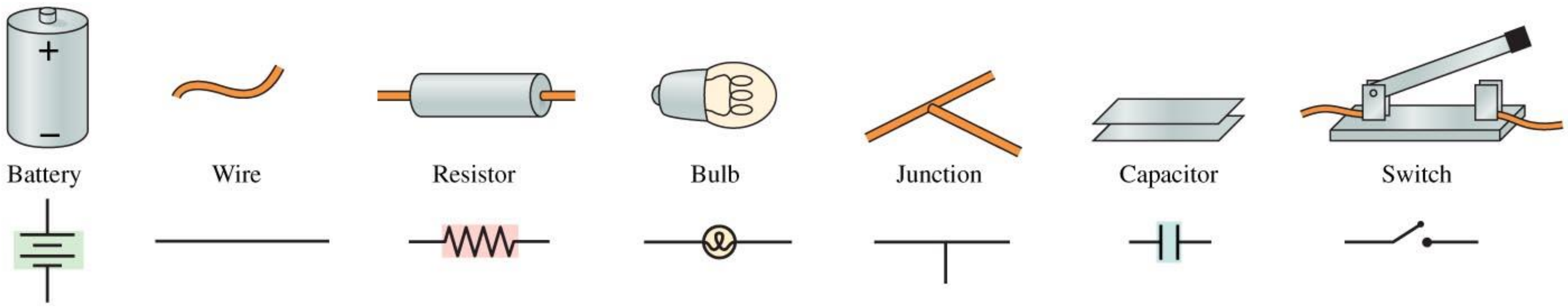
Lecture 15: Kirchhoff’s Laws

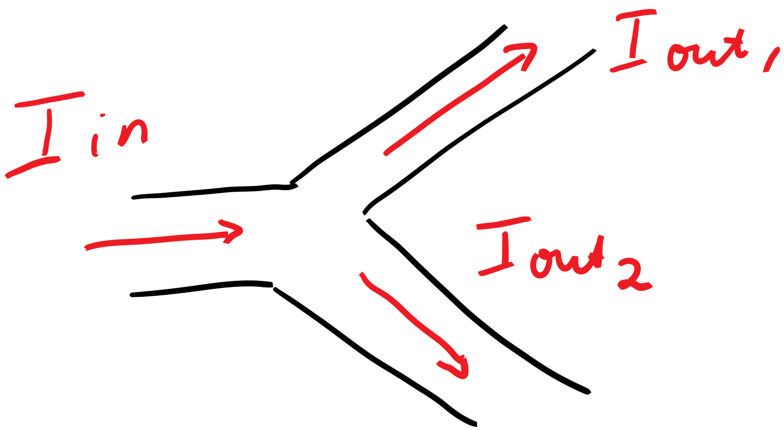
Drawing Circuit Diagrams



Kirchhoff's Laws: Junction Law

Lecture 14:
Current is the same at all points in a current-carrying wire.

