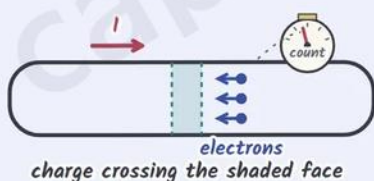


charge on the move, and what stands in its way

Current, and current in conductors

- current $I = \frac{Q}{t}$, the rate of charge crossing a cross-section, unit ampere
- conventional current runs the way a positive charge would move, opposite to electron flow in metals
- conductors: free electrons carry the current; electrolytes: both + and - ions carry it, adding
- current is a scalar: currents add arithmetically at a junction, never by a vector rule



charge crossing a shaded cross-section: $I = Q/t$, conventional I marked one way, electrons the other

Ohm's law

Ohm's law, physical conditions unchanged

$$V = IR$$

resistance from geometry

$$R = \frac{\rho L}{A}$$

conductance

$$G = \frac{1}{R}$$

conductivity

$$\sigma = \frac{1}{\rho}$$

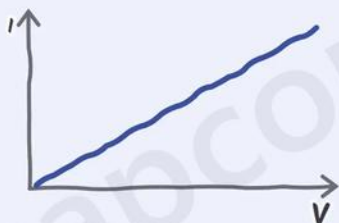
current density form

$$j = \sigma E$$

ohmic means R stays the same as V changes, with physical conditions unchanged, nothing more

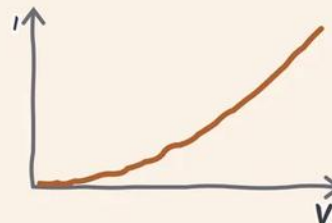
Ohmic vs non-ohmic

Ohmic



- $V-I$ is a straight line through the origin
- metals, resistors, wires at fixed temperature

Non-ohmic



- $V-I$ bends, or is not single valued
- diode, gas discharge tube, a heated filament

the $V-I$ graph's slope gives R : a steeper line means a bigger resistance