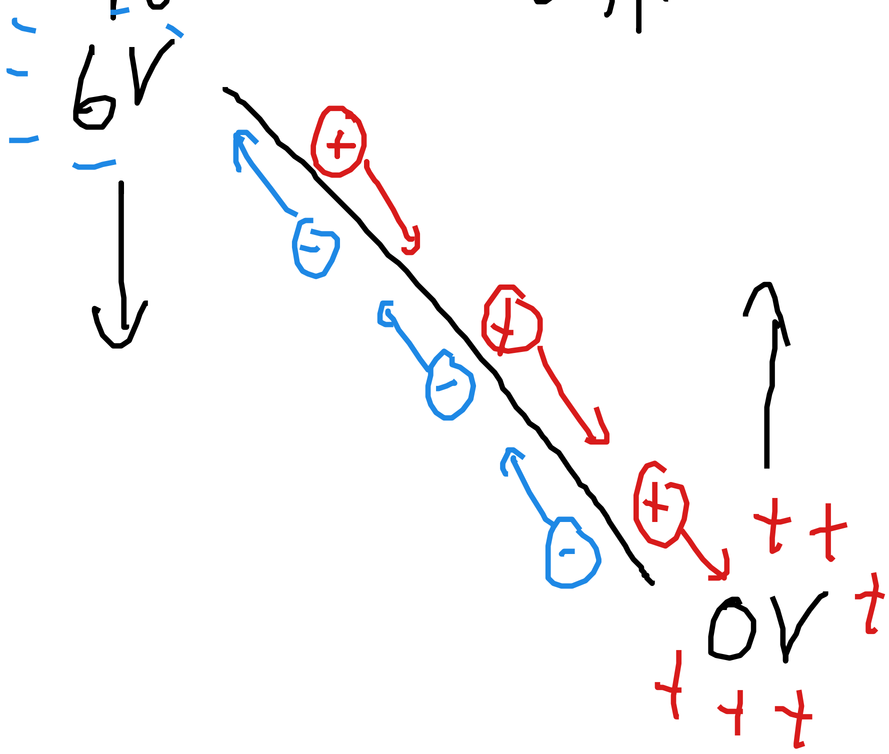
Conductors vs Insulators

Conductors	Insulators
• have free-flowing charge carriers inside (e.g. electrons in a metal)	• no/few charge carriers inside
• charge can flow through material easily	• charge can't flow easily

Potential Difference



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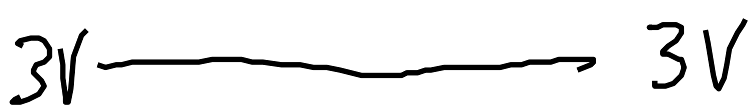
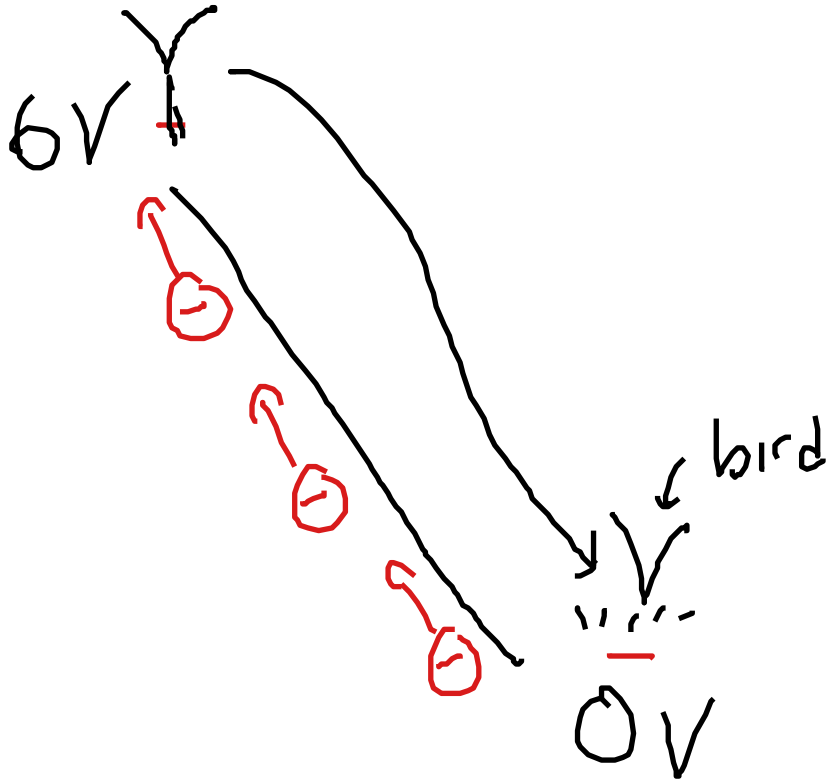


no more charge flows

In a conductor:

charge carriers flow until potential is the same everywhere in conductor



if this process is thwarted
(charge carriers are continuously
moved back to their
starting point)
then charge flow doesn't stop.

