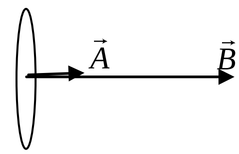
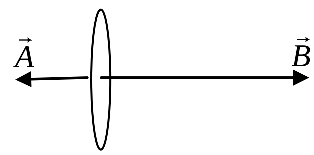
Q- A 25 turn circular coil of wire has a diameter of 1.0m. It is placed with its axis (a line through the centre of the coil at right angles to its plane) along the direction of the Earth's magnetic field of 50 μT. The coil is then flipped in a time of 0.2s through an angle of 180^0. Calculate the magnitude of the emf generated in the coil.

The area of the coil $A = \pi R^2$





Initially the field is parallel to the axis of the coil or parallel to the area vector, hence the magnetic flux through the area A will be given by

$$\phi_B = \vec{B} \bullet \vec{A} = B * A * \cos\theta$$

Or $$\phi_B = B * \pi R^2 * \cos 0^0 = B * \pi R^2$$

As the number of turns in the coil is n = 25, the flux through the coil will be given by

$$\phi_1 = n * B * \pi R^2$$

When the coil is flipped by 180^0, now the flux through it is negative (crossing in opposite direction) given as

$$\phi_2 = n * B * \pi R^2 * \cos 180^0 = -n * B * \pi R^2$$

Hence during the flipping, the change in magnetic flux through the coil will be

$$\phi_2 - \phi_1 = -n * B * \pi R^2 - n * B * \pi R^2 = -2n * B * \pi R^2$$

As this change occurs in Δt = 0.2 s, according to Faraday's laws of electromagnetic induction the induced EMF is given by

$$e = -\frac{\Delta\phi_B}{\Delta t} = \frac{2nB\pi R^2}{\Delta t}$$

Substituting the values we have

$$e = \frac{2nB\pi R^2}{\Delta t} = \frac{2 * 25 * 50 * 10^{-6} * \pi * (0.5)^2}{0.2} = 9.82 * 10^{-3} V$$

Or induced EMF in the coil will be **9.82 mV**.