

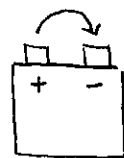
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(Electric) Motor: Electricity \rightarrow Mechanical ForceGenerator: Force \rightarrow Electricity

But first, Electricity:

moving charge (+ or -) \rightarrow current

$$\text{Current} = \frac{\text{charge}}{\text{time}}$$



battery

current goes from + to -

(assumes positive charge in motion)

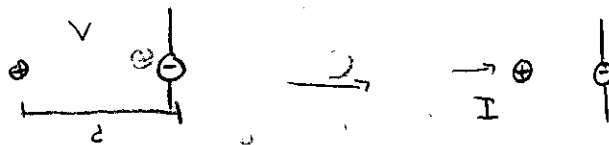
voltage is a relative measurement

 \hookrightarrow measures difference between 2 pts

it is kind of like gravitational potential energy

gravitypotential energy \rightarrow kinetic energybigger mass \rightarrow more energy

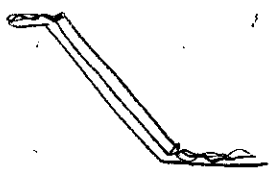
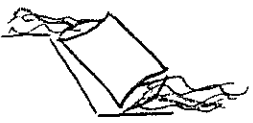
$$P = \frac{\text{mass}}{\text{time}} \cdot \frac{\text{energy}}{\text{mass}}$$

electricityvoltage \rightarrow currentmore charge \rightarrow greater energy

let voltage = energy / charge

$$P = \frac{\text{charge}}{\text{time}} \cdot \frac{\text{energy}}{\text{charge}}$$

$$P = I \cdot V$$



larger pipe \rightarrow more current

less resistance

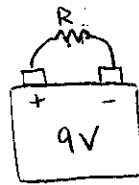
larger height difference \rightarrow more current

$$I \propto \frac{1}{R}$$

$$I \propto V$$

$$V = IR$$

Ohm's Law



Ohm's Law: $V = IR$

$$I = V/R$$

small resistor like large pipe

large resistor like small pipe

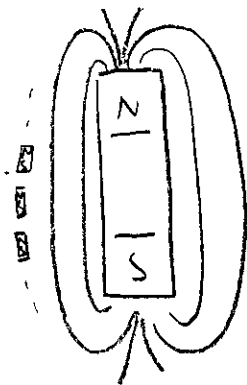
With the power law,

$$P = IV = I^2 R = \frac{V^2}{R}$$

Lightbulb: large resistor! small amount of energy \rightarrow current
most energy \rightarrow heats up wire, radiates!

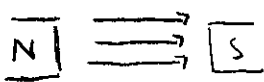


Next, Magnetism:
(B)



density of lines \rightarrow strength of field

magnetic fields apply force to moving charge:



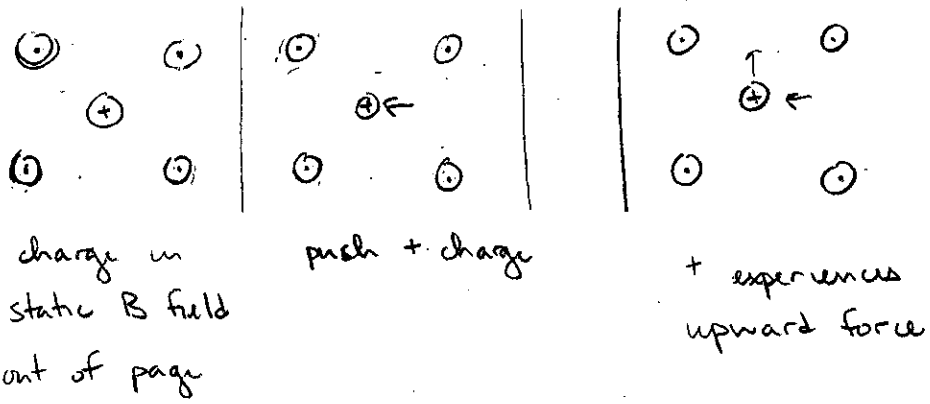
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right hand rule: thumb in direction of motion

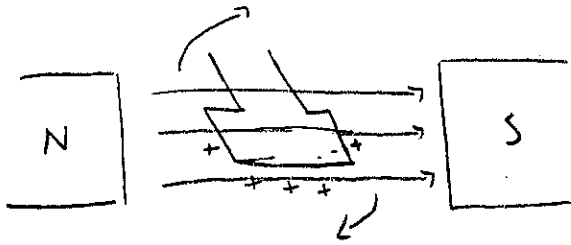
• fingers along \vec{B} lines

• palm in direction of force

Consider:

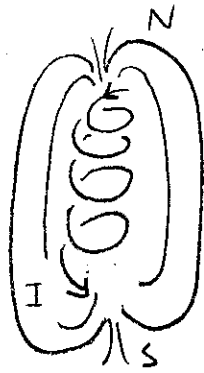


Generator:

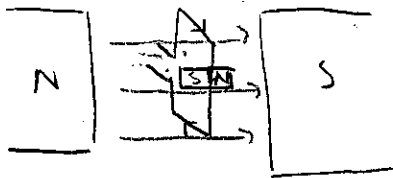


rotate wire loop through B field
generates current in loop!

How to make a magnet



Motor:



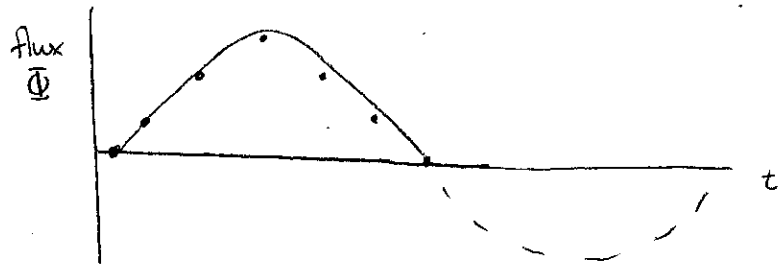
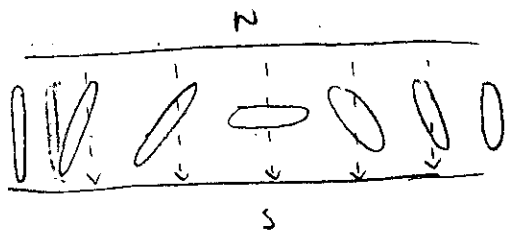
- current loops generates B field against
B field of external magnet

- loop will rotate to align B-fields
mechanical force!

Faraday's Law: the force in a loop is proportional to the change of the B-field

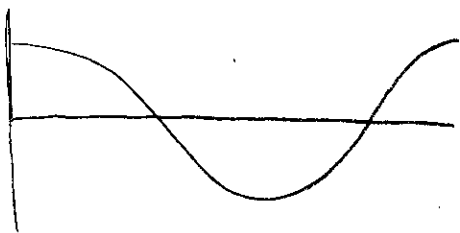
(?)

this force opposes change to the B-field



flux: # of field lines flowing through loop

so the change in the flux
 $(\frac{d\Phi}{dt})$



$$\mathcal{E} \propto \frac{d\Phi}{dt}$$

Qualitatively: turn a loop in a magnetic field, and it will generate an current \Rightarrow generators

Summary: $I = Q/t$ ($Q = \text{charge}$)

current flows from + to - voltage

$V =$ like potential gravitation energy

$$P = IV$$

$$V = IR \quad (\text{Ohm's Law})$$

Resistance is like having a small or large pipe

Ampere's Law: a current loop in a B field generates rotation

Faraday's Law: a rotating wire loop in a B field generates current