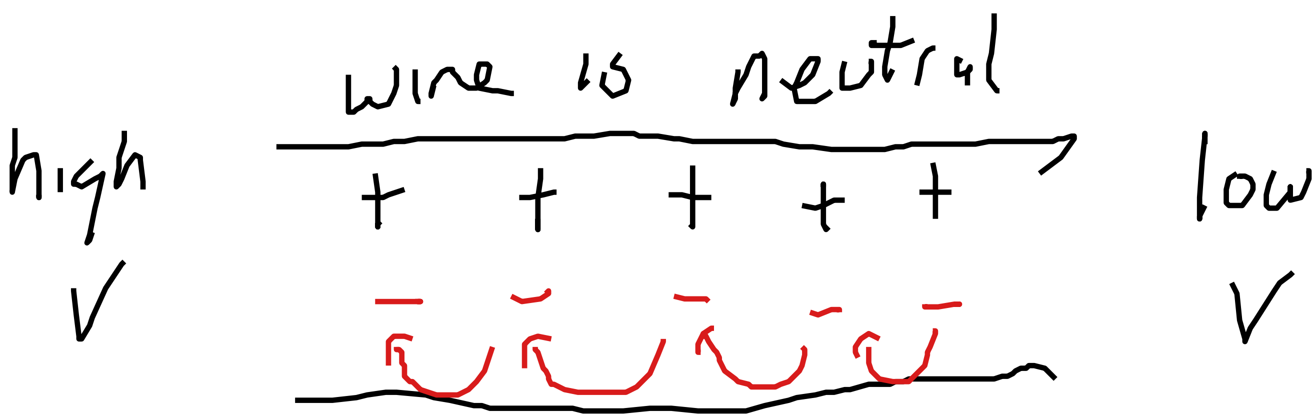
flow of charge : current

Current : I : $\frac{\text{charge}}{\text{second}}$

Units of I: $1 \frac{C}{s} = 1$ Ampere (A)

