Answer on Question #74121, Physics / Electromagnetism

A conducting ring of radius 0.15m is set to turn around a vertical axis in a region where there is a horizontal magnetic field. The intensity of the magnetic field is 0.04T.

a) What is the magnitude of the maximum value attained by the magnetic flux through the ring?

b) If the ring takes 2 seconds to do a full 360 degree revolution, what is the magnitude of the average emf produced as it does one quarter turn, passing from an orientation parallel to the field to an orientation perpendicular to it?

Solution:

a) In the case that the surface is perpendicular to the field the magnetic flux is:

$$\Phi = B \cdot Area = B \cdot \pi r^2$$

Substituting,

$$\Phi = (0.04\ \text{T}) \cdot \pi \cdot (0.15^2\ \text{m}^2) = 0.0028\ \text{Wb}$$

b)

According to Faraday's Law

$$\text{Emf} = -\frac{\Delta\Phi}{\Delta t}$$

where Φ = magnetic flux. The minus sign denotes Lenz's Law.

$$\Delta t = \frac{2}{4} = 0.5\ s$$

$$\Delta\Phi = \Phi_\text{f} - \Phi_\text{i} = 0.0028 - 0 = 0.0028\ \text{Wb}$$

Thus, the magnitude of the average emf

$$\text{Emf} = \left|\frac{\Delta\Phi}{\Delta t}\right| = \frac{0.0028\ \text{Wb}}{0.5\ \text{s}} = 0.0056\ \text{V}$$

Answer: a) 0.0028 Wb; b) 0.0056 V.