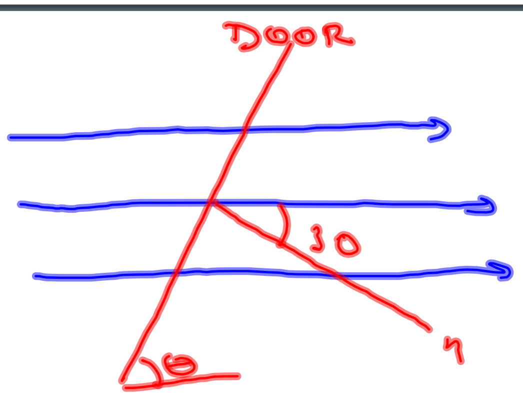
Reminders 3-25-08:
-Chapter 20 homework due 3/27
-Exam 3 April 1
-Read 21.8-21.13

Objectives:
-More on Induced EMF and Current
-Magnetic Flux
-Faraday's Law and Lenz's Law
-AC Generators and AC Motors
-Eddy Currents

What is the flux through a 1.0m by 2.0m door in a uniform B-field of 0.25T that is parallel to the floor if the (normal to) door is partially opened at 30°? measured w.r.t. direction of B-field

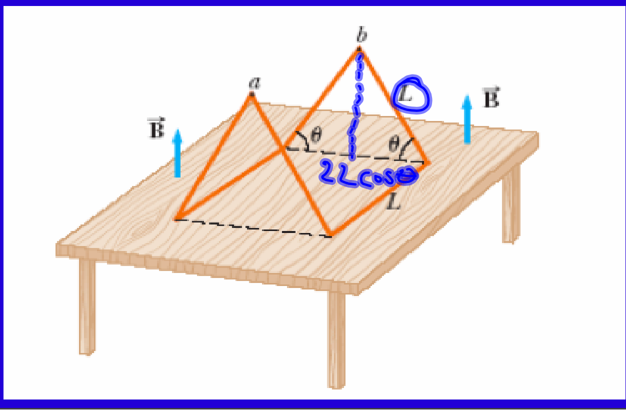


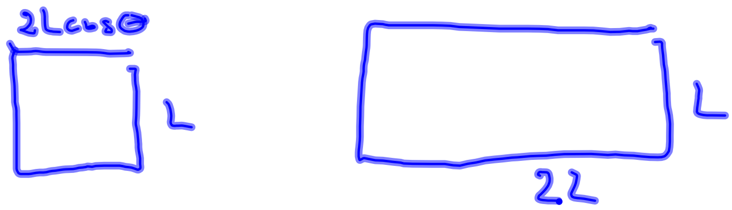
Top view

$$\Phi = BA\cos\theta = (0.25)(1.0)(2.0)\cos 30^\circ$$

unit Tm^2 or V-s

A wire is bent in the shape of a tent with $\theta = 60^\circ$ and $L = 1.4$ m, and is placed in a uniform B-field of 0.25 T directed ⊥ to the tabletop. If the tent is flattened out in 0.14 s, what is the average induced emf in the wire during this time? Note: the field lines enter the bottom surface and leave the side surfaces.





$2L^2\cos\theta$ $\qquad$ $2L^2$

$$\Delta\Phi = B(2L^2 - 2L^2\cos\theta) = 2L^2(1-\cos 60)B$$

$$\Delta\Phi = B2L^2\left(1-\tfrac{1}{2}\right) = L^2 B$$

$$|\Delta V| = \left|\frac{\Delta\Phi}{\Delta t}\right| = \frac{L^2 B}{\Delta t} = \frac{(1.4)^2(.25)}{.14\,s}$$

$$= 3.5\,V$$

Example:

What is the maximum torque delivered by an electric motor if it has 80 turns of wire wrapped on a rectangular coil of dimensions 2.50 cm by 4.00 cm? Assume that the motor uses 10.0A of current and that a uniform 0.800T magnetic field exists within the motor.

If the motor rotates at 3600 rev/min, what is the peak power produced by the motor?

$$\tau = NAIB$$
$$= (80)(.025)(.04)(10A)(.8T) = 0.64\,N\text{-}m$$

$$P = IV = I(NAB\omega)$$
$$= (10)(80)(.025)(.04)(.8)(60)$$
$$= 241\ \text{Watts}$$

Back EMF

- Because the coils of any motor rotate in a B-field an EMF is induced (back EMF) which tends to oppose the applied voltage V. Thus, the net voltage across the motor is V-$\mathcal{E}$, and the current drawn by the motor is I=(V- $\mathcal{E}$)/R.

- Suppose a motor has a resistance 4.1Ω. It is then plugged into a 120V outlet. At normal speed the back EMF is 118V. Calculate I at startup and at normal running speed.

$$I = \frac{120\,V}{4.1\,\Omega} = 29.2\,A$$

$$I = \frac{120\,V - 118\,V}{4.1\,\Omega} = 0.49\,A \text{ running}$$