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~~HOW DOES~~ CURRENT GENERATES MAGNETIC FIELD
& MAGNETIC FIELDS AFFECT CURRENT BY
MEANS OF MAGNETIC FORCES

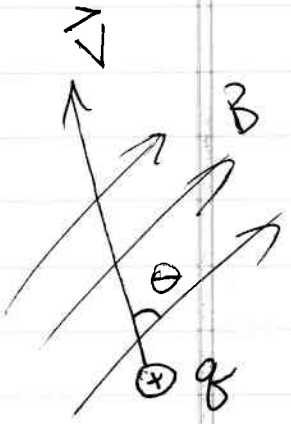
UNITS OF $\vec{B}$: TESLA (T) (S.I. UNIT)

1 (T) IS LARGE

ALSO GAUSS (G) (NOT S.I.)

1 (T) = 10,000 (G) (EARTH'S B-FIELD ~ 0.5G)

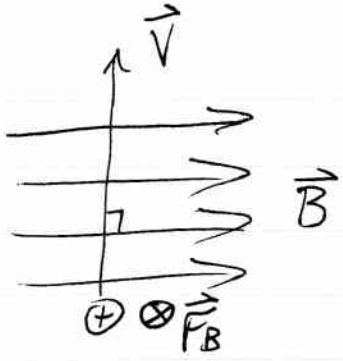
A MOVING CHARGE GENERATES A MAGNETIC FIELD
MOVING CHARGES DETECT MAGNETIC FIELD
BY MEANS OF A FORCE, $\vec{F}_B$



$\vec{F}_B$ DEPENDS ON:

- q — SIZE OF CHARGE
- B — STRENGTH OF FIELD
- V — SPEED OF CHARGE
- θ — F_B IS LARGEST WHEN $\vec{V} \perp \vec{B}$
  F_B IS 0 WHEN $\vec{V}$ PARALLEL TO $\vec{B}$

$\vec{F}_B$ IS DIRECTED PERPENDICULAR TO BOTH $\vec{V}$ AND $\vec{B}$



WE USE THE RIGHT-HAND-RULE TO FIND DIRECTION OF $\vec{F}_B$

	$\vec{F}$	$\vec{V}$	$\vec{B}$
	THUMB	INDEX FINGER	MIDDLE FINGER

$\vec{F}_B$ IS INTO PAGE

INTO PAGE $\otimes$ OUT OF PAGE $\odot$ $\bullet$

FOR ELECTRIC FIELDS: $\vec{F}_E = q\vec{E}$ $\vec{F}$ IN SAME DIRECTION AS $\vec{E}$

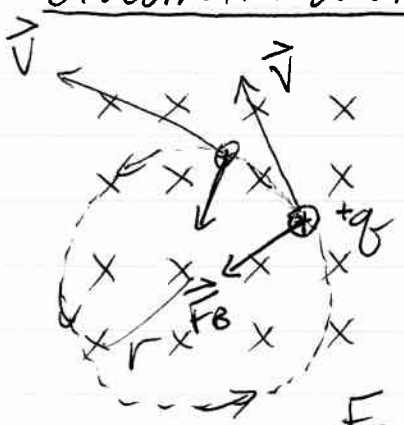
(DOES WORK) (SPEEDS UP OR DOWN)

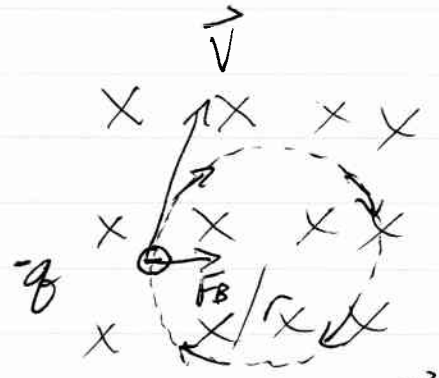
FOR MAGNETIC FIELDS:

$$\vec{F}_B = (q\vec{v}) \times \vec{B}$$
$$= qvB\sin\theta \quad \perp \text{ TO } \vec{v}, \perp \text{ TO } \vec{B}$$

(DOES NO WORK)
(ONLY TURNS THE DIRECTION)

