Homework 30.1

In fig 30-33, a circular loop of wire 10 cm in diameter (seen edge on) is placed with its normal **N** at an angle $\theta = 30^{\circ}$ with the direction of a uniform magnetic field **B** of magnitude 0.50 T. The loop is then rotated such that **N** rotates in a cone about the field direction at the rate 100 rev/min; angle θ remains unchanged during the process. What is the emf induced in the loop?

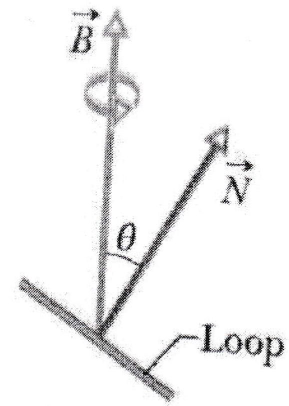


Figure 30-33

$\phi = BA\cos\theta = \vec{B}\cdot\vec{A}$

ϕ is constant

$\therefore \frac{d\phi}{dt} = 0 =$ emf induced

Homework 30.7

In fig 30-38, the magnetic flux through the loop increases according to therelation $\Phi_B = 6.0\,t^2 + 7.0\,t$, where Φ_B is in milliwebers and t is in seconds. (a) What is the magnitude of the emf induced in the loop when $t = 2.0\ s$? (b) Is the direction of current through R to the right or left?

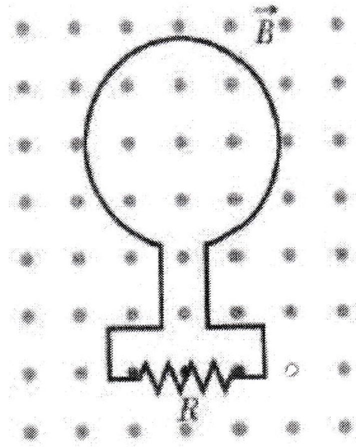


Figure 30-38

$\phi = 6.0t^2 + 7.0t$ OUT of Page

$\mathcal{E} = \frac{d\phi}{dt} = 12t + 7$ $\frac{\text{milli webers}}{\text{sec}}$

at $t = 2$

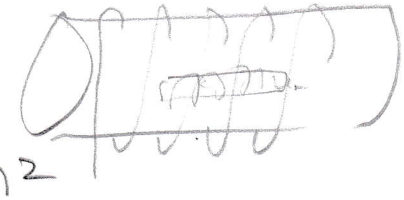
$\mathcal{E} = 24 + 7 = \underline{31\ mV}$

Since ϕ is increasing out of the page By Lenz's LAW the induced current will create a flux into the page to counter the increase in ϕ. By the RHR a clockwise current produces flux into the page.

Current flows clockwise around the loop and left through R

Homework 30.9

A small loop of area 6.8 mm^2 is placed inside a long solenoid that has 854 turns/cm and carries a sinusoidally varying current *i* of amplitude 1.28 A and angular frequency 212 rad/s. The central axis of the loop and the solenoid coinside. What is the amplitude of the emf induced in the loop?



$A = 6.8\ mm^2 = 6.8 \times 10^{-6}\ m^2$

$i = 1.28 \sin \omega t \qquad \omega = 212\ rad/sec$

$n = 854 \frac{Turns}{cm} \times \frac{100 cm}{m} = 8.54 \times 10^4 \frac{Turns}{m}$

$B = \mu_0 i n = \mu_0\ 1.28 \sin \omega t \times 8.54 \times 10^4$

$\phi = BA = \mu_0\ 1.28 \sin \omega t \times 8.54 \times 10^4 \times 6.8 \times 10^{-6}$

$\mathcal{E} = \frac{d\phi}{dt} \qquad \frac{d}{dt}(\sin \omega t) = \omega \cos \omega t$

$\mathcal{E} = \mu_0\ 1.28\ \omega \cos \omega t \times 8.54 \times 6.8 \times 10^{-2}$

$= 4\pi \times 10^{-7} * 1.28 * 212 \cos \omega t * 8.54 \times 6.8 \times 10^{-2}$

$\text{Amplitude} = 4\pi * 1.28 * 212 * 8.54 \times 6.8 \times 10^{-9}$

$= 0.198 \times 10^{-3}$

Amplitude = 0.198 mV

Homework 30.21

In Fig. 30-46, a stiff wire bent into a semicircle of radius a = 2.0 cm is rotated at constant angular speed 40 rev/s in a uniform 20 mT magnetic field. What are the (a) frequency and (b) amplitude of the emf induced in the loop?

