space

Current:

Amount of charge passing through a given area per unit time
i.e. time rate of change of charge at a point,
1 Amp = 1 C/s

mA (milliamp)	10^{-3} Amps
μA (microamp)	10^{-6} Amps
nA (nanoamp)	10^{-9} Amps
pA (picoamp)	10^{-12} Amps

Current direction given by direction of motion of *positive* charges

(in metals and semiconductors the charge carriers are, in fact, electrons
so direction of charge carriers is not the direction of current)

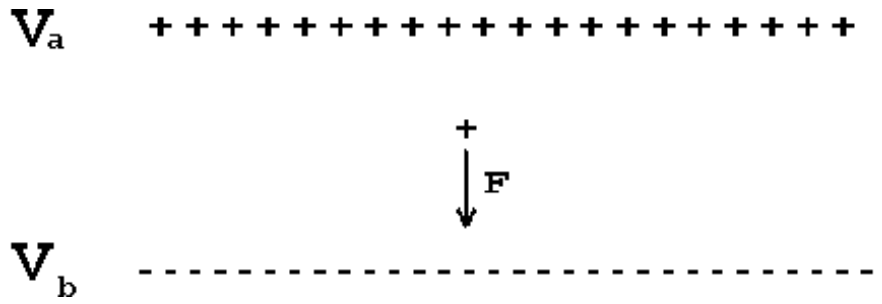
Potential Difference (Voltage or Voltage Drop):

Electrical forces introduce differences in potential energy for charged bodies at different positions

The difference in potential energy for a unit charge is the POTENTIAL DIFFERENCE

SI unit for energy is Joule = Newton-metre, SI unit for potential difference is VOLT

1 Volt = 1 Joule/Coulomb



Voltage is always a measure of difference in potentials:
there is no absolute voltage, only voltage differences, usually referenced to
eg potential of earth (ground)

$$V_{ab} = V_a - V_b$$

Resistance:

electrons moving in materials produce current (conduction electrons) but electrons collide with the atomic lattice of the material. The average distance between collisions in the material is characterized by a bulk property of the material known as ***resistivity (ρ)*** .

A material of length L and cross sectional area A has resistance:

$$R = \rho L / A$$

SI unit: Ohm (Ω)

eg 0.032 inch diameter copper wire has resistance of 11.3 Ω/1000 feet.

(i.e. 20 gauge copper wire has resistance of 0.34 mΩ / m)