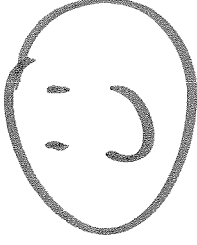
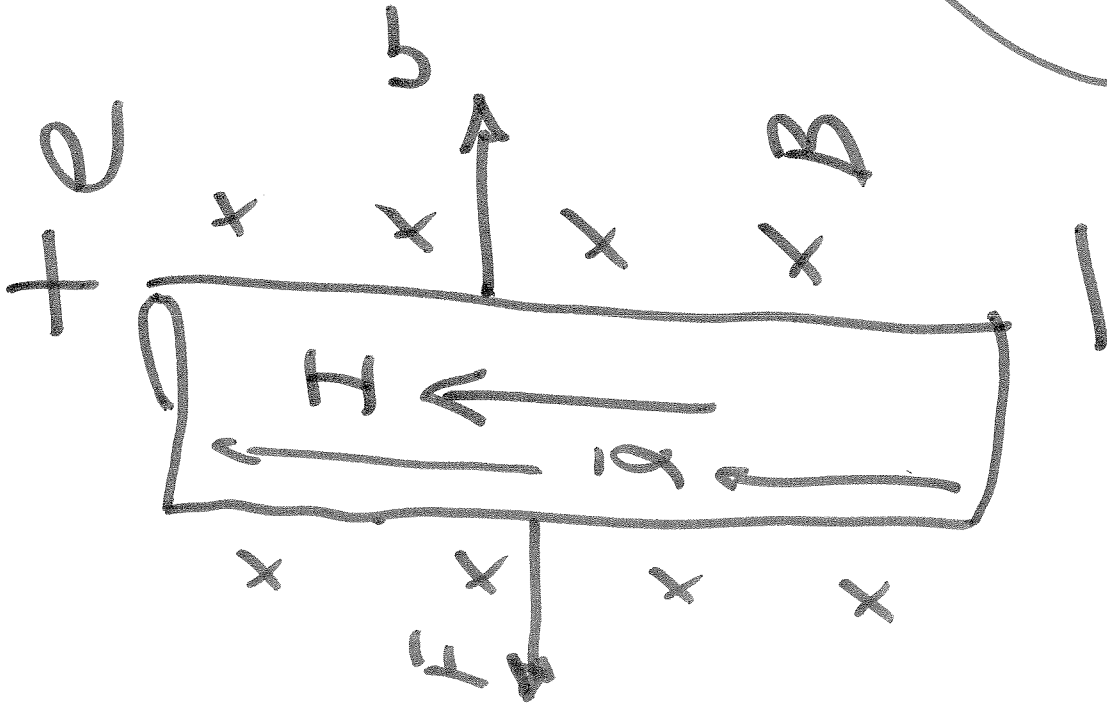


ECE 320 & ECE 329

ENERGY SYSTEMS I  
BACKGROUND STUDY IN ENERGY SYSTEMS

SESSION no. 18



MOTOR LAW

$$\vec{F} = I \cdot (\vec{l} \times \vec{B})$$

$$F = I l B \sin \theta$$

( $\theta$  = angle between  $\vec{l}$  &  $\vec{B}$ )

