PHYS2

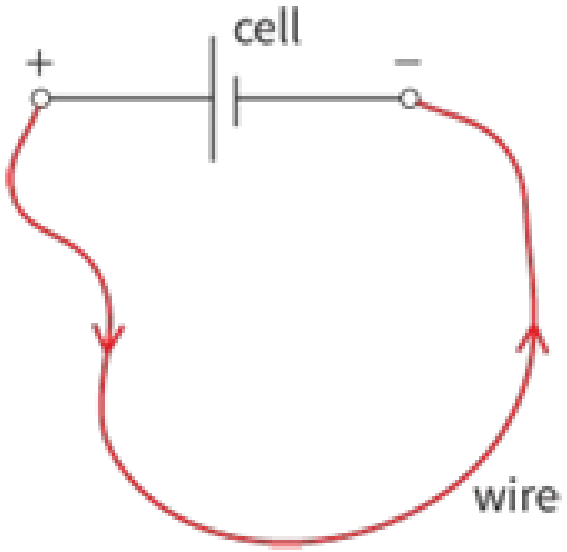
Electric Current

Electric Current

Electric Current

- is the rate of flow of electrons in a conductor. Represented by unit Amperes (Amp).

$$I = \frac{\Delta Q}{\Delta t}$$



Where:

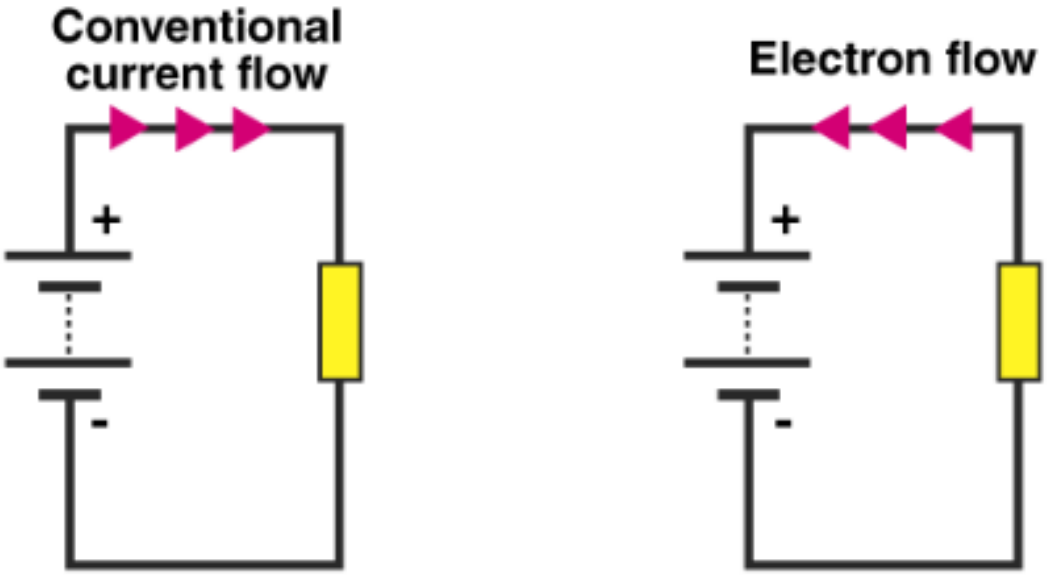
I = current, A (amperes)

Q = charge, C (Coulombs)

t = time

Electric Current

Current Flow vs Electron Flow



Current Flow – positive to negative

Electron Flow – negative to positive

Electric Current

Electric Charge

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Where:

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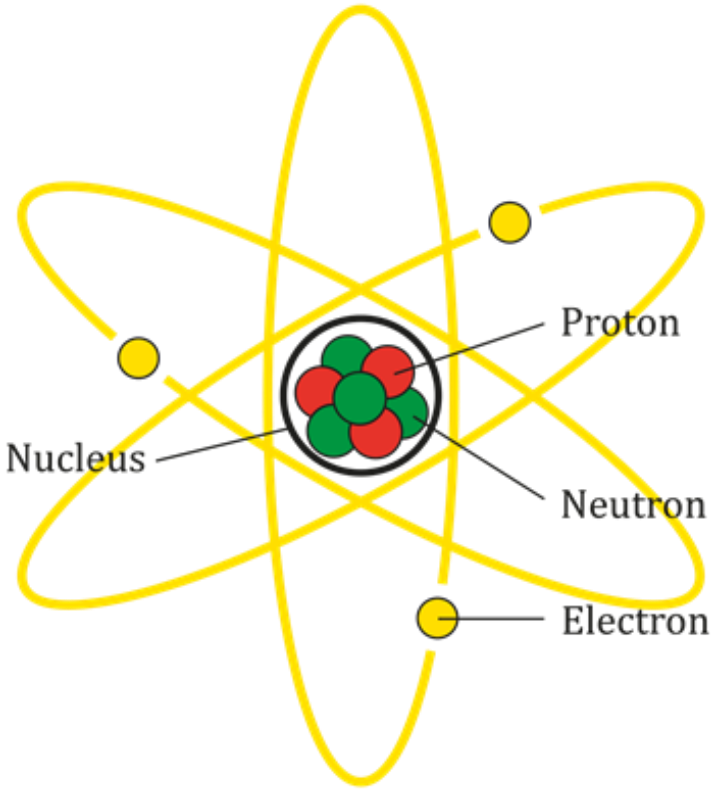
Q = charge, C (Coulombs)