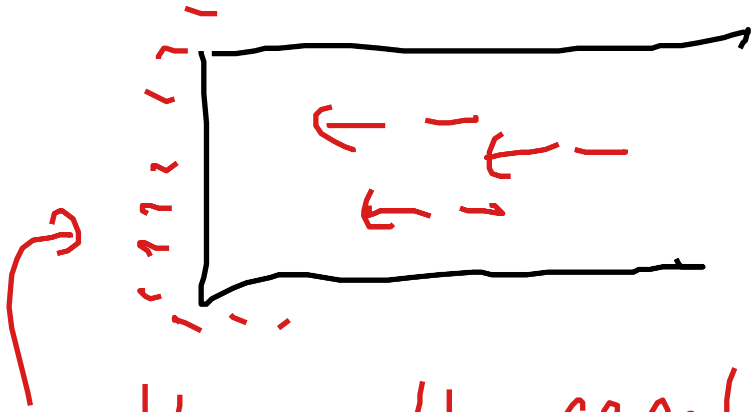
1 A is large but not crazy

1 C is crazy large

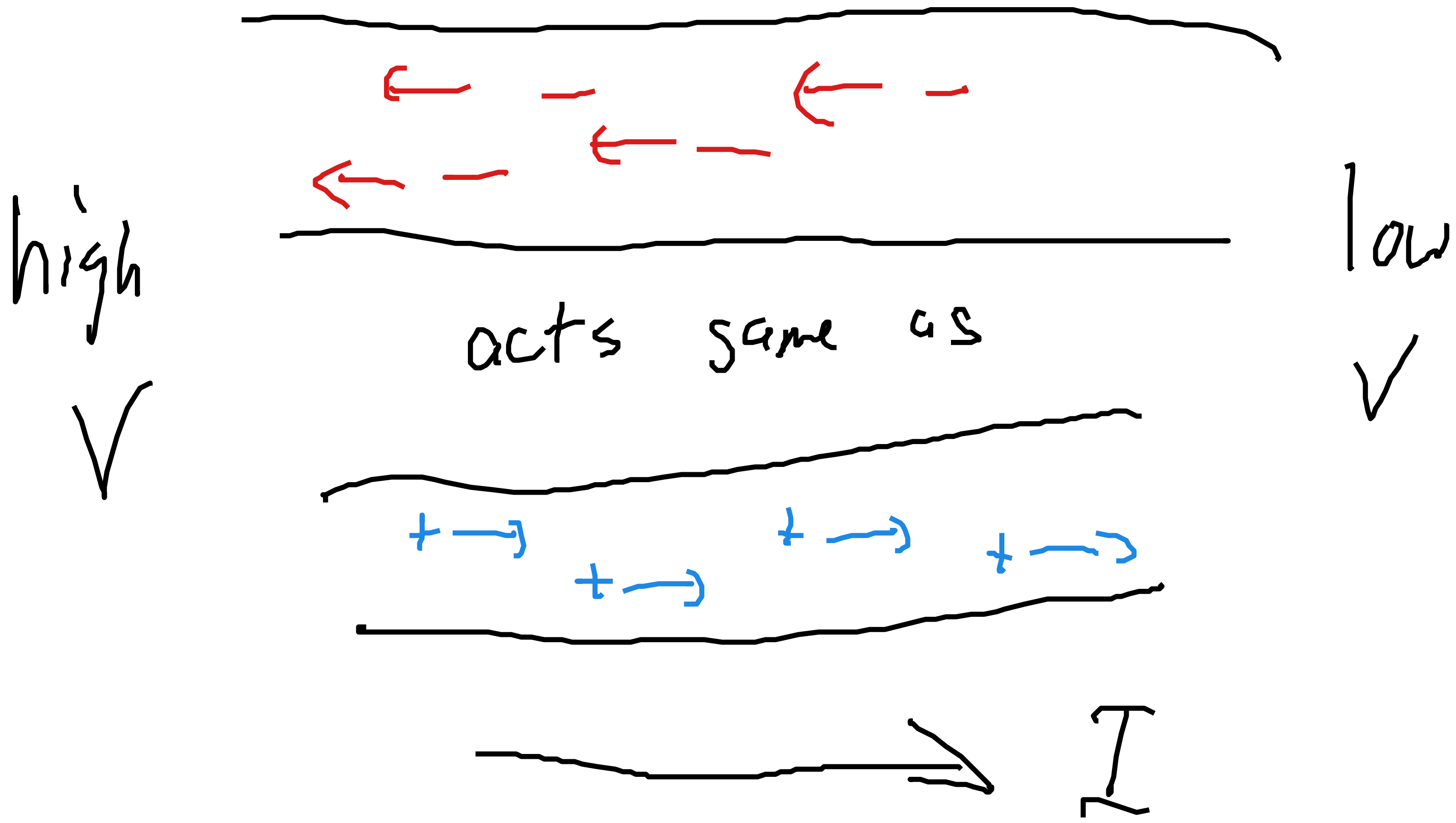


No buildup of charge so long as current makes a closed circuit

Cut in the wire



this will repel
newer electrons:
current will stop (quickly)

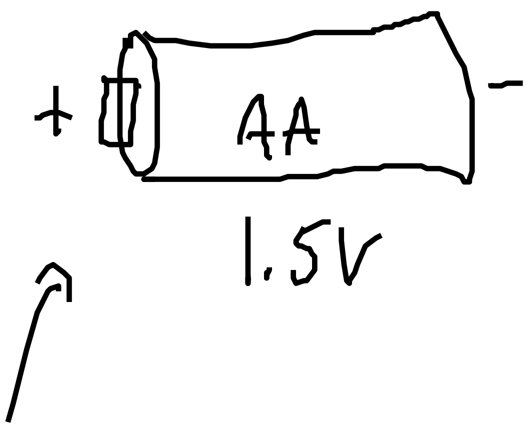


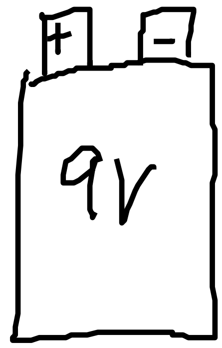
"conventional current":

- direction positive charge carriers would be moving
- flows downhill: high to low V
- electrons move opposite I
- I has direction but is not a vector: only ±.

To thwart equilibrium in a conductor requires energy

- battery
- power supply





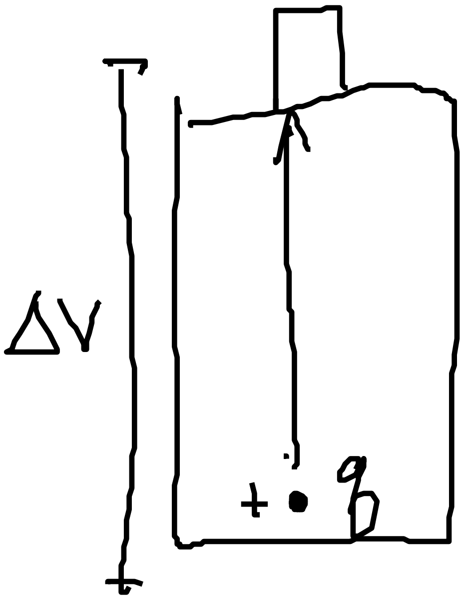
Positive terminal is 1.5V higher than the negative terminal

A battery's <u>primary</u> <u>job</u> is to maintain this potential difference.

battery wants to maintain ΔV

wire wants potential to be equal.