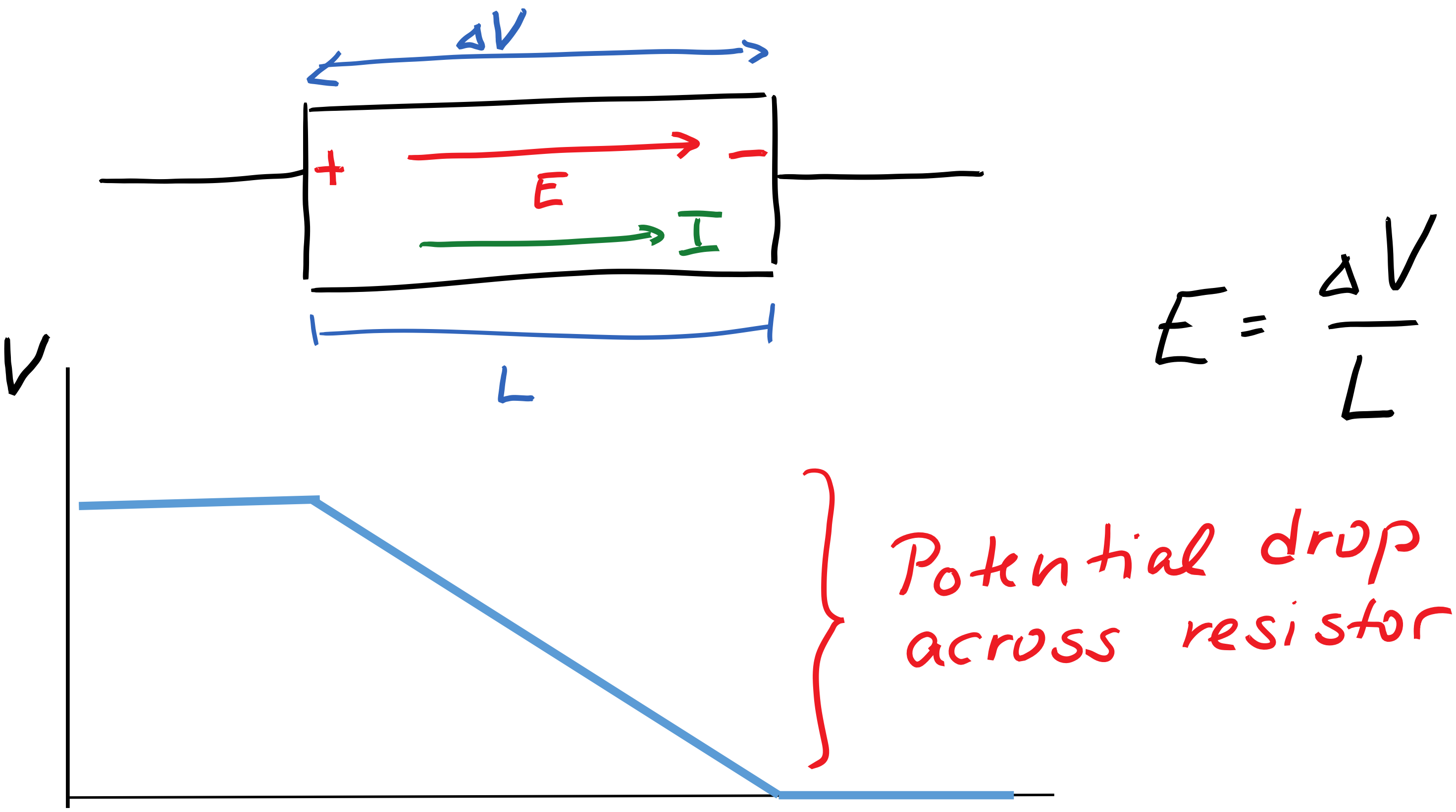
Current is not "used up". Charge cannot be created or destroyed.
"What goes in must come out".



$$\sum I_{in} = \sum I_{out}$$

Current flow through resistor (from lec 14)

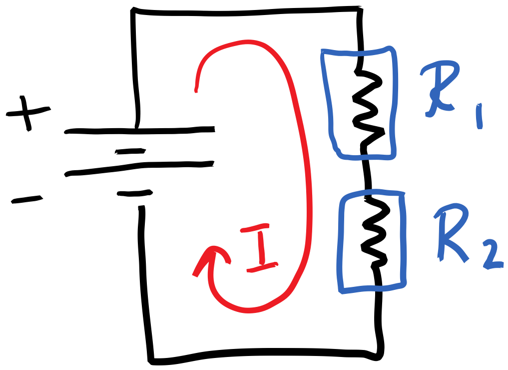
Assume “ideal wires” (R=0).
In reality: R wire << R circuit element
Example: flashlight bulb R=3Ω; wire connecting bulb to battery: R=0.01Ω

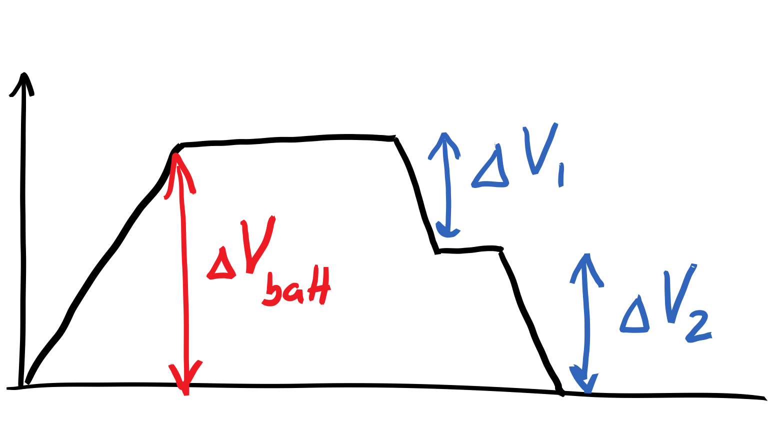


Kirchhoff's Laws: Loop Law

Potential energy depends on position.
If we come back to the same point, we come back to the same value of potential energy.
For closed loop: $\Delta U_{el} = 0$
Because $V = U/q$: $\Delta V = 0$

