Electric quantities $v \rightarrow \vec{E} \rightarrow i$

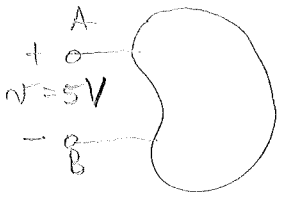
(a) Charge q, [C]

(b) Voltage

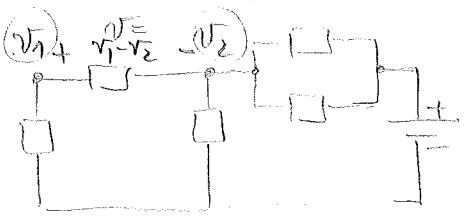
- potential energy
- electric potential (1) $v \triangleq \frac{dW}{dq}$ $[V] = \left[\frac{1J}{1C}\right]$ W [J]

- voltage or voltage drop is potential difference.
- it is a measure of work (or energy) spent to push charge through an element.

Example:



SKIP THIS.



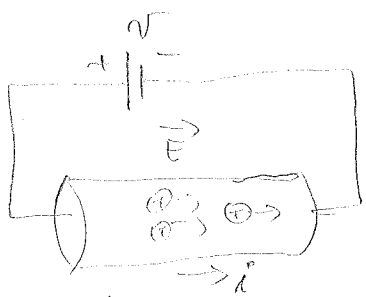
$v = v_1 - v_2$ $v_1 = -5, 0, +7V$

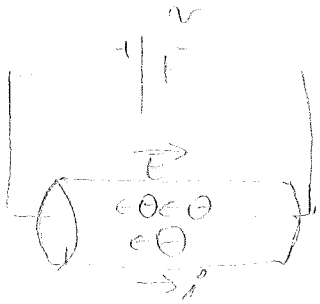
Ask in class: $v_2 = -2, 11, +8V$

(c) Current

- Charges exposed to an electric field will drift; this stream is called current.
- The rate at which charge crosses a ⊥ reference plane is called instantaneous current

(2) $i \triangleq \frac{dq}{dt}$ $[A] = \left[\frac{1C}{1s}\right]$





(2') $Q = \int_{t_1}^{t_2} i(t)\,dt$

Example:

$v \rightarrow \vec{E} \rightarrow i$

(d) Power

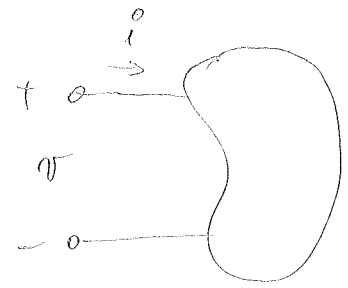
To sustain current inside a piece of material (e.g. a circuit element) energy must be expended. The rate at which energy is expended is called instantaneous power:

(3) $p \triangleq \frac{dw}{dt} = \frac{dw}{dq} \cdot \frac{dq}{dt} = v \cdot i$ $[W] = \frac{[J]}{[s]} = [V] \cdot [A]$

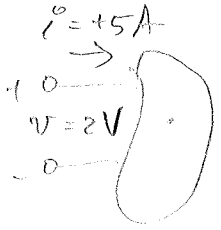
$p = v \cdot i$ (4)

(3') $$W = \int_{t_1}^{t_2} p(t)\,dt$$ [watt-second] or [kilowatt-hour].

Coming back to the circuit element:

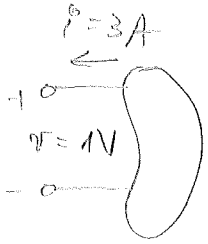


(a) The element is supplied (receives, absorbs, is delivered) power: the current entering the "+" terminal is positive:



$p = v \cdot i = 10\ W.$

(b) The element supplies (provides, delivers, delivers) power: the current exits the "+" terminal (and is positive)



$p = v \cdot i = 3\ W$

→ Talk about "passive sign convention".