CYCLOTRON MOTION

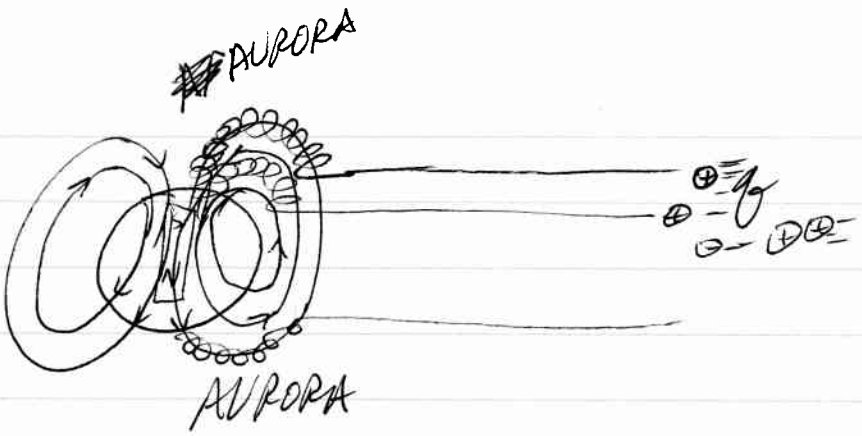




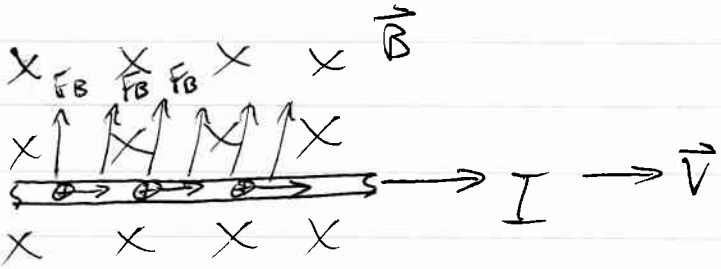
F_B IS CENTRIPETAL FORCE $= \frac{mv^2}{r}$

UNIFORM CIRCULAR MOTION

(CENTRIPETAL ACCELERATION $a_{CENT} = \frac{v^2}{r}$)

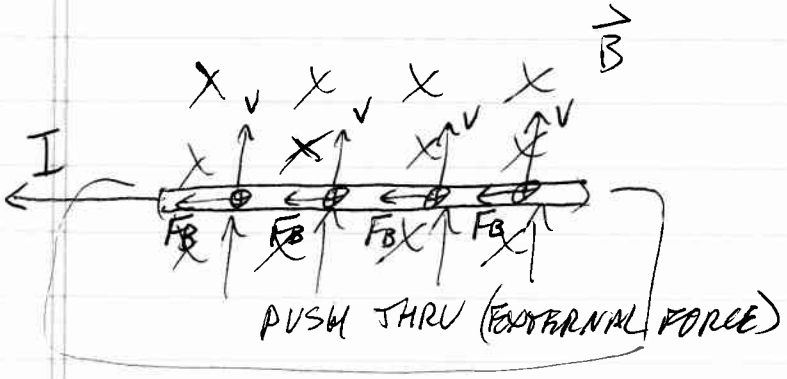


CURRENT PASSING THRU A MAGNETIC FIELD



CURRENT GENERATES FORCE ON A WIRE (ELECTRIC MOTOR)

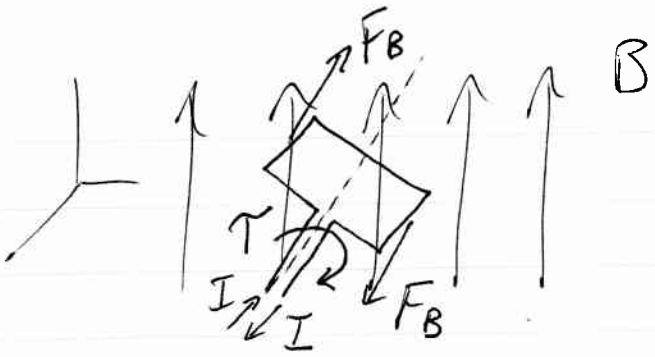
WIRE LOOP PASSING THRU A MAGNETIC FIELD



FORCE ON A WIRE GENERATES A CURRENT (ELECTRIC GENERATOR)