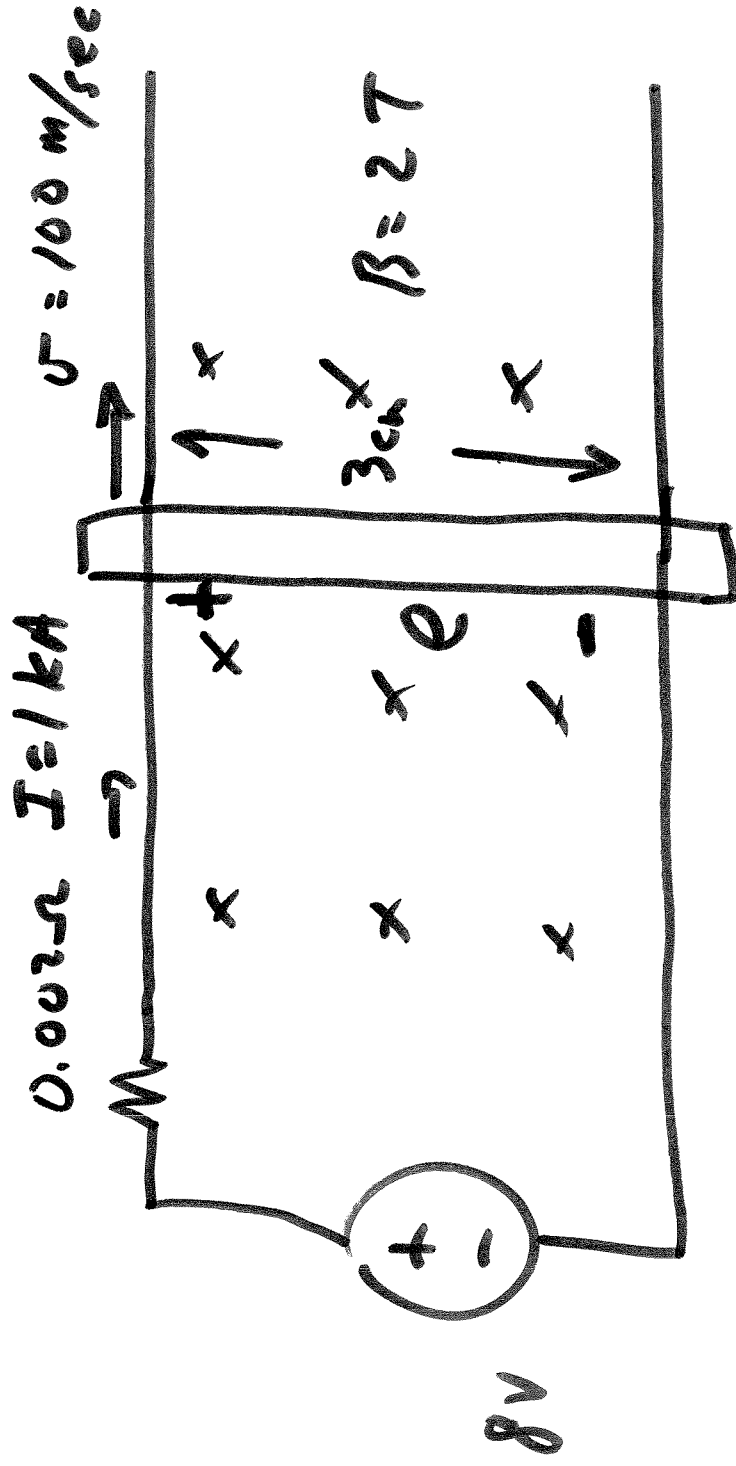
GENERATOR LAW

$$\mathcal{E} = (\vec{v} \times \vec{B}) \cdot \vec{l}$$

$$\mathcal{E} = v B l \sin \theta \cos \phi$$

$\phi$  = angle dot product

Σ Kf m n c s



FIND FORCE

$$F = B l i$$

$$F = (27)(3 \text{ cm})(1 \text{ kA})$$