t = time

Electric Current

Charged Particles

An electric current is a flow of charge due to the passage of charged particles.



Electric Current

Charged Particles

Protons = positively charged (e^+)

= 1.6×10^{-19} coulombs

Electrons = negatively charged (e^-)

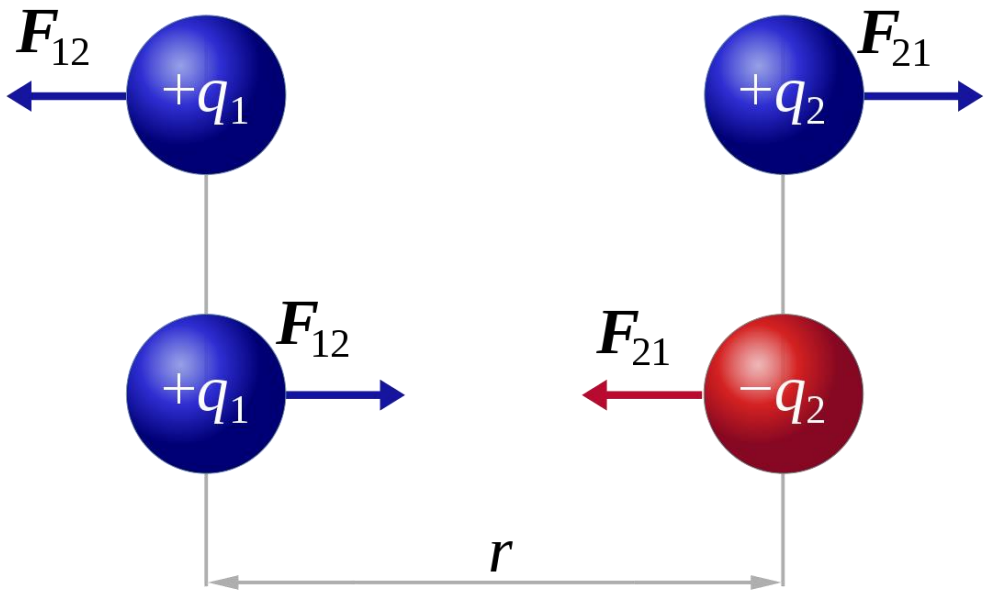
= -1.6×10^{-19} coulombs

Neutrons = neutrally charged

*charge is quantized, which means it is only found in whole number multiples of 1.6×10^{-19} coulombs

Electric Current

Coulomb's Law is the force between two charged bodies. The charges and distance between the charged bodies are the factors the determine the power and influence of the force.



Electric Current

$$F = \frac{k\ q_1\ q_2}{r^2}$$

Where:

F = electric force , N

k = proportionality constant = 9 x 10^9 $\frac{N\ -m^2}{C^2}$

$= \frac{1}{4\ \pi\ \boldsymbol{\varepsilon o}}$; $\boldsymbol{\varepsilon_o}$ = permittivity of free space

$= 8.85 \times 10^{-12}\ \frac{C^2}{N\ -m^2}$

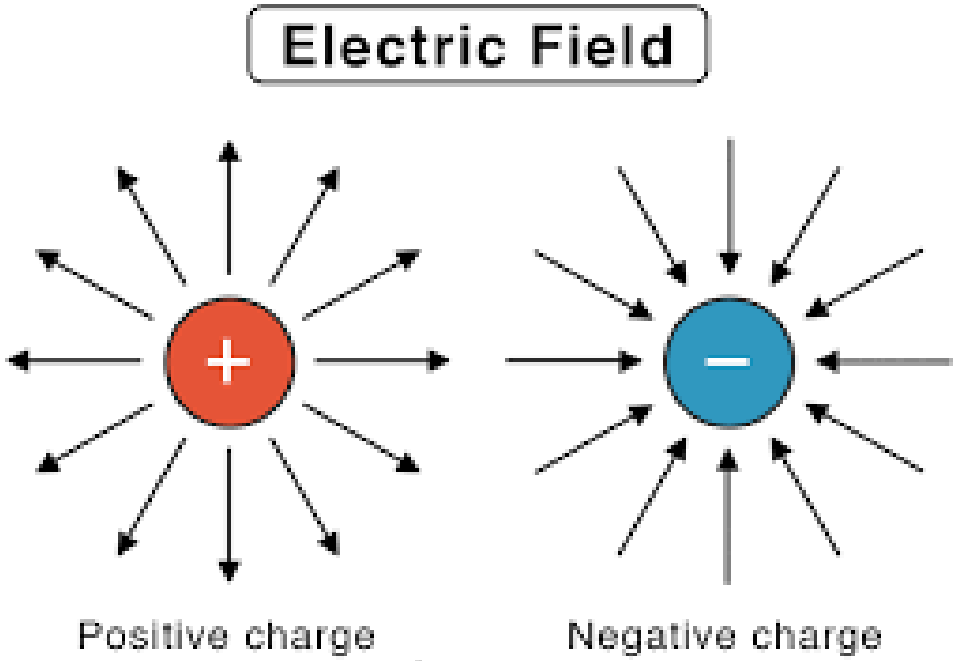
q_1/q_2 = charges, C (Coulombs)

