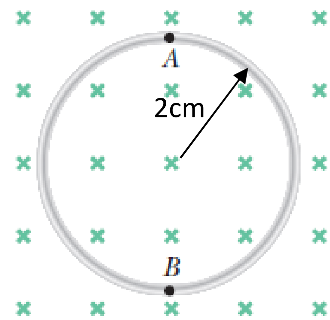
Name: ______________________________

PHY 232 Summer 2016 Class Work

Class 32. More Faraday's Law



Consider a 100 turns circular loop (2cm in radius) placed in a uniform field of 1.5T as shown in the diagram, at t=0. Calculate the induced emf (magnitude only) in the following cases:

(a) The field is increased from 1.5T to 3T in 0.5s.

$$\text{Total iniital magnetic flux} = 100 \times \pi\,(0.02)^2 \times 1.5$$
$$\text{Total final magnetic flux} = 100 \times \pi\,(0.02)^2 \times 3.0$$
$$\begin{aligned}\Delta\Phi_B &= 100 \times \pi\,(0.02)^2 \times 3.0 - 100 \times \pi\,(0.02)^2 \times 1.5 \\ &= 100 \times \pi\,(0.02)^2 \times (3.0 - 1.5) \\ &= 100 \times \pi\,(0.02)^2 \times 1.5 \\ &= 0.1885\end{aligned}$$
$$\therefore |\,\text{Induced emf}\,| = \left|\frac{\Delta\Phi_B}{\Delta t}\right| = \frac{0.1885}{0.5} = \underline{\underline{0.377\text{V}}}$$

(b) The loop is grasped at points *A* and *B* and stretched until its area is nearly zero in 0.1s.

$$\text{Total iniital magnetic flux} = 100 \times \pi\,(0.02)^2 \times 1.5$$
$$\text{Total final magnetic flux} = 100 \times \pi\,(0.02)^2 \times 0$$
$$\begin{aligned}\Delta\Phi_B &= 0 - 100 \times \pi\,(0.02)^2 \times 1.5 \\ &= -0.1885\end{aligned}$$
$$\therefore |\,\text{Induced emf}\,| = \left|\frac{\Delta\Phi_B}{\Delta t}\right| = \frac{0.1885}{0.1} = \underline{\underline{1.885\text{V}}}$$

(c) What is the emf as a function of t if the loop is rotating with bearing at A and B with an angular speed of 10 radian per second?

$$\text{Magnetic flux} = 100 \times \pi\,(0.02)^2 \times 1.5 \times \cos\omega t \quad (\cos\omega t \;\text{ because angle between loop area and the magnetic field is } 0^\circ \text{ at } t = 0)$$
$$= 0.1885 \cos 10\,t$$
$$\begin{aligned}\therefore \text{Induced emf} &= \frac{d\,\Phi_B}{d\,t} = \frac{d}{d\,t}\,0.1885 \cos 10\,t \\ &= -0.1885 \times 10 \sin 10\,t \\ &= \underline{\underline{-1.885 \sin 10\,t}}\end{aligned}$$