$$F = 60 \text{ newtons (Accelerating)}$$

FIND VOLTAGE GENERATED

$$e = v B l$$

$$e = (100 \text{ m/sec})(27)(3 \text{ cm})$$

$$e = \underline{\underline{6 \text{ Volts}}} \text{ (opposes input voltage)}$$

$$P = e \cdot i$$

$$P = F \cdot v$$

$$P = (60) (1 \text{ kA})$$

$$P = (60 \text{ N})(100 \text{ m/sec})$$

$$P = 6 \text{ kW}$$

$$P = 6 \text{ kW}$$

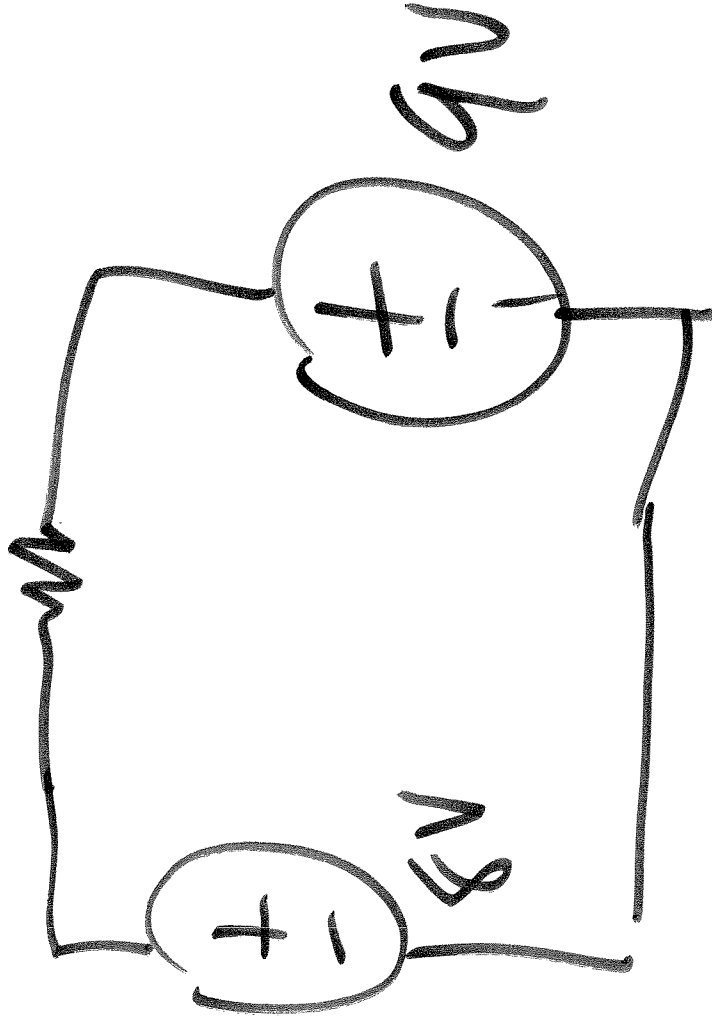
INCREASE SPEED TO 150 m/sec

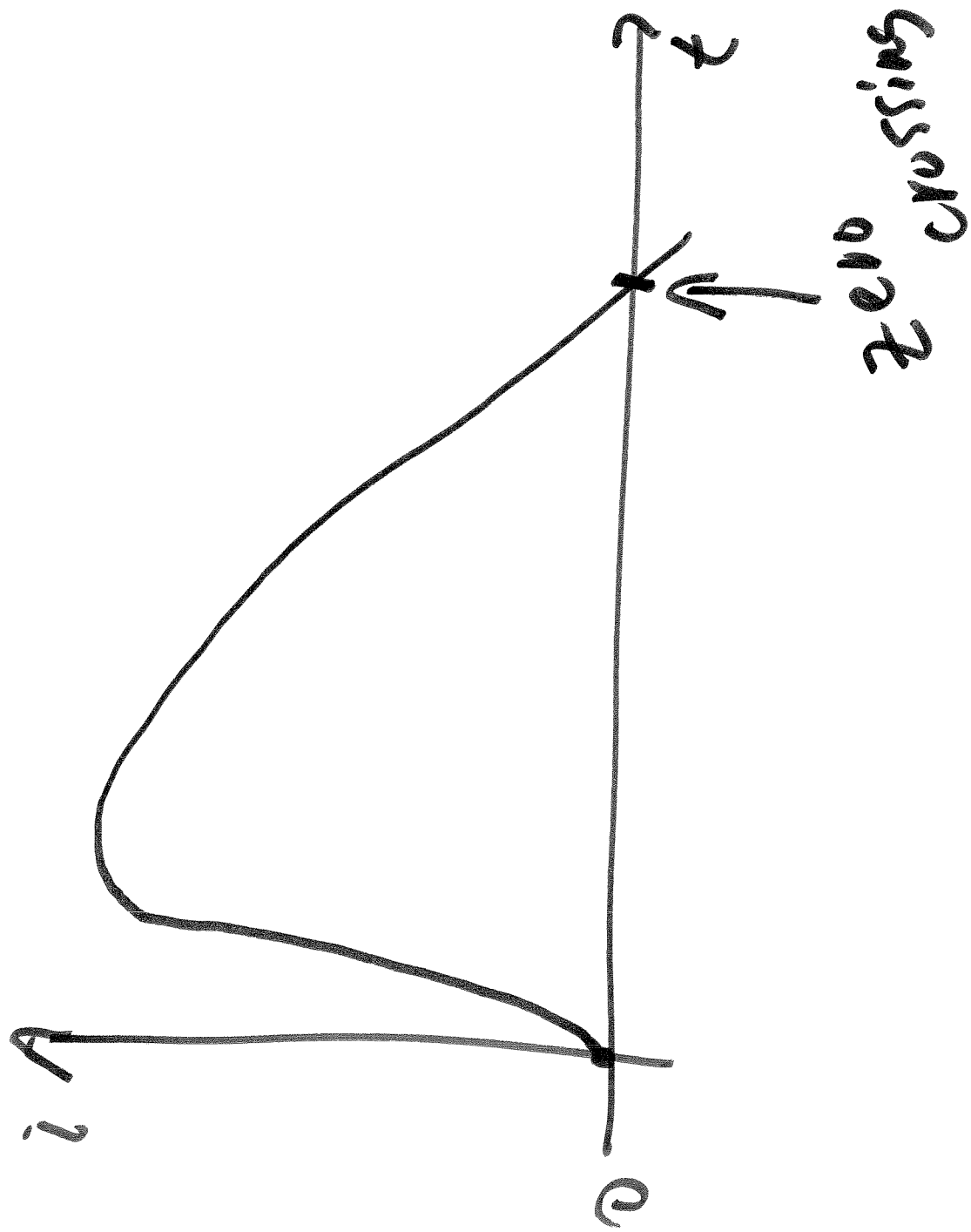
$$e = 0.8 \text{ f}$$

$$e = (150 \frac{\text{m}}{\text{sec}})(27)(3 \text{ cm})$$