$$\Delta V_{loop} = \sum_i \Delta V_i = 0$$

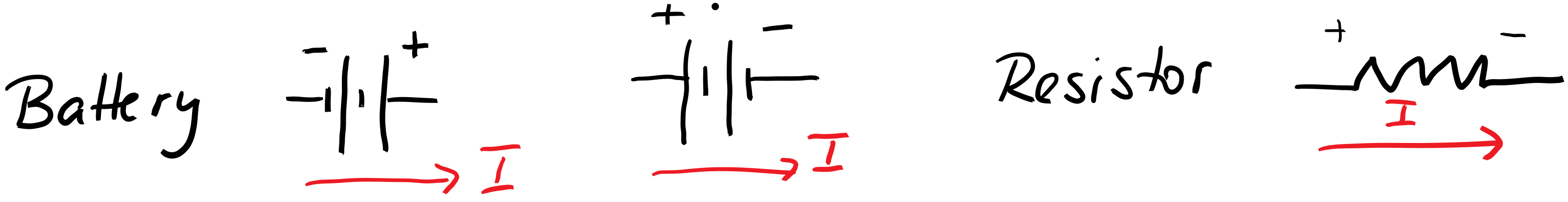




Analyzing circuits

1. Draw circuit diagram. Label known and unknown quantities
2. Assign direction for current, based on batteries.
3. Pick starting point, travel around the loop.

$$\Delta V = V_{downstream} - V_{upstream}$$

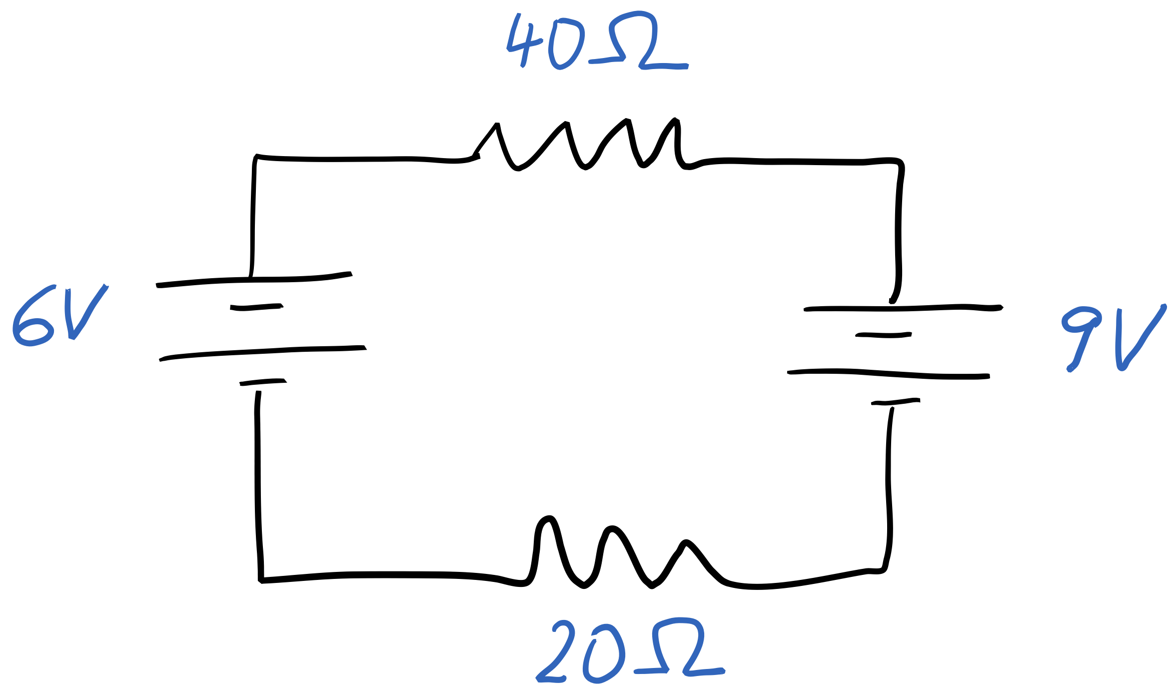


$\Delta V_{bat} = +\mathcal{E}$ $\quad$ $\Delta V_{bat} = -\mathcal{E}$ $\quad$ $\Delta V_R = -IR$

Potential decreases

4. Use loop law $\sum \Delta V_i = 0$

Example



I ?

V for each resistor ?