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**Lorentz Force:** $\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$

cross product ⊥ to $\vec{v}$ + $\vec{B}$

$q$ - charge $\qquad$ $\vec{v}$ - velocity of charged particle

$\vec{E}$ - electric field $\qquad$ $\vec{B}$ - magnetic field

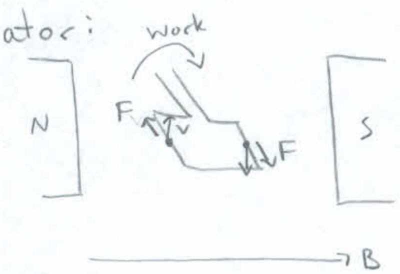
$\vec{F}$ - force on particle due to $\vec{E}$ + $\vec{B}$

Electric field: $\vec{F} \parallel \vec{E}$

Magnetic field: $\vec{F} \perp \vec{B}$ ! → non-intuitive

↳ can only create a force if particle already moving

generator:



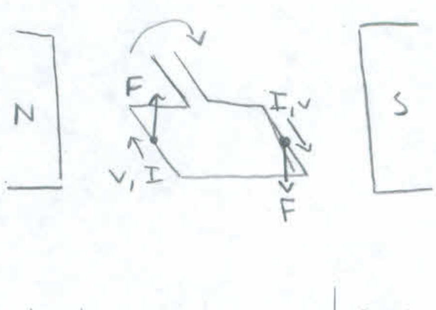

$(E=0)$

use right hand rule:

$\vec{F} = q\vec{v} \times \vec{B}$ $\qquad$ ($q$ negative)

F along wire ⇒ flow of charges = current!

motor:

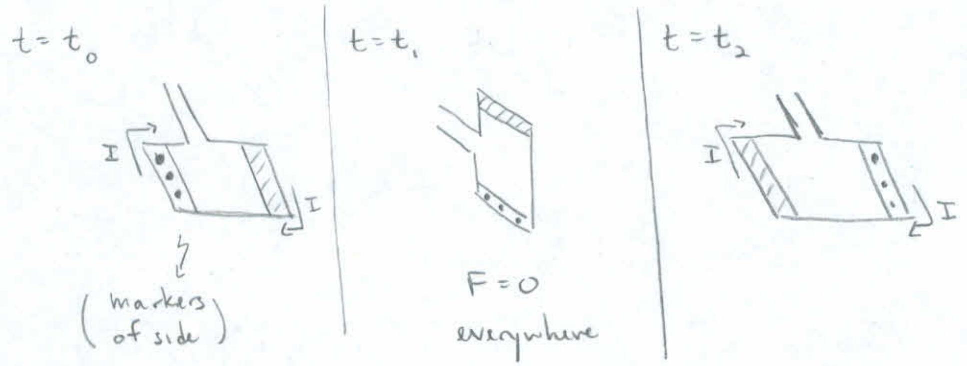



use right hand rule:

v in direction of current

$\vec{F} = q\vec{v} \times \vec{B}$ $\qquad$ ($q$ negative)

F ⊥ to wire ⇒ the wire swivels/rotates




alternating current!

charge "sloshes back + forth"

why do we want | how can we use A.C.?

ex. lighting:

lightbulbs don't care which direction the current goes in, as long as it's there.

power used: $P_{light} = I V = I^2 R$ → resistive heating (how lightbulbs work)

E & M quantities: recall that we're measuring relative terms

$P = I V$ → is actually $P = I \Delta V$

$V = I R$

↳ power used is proportional to drop in voltage across that element.

$\left( P = I^2 R = V^2/R \right)$

$\Delta V = I R$

↳ current across element is the drop in voltage over that element divided by its resistance.

In general, resistive heating uses power → power loss

$$P_{loss} = I^2 \cdot R_{wire}$$

How to reduce resistive heating power loss:

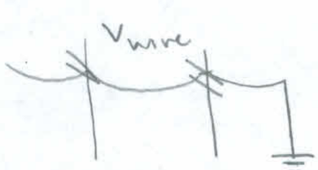
lower R: thicker wires, better conductive material

reduce I: increase the voltage

$P = I V$, $I = P/V$. | To decrease I & keep the same power, increase the voltage. |

⇓

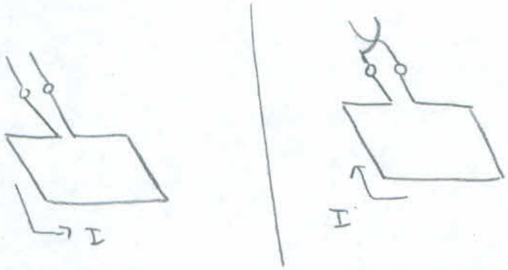
high-voltage transmission




$P = I_{wire} \cdot V_{wire}$

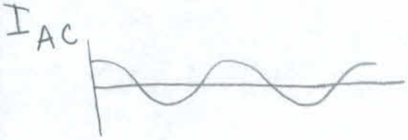
$\Delta V = V_{wire} - V_{GND} = V_{wire}$

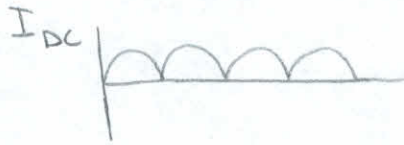
But what if we don't want AC? How do we get direct current?

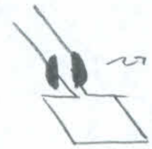



switch wires when I in loop switches direction so that the current out is the same.

device that does this: commutator



conductive hunk of metal w/ slit in middle

How to get rid of bumps: add more wires, offset from each other


When do we use AC?

- wall power (anything with a plug)

DC? - batteries (without a plug)
- computers (must convert power to DC when plugged in)

↳ See slides for advantages & disadvantages