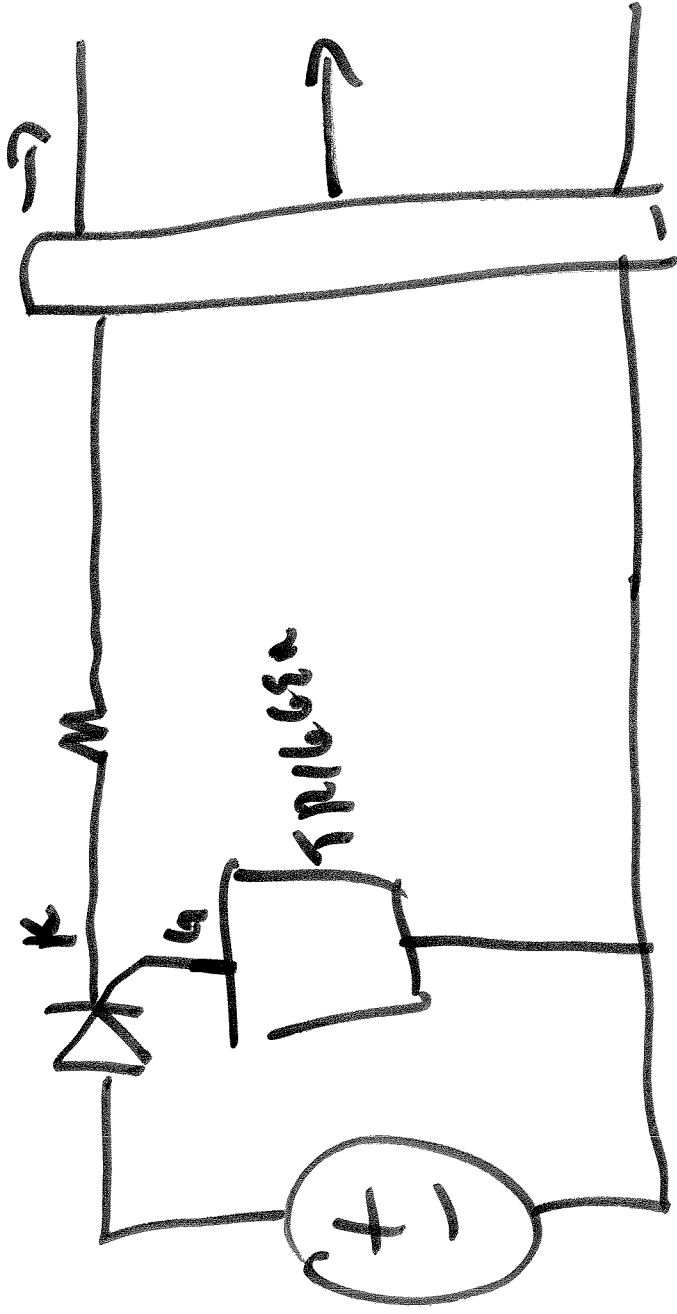
$$e = 9.0 \text{ volts}$$

65 N/m<sup>2</sup> (not)

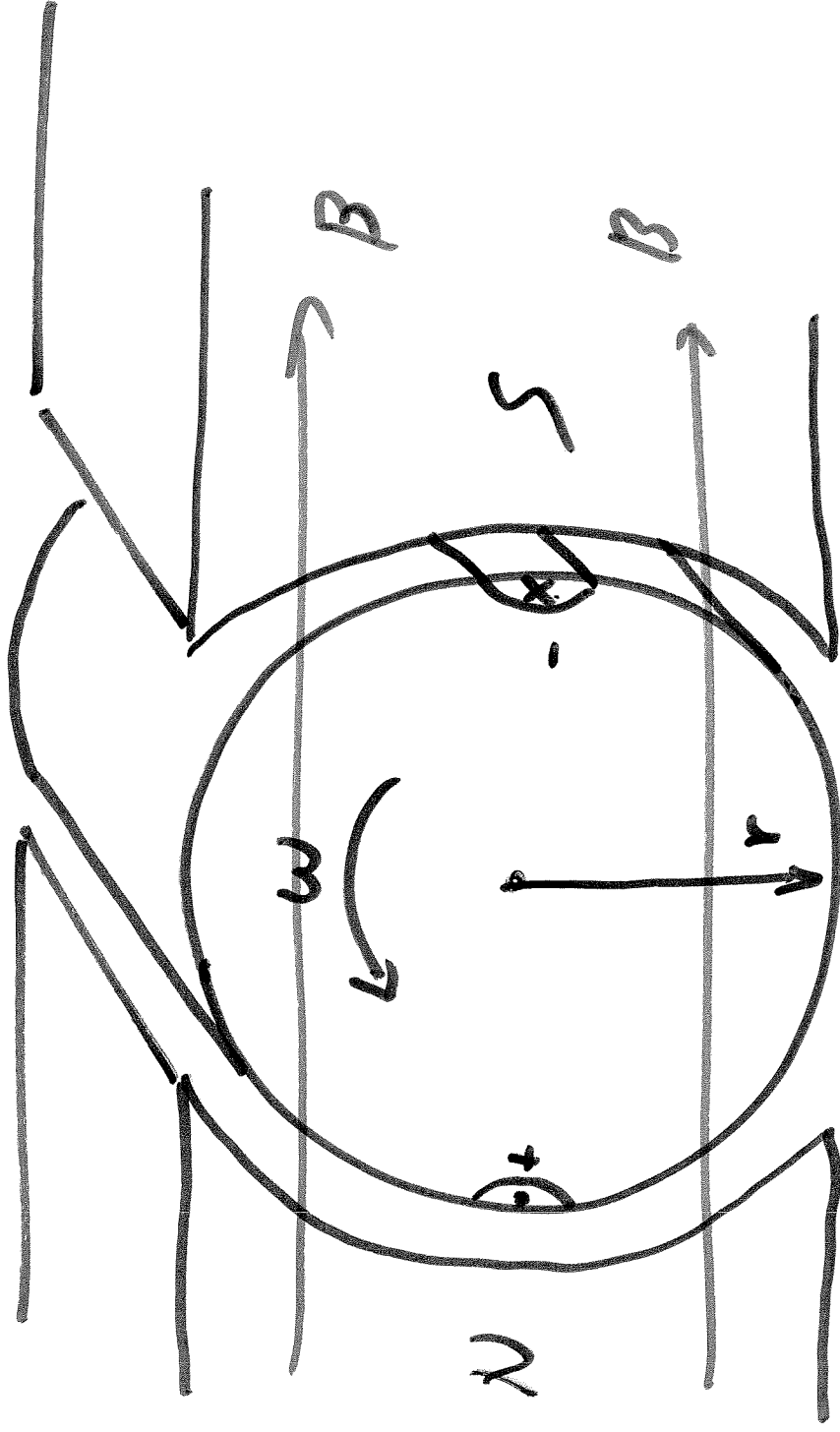




202518 KHL







$$E = (\vec{v} \times \vec{B}) \cdot d\vec{l} \quad \vec{v} = \omega r \text{ tangential}$$