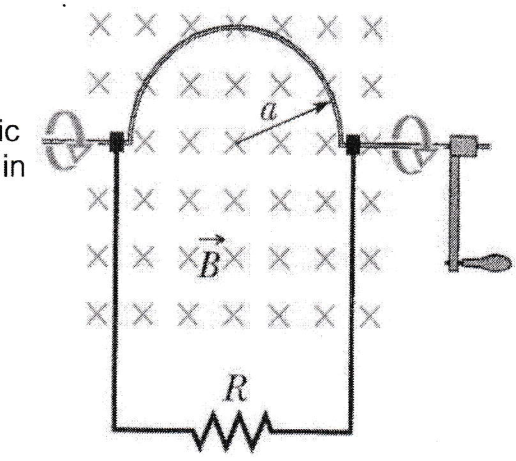


Figure 30-46

$$\phi = \vec{B} \cdot \vec{A} = BA\cos\theta$$

$$\theta = \omega t$$

$$A = \frac{\pi r^2}{2} = \frac{\pi a^2}{2}$$

$$\phi = 20\times10^{-3}\,\frac{\pi a^2}{2}\cos\omega t$$

$$\mathcal{E} = \frac{d\phi}{dt} = 20\times10^{-3}\,\frac{\pi a^2}{2}\,\omega \sin\omega t$$

$$= \frac{20}{2}\times10^{-3} * \pi(.02)^2 * 40\,\frac{\text{rev}}{\text{s}} * \frac{2\pi\ \text{rad}}{\text{rev}}\ \sin\omega t$$

Amplitude

$$\text{Amplitude} = \pi\times10^{-2}\,(0.02)^2 * 40 * 2\pi$$

$$= 0.316\times10^{-2}$$

$$= 3.16\ \text{mV}$$

Homework 30.29

In Fig. 30-52, a metal rod is forced to move with constant velocity **V** along two parallel metal rails, connected with a strip of metal at one end. A magnetic field of magnitude $B = 0.350$ T points out of the paper. (a) If the rails are separated by L = 25.0 cm and the speed of the rod is 55.0 cm/s, what emf is generated? (b) if the rod has a resistance of 18.0 Ω and the rails and connector have neglible resistance, what is the current in the rod? (c) At what rate is energy being transfered to thermal energy?

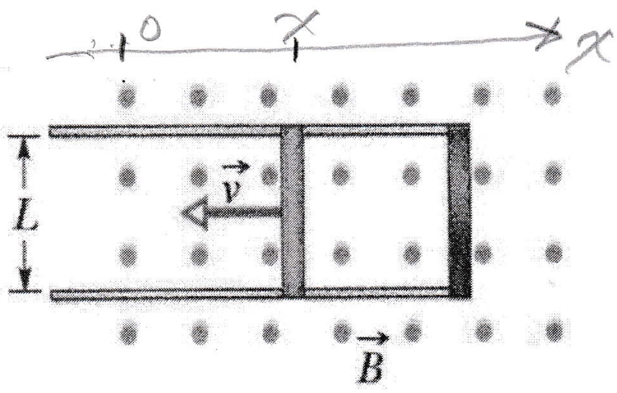


Figure 30-52

$$\phi = BA = BLx$$

$$\mathcal{E} = \frac{d\phi}{dt} = BL\frac{dx}{dt} = BLv$$

$$= 0{,}350 * 0{,}254 * 0{,}55$$

a) $\mathcal{E} = 48.1\ mV$

b) $i = \frac{\mathcal{E}}{R} = \frac{48.1 \times 10^{-3}}{18} = 2.67\ mA$

c) $P = i^2 R = (2.67)^2 \times 10^{-6} \times 18\ \Omega$

$P = 0.128\ mW$