

5.1.1 Electrical Current and Charge

An electric current (I) is the rate of flow of charge (Q), or the amount of charge that flows per second.

Mathematically:

$$I = \frac{\Delta Q}{\Delta t} \quad \text{where } t \text{ is time}$$

The unit for charge is the coulomb (C), and the unit for current is the ampere (A).

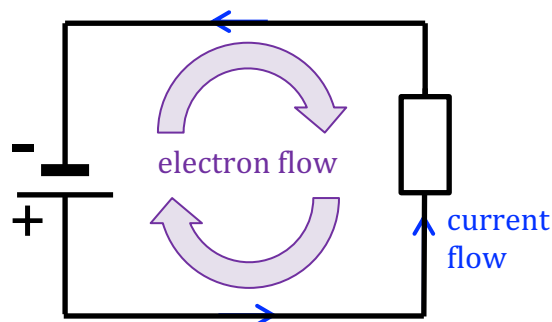
(1) *How is the ampere related to the coulomb?*

Electric charge is either positive or negative. Protons in the nuclei of atoms carry a positive charge and electrons carry a negative charge.

(2) *What is the charge on one proton?*

(3) *What is the charge on one electron?*

In electric circuits, it is the electrons that flow. They flow when there is a potential difference (voltage) applied and there is a complete circuit of conducting material.



Most metals are good conductors because they have loosely bound outer electrons which can move freely through the metal.

Because electrons are negatively charged they will move from the negative terminal of a power supply to the positive terminal, through the connecting circuit. This is the direction of 'electron flow'.


Historically, electric current was defined as the rate of flow of positive charge. This means that 'electric current' flows from the positive terminal to the negative terminal (the opposite direction to electron flow!). Don't panic about this. It is just a matter of definition.




videos

Have a play with the following simulation:
<https://tinyurl.com/hqg6r4n>


Watch the following video clip:
<https://tinyurl.com/zfjqavg>


(4)  What factors affect the current?


(5)  How does increasing/decreasing these factors affect the current?


Let's take a look at the equation for current:

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

(6)  Rearrange this formula to find a formula that gives you the amount of charge ΔQ that would flow in a time Δt . (i.e. $\Delta Q = \dots$)

(7)  Rearrange to find a formula that gives you the time Δt it would take for an amount of charge ΔQ to flow past a certain point in a circuit if the current is I . (i.e. $\Delta t = \dots$)

(8)  Calculate the amount of charge that would flow in 2 seconds if the current is 10A.

(9)  Calculate how long it would take for 6 coulombs to flow past a certain point if the current is 5A.