ECE159 Notes

QiLin Xue

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- Electric current describes the rate of *positive* charge flow[1]:

$$i(t) = \frac{dq}{dt} \tag{1}$$

and is measured in amperes $[A]$. The charge Q that passes a given point is:

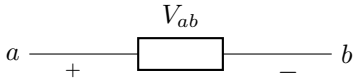
$$Q = \int_{t_0}^{t} i \, \mathrm{d}t \tag{2}$$

and is measured in coulombs $[C]$.

- Voltage describes the electric potential difference across the element:

$$V_{ab} = \frac{dW}{dq} \tag{3}$$

which is physically described as the work required to move a unit positive charge of +1C from b to a. It is measured in volts $[V]$.



Notice that the below two setups are equivalent:

- Power is the rate of energy flow:

$$P = V \cdot I \tag{4}$$

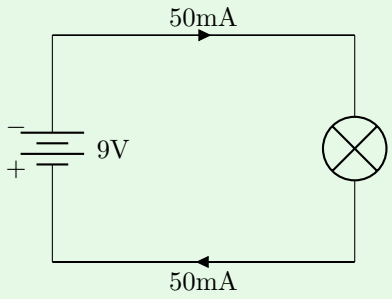
Energy produced by the battery and the current generated runs through the bulb and the energy is dissipated into heat and light. Measured in watts $[W]$. We show this is true from the classical definition of power:

$$P = \frac{dW}{dt} = \frac{dW}{dq} \cdot \frac{dq}{dt} = V \cdot i \tag{5}$$

- In a DC (direct current) circuit, current flows in one direction and is constant with respect to time. In an AC (alternating current) circuit, the curret varies direction with respect to time.
- To distinguish between supplying or absorbing power, we use passive sign convention:

[1] https://xkcd.com/567/

Definition: If power is positive, the element absorbs power and if negative, the element supplies power. Take the following circuit for example:



and we will get:

$$P_{\text{bulb}} = +iV = +0.45\text{W, (absorbing)} \tag{6}$$

$$P_{\text{battery}} = -iV = -0.45\text{W, (supplying)} \tag{7}$$

which gives:

$$\sum P = 0 \tag{8}$$