r = distance between charged bodies

Electric Current

Electric Field

- is a vector field that can be associated with each point in space, the force per unit charge exerted on a positive test charge at rest at that point.



Electric Current

Electric Field

- is a vector field that can be associated with each point in space, the force per unit charge exerted on a positive test charge at rest at that point.

$$E = \frac{F}{q}$$

Where:

E = electric field, newton per coulomb

F = electric force, newton

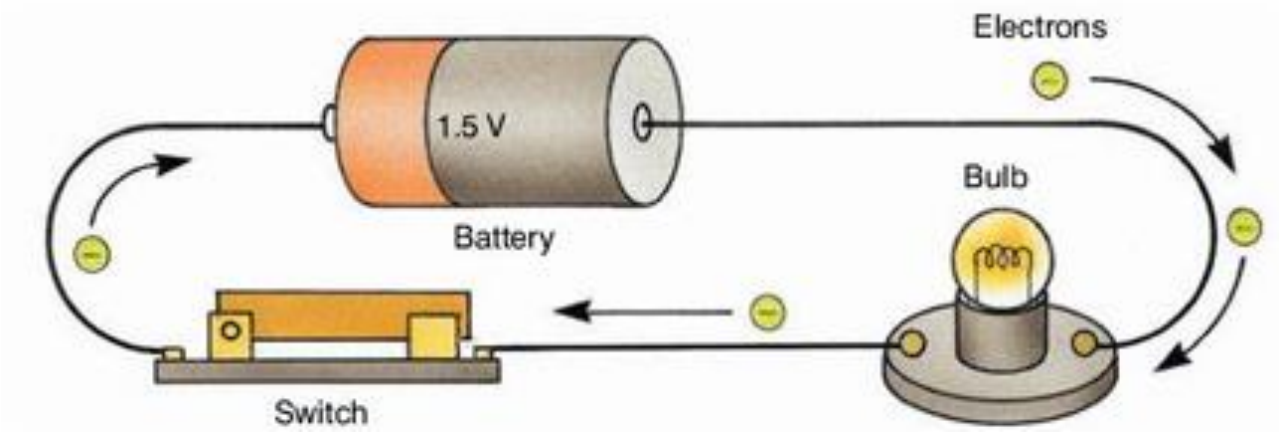
q = charge, coulombs

Electric Current

Electric Potential Difference

- is defined as the work done (energy transfer) per unit charge.

- the term is used when charges lose energy by transferring electrical energy to other form of energy. Potential Difference , Volt (V), is defined as the energy transfer per unit charge.



Electric Current

Electric Potential Difference

Potential Difference = $\frac{energy\ transferred}{charge} = V = \frac{\Delta W}{\Delta Q}$

Where;

Potential Difference, Volts

W = work done (energy transferred), Joules

Q(q) = electric charge, coulombs

Sample problem

1. A battery is capable of delivering a current of 0.2 A for 4000 seconds before its voltage drops. Determine (a)the total charge the battery can deliver? (b) maximum time it could be used if the running current through is 0.5 A
2. Calculate the number of electrons passing a point in a wire in 60 seconds when the running current is 1mA?
3. A 10μC point charge is 25cm away from a -20μC point charge. Determine the magnitude and direction of the electric force between them.
4. How many electrons represent a charge of -70μC?

5. The electric force between two point charges with magnitude of 800μC and 900μC is 15 newtons. How far apart are the two charges from each other in centimeters.

6. A force of 500 newtons exists between two identical charge point separated by a distance of 40 meters. Calculate the charges of the two points.

7. If the potential difference across a component in a circuit is 12V and a charge of 3C passing through the component. What would be the energy transfer from the battery to the component?

8. 100 J of work was done by an electric field on a 5C to accelerate it from point A to B. (a) determine the voltage across point A and B. (b) if the electric potential at point A is 50V, what is the electric potential at point B?