Charge, Current and Potential Difference

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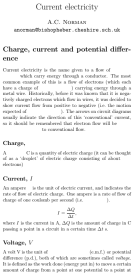
You ought already to have printed a copy of the notes with blanks in from E:HEBER:



Current electricity

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Charge, current and potential difference

Current electricity is the name given to a flow of which carry energy through a conductor. The most common example of this is a flow of electrons (which each have a charge of) carrying energy through a metal wire. Historically, before it was known that it is negatively charged electrons which flow in wires, it was decided to show current flow from positive to negative (i.e. the motion expected of). The arrows on circuit diagrams usually indicate the direction of this 'conventional' current, so it should be remembered that electron flow will be to conventional flow.

Charge,

A C is a quantity of electric charge (it can be thought of as a 'droplet' of electric charge consisting of about electrons)

Current, I

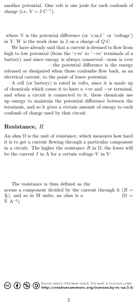
An ampere is the unit of electric current, and indicates the rate of flow of electric charge. One ampere is a rate of flow of charge of one coulomb per second (i.e.).

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

where I is the current in A, ΔQ is the amount of charge in C passing a point in a circuit in a certain time Δt s.

Voltage, V

A volt V is the unit of (e.m.f.) or potential difference (p.d.), both of which are sometimes called *voltage*. It is defined as the work done (energy put in) to move a certain amount of charge from a point at one potential to a point at



another potential. One volt is one joule for each coulomb of charge (i.e. $V = J\ C^{-1}$).

where V is the potential difference (or 'e.m.f.' or 'voltage') in V, W is the work done in J on a charge of Q C.

We have already said that a current is deemed to flow from high to low potential (from the '+ve' to '−ve' terminals of a battery) and since energy is always conserved—none is ever —the potential difference is the energy released or dissipated when those coulombs flow back, as an electrical current, to the point of lower potential.

A cell (or battery) is rated in volts, since it is made up of chemicals which cause it to have a +ve and −ve terminal, and when a circuit is connected to it, these chemicals use up energy to maintain the potential difference between the terminals, and so it gives a certain amount of energy to each coulomb of charge used by that circuit.

Resistance, R

An ohm Ω is the unit of resistance, which measures how hard it is to get a current flowing through a particular component in a circuit. The higher the resistance R in Ω, the lower will be the current I in A for a certain voltage V in V:

The resistance is thus defined as the across a component divided by the current through it ($R = \frac{V}{I}$), and so in SI units, an ohm is a ($\Omega = V\ A^{-1}$).

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Lesson Objectives

1. To know what an electrical current is.
2. To be able to define basic electrical units.
3. To do some simple calculations.

Textbook pp. 46–50

REMINDER: Office hours are week 1 Tuesdays 3.45–5.0 p.m. in room 19.
Next office hours: Tuesday 25 September 2012

Specification Requirement

Charge, current and potential difference
Electric current as the rate of flow of charge; potential difference as work done per unit charge.

$$I = \frac{\Delta Q}{\Delta t} \text{ and } V = \frac{W}{Q} \text{ Resistance is defined by } R = \frac{V}{I}$$

[AQA GCE AS and A Level Specification Physics A, 2009/10 onwards]