$$E = \omega r \ell B \quad A = \pi r \ell$$

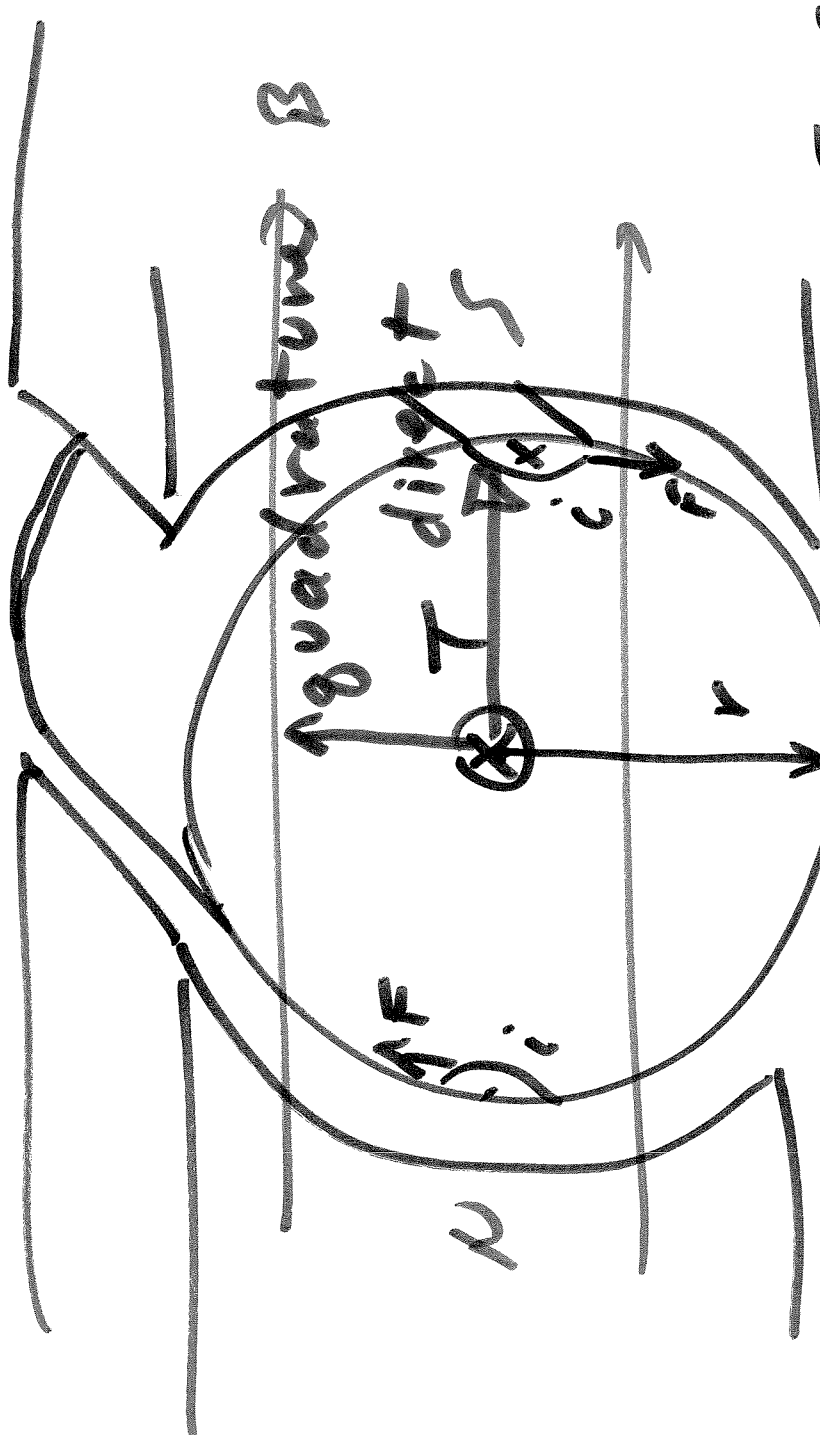
$$C = \frac{2}{\pi} B A \omega = \frac{2}{\pi} \phi \omega$$

$$\mathcal{E} = \frac{d\phi}{dt}$$

SPEED  
VARIABLE

MAGNETIC  
FLUX

ANGULAR  
VELOCITY



$$\vec{F} = i (\vec{L} \times \vec{B}) \quad \vec{T} = \vec{r} \times \vec{F}$$

$T = 2\pi i \wedge B$  tangent + force

$$T = \frac{2}{\pi} A B i = \frac{2}{\pi} \phi i$$

$$E_A = K_s \phi_d \omega$$

$$I_e = K_s \phi_d I_a$$

ECE 320

Energy Systems I

Lesson 18

DC Machines

Elementary dc motor or generator

Motor absorbs electrical energy and converts it to mechanical (kinetic and heat) energy

Generator converts mechanical (kinetic) energy to electrical energy

Two main purposes of an electric machine

1. Voltage Generation
2. Torque production

Generator: Force opposes velocity

Motor: Force aids velocity

Current ... Force or Torque

Voltage ... Speed