$\vec{B}$ IS CONSTANT, SO THESE MAGNETS DON'T LOSE STRENGTH, THEY FACILITATE CONVERSION FROM MECHANICAL ENERGY $\leftrightarrow$ ELECTRICAL ENERGY

ELECTRIC MOTOR



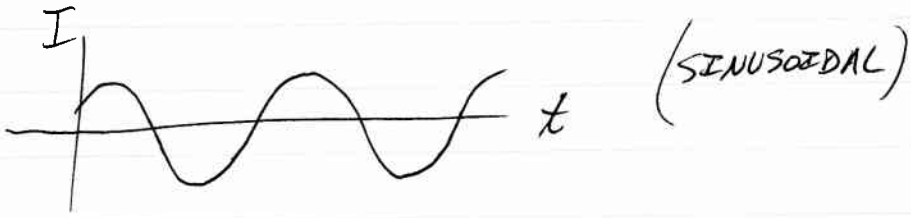
INPUT: I CURRENT
OUTPUT: τ TORQUE

MORE LOOPS → MORE TORQUE

ELECTRIC GENERATOR

INPUT: TORQUE

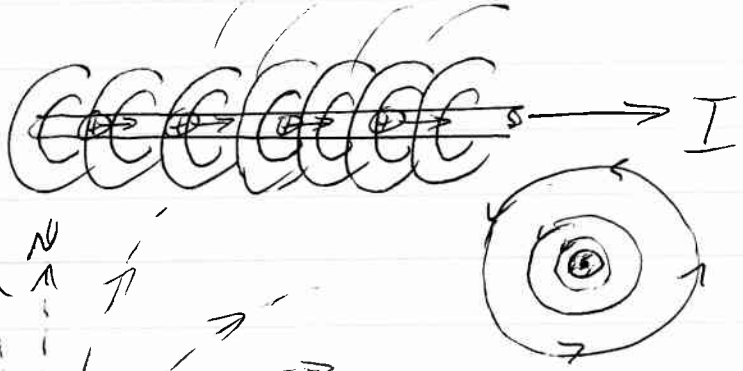
OUTPUT: CURRENT (AC)



(SINUSOIDAL)

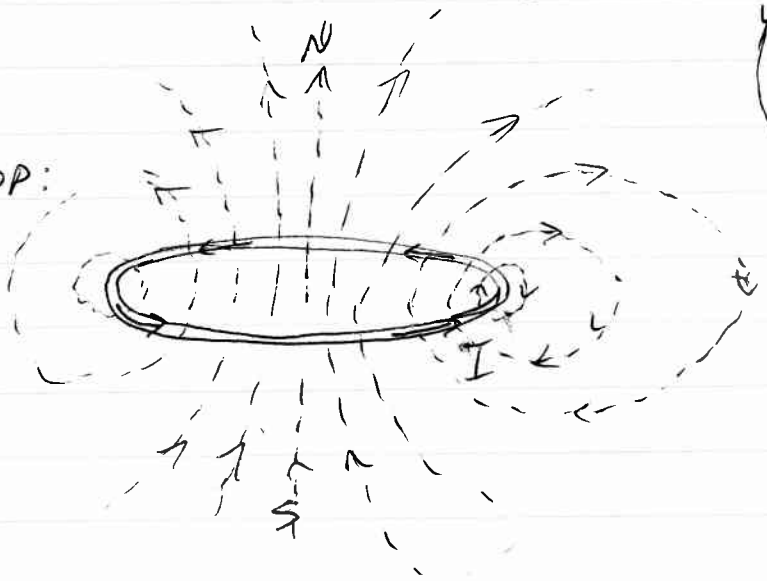
USING CURRENT TO GENERATE A MAGNETIC FIELD

STRAIGHT WIRE:

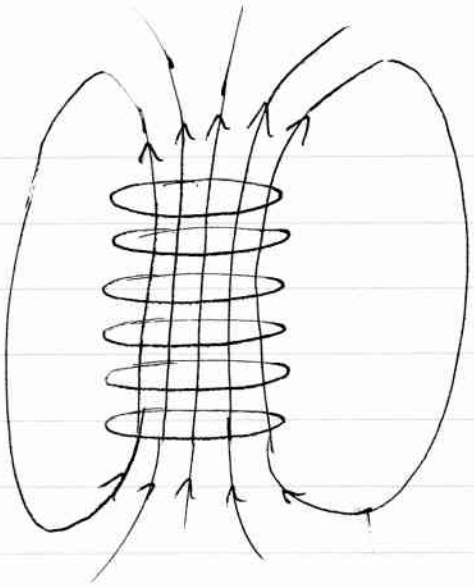


WIRE LOOP:

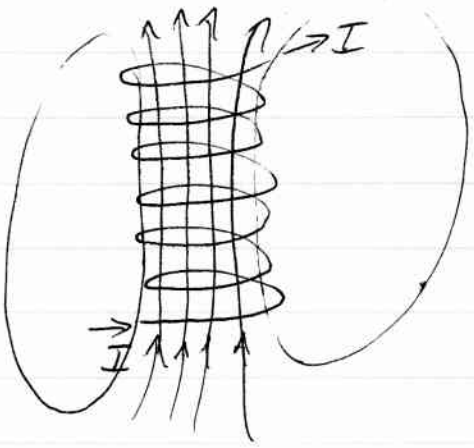
LOOP OF CURRENT



SERIES OF LOOPS:



SOLENOID



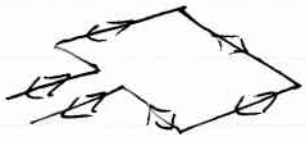
UNIFORM MAGNETIC FIELD INSIDE

INDUCTOR OR SOLENOID —ᔓᔓᔓ—

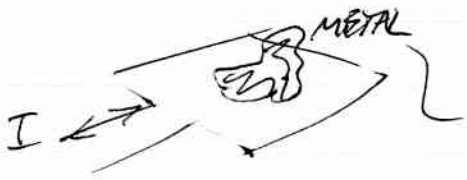
MAGNETIC 'INERTIA' FOR CIRCUITS

INDUCTIVE SENSORS

A.C.
I



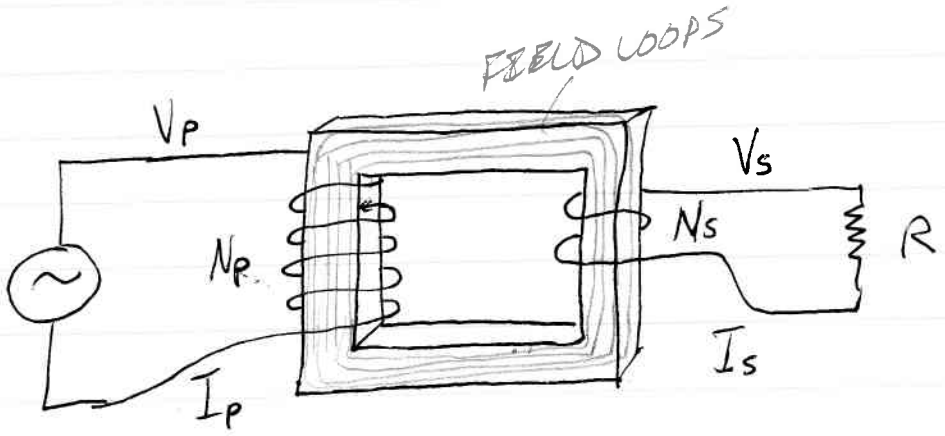
GEOMETRY GOVERNS INDUCTANCE, WHICH AFFECTS CURRENT FLOW RATE



AFFECTS MAGNETIC FIELD AND INDUCTANCE AND FLOW

TRANSFORMERS

(AC SYSTEM)



PRIMARY (SOURCE)

SECONDARY (LOAD)

IDEAL TRANSFORMER $\quad V_S = \left(\frac{N_S}{N_P}\right) V_P \qquad I_S = \left(\frac{N_P}{N_S}\right) I_P$

IF $N_P > N_S$, $V_S < V_P$ (STEP-DOWN) AND VICE VERSA