- battery acts like a pump, moving current back uphill
- battery supplies energy to current
- current dissipates energy as it flows downhill



Potential difference

$$\Delta V = V_f - V_i$$

Energy gained by charge: $\Delta PE = q\,\Delta V$

Power = energy per second: $\dfrac{\Delta PE}{\text{time}} = \dfrac{q\,\Delta V}{\text{time}}$ "per second"

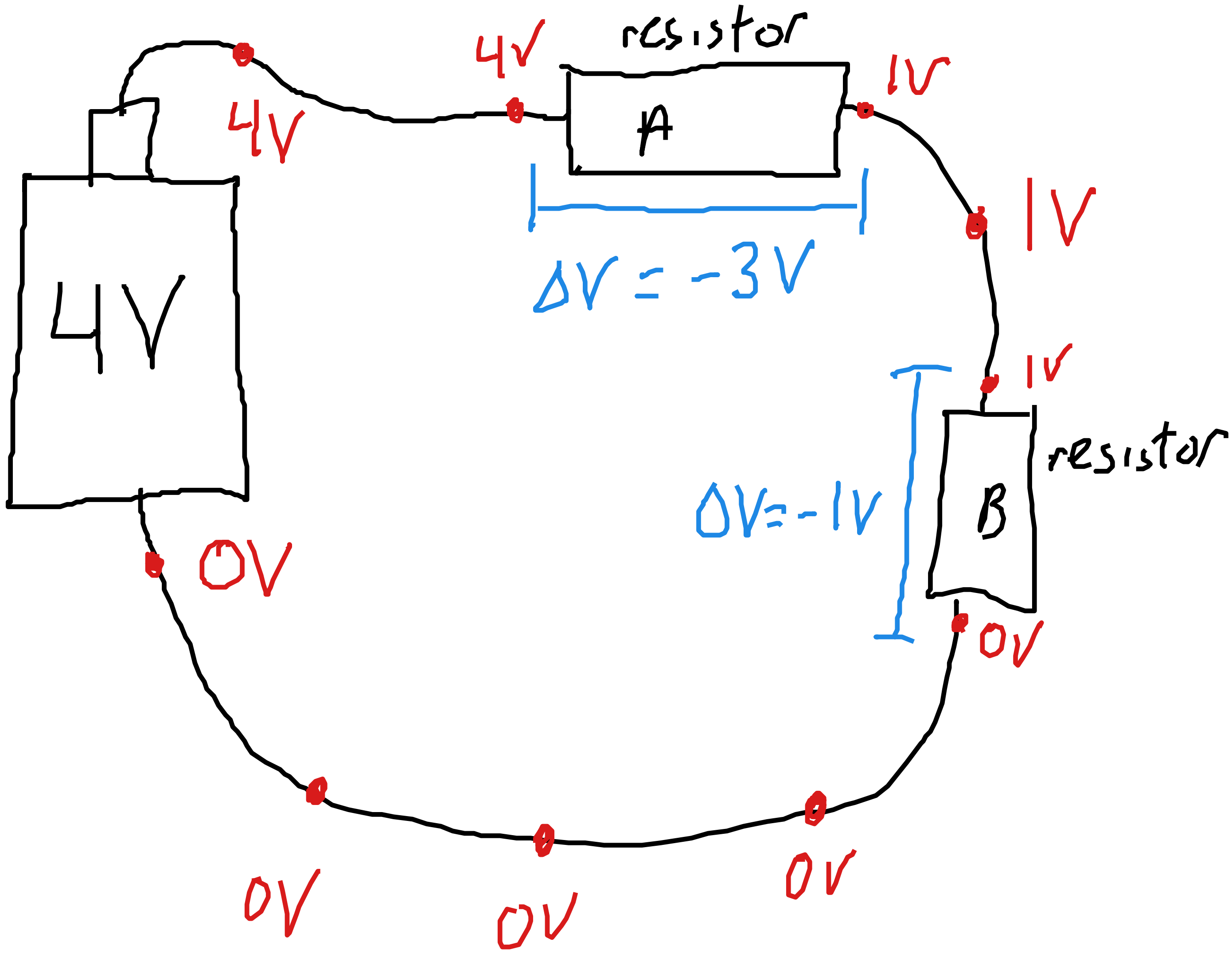
$$P = I\,\Delta V$$

Power: units of $\dfrac{\text{Joules}}{\text{second}}$ = Watt (W)

- When current flows <u>up</u> a potential difference, it must be supplied $P = I\Delta V$ of power

- When current flows downhill, it releases $P = I\Delta V$ of power.

<u>Resistors</u>: serve as an obstacle ("friction") to the current, slowing it down



Total change in V around a circuit is <u>zero.</u>

4V up, 4V down