

Homework 5.

Electric current

If we connect two points corresponding to different electric potential energies with a metal wire, the charged particles in the metal, the electrons, will move from the point of higher potential energy to the point of lower potential energy. ***The transfer of electric charge is called “electric current”.*** Any material with charged particles which are able to move can conduct electric current. This class of material is called “conductors”. Metals, for example, are conductors. In most of the metals electric current is conducted by negatively charged electrons. In salt solution the current is conducted by both positively and negatively charged ions. Materials which do not conduct electric current are called insulators.

Magnitude of electric current in a conductor is equal to the charge which passes through the cross section of the conductor per unit time. Current is measured in Amperes (A). This name is after Andre-Marie Ampere (1775-1836), a French physicist and mathematician.



Andre-Marie Ampere (1775-1836)

1A means that a charge of 1C passes through the cross section of a conductor per 1 second. Historically, it is the unit of charge (1 Coulomb) which was defined through the unit of electric current. We remember that to introduce a unit for measuring of “something” we have to provide a recipe or describe the experiment which will allow any scientist or engineer to calibrate the measuring device. There is a relatively simple experiment which makes possible calibration of electric current magnitude. This experiment is based on the property of two parallel wires with same direction of electric current to attract each other. If the current directions in the wires are opposite the wires repel each other. The origin of this force is magnetic field surrounding the wires. Later we will discuss magnetic field in details. What is important for us now is the fact that the force of attraction (repulsion) of the wires depends on the distance between the wires, the wire lengths, the type of media surrounding the wires, and, the most important fact, on the *magnitude of electric current* in the wires. So, if two parallel wires with the same current magnitude, 1m long, separated by a distance of 1m in vacuum interact with the force of $2 \times 10^{-7} \text{N}$, the current in the wires is 1A. Then we can measure the charge, transferred through the cross section of the wire. This amount of charge is called 1 Coulomb.

Problems:

1. Copper and salt water are conductors. What is similar and what is different in the ways they conduct electric current?
2. Is it correct to say that lightning is electric current? Explain.
3. Molecules of hydrogen consist of charged particles – electrons and protons. Is it correct to say that flow of hydrogen is electric current?
4. A charge of 300C passes through the filament of a bulb in 10 min. Find the current in the filament.