

Answer on Question #57893, Physics / Electromagnetism

An armature coil consists of 20 turns of wire, each of area $A = 0.09\text{m}^2$ and total resistance 15.0 . It rotates in a magnetic field of 0.5T at a constant frequency of $150/3.14$. Calculate the value of (i) maximum (ii) average induced emf produced in the coil 2

Find: $\text{emf}_{\text{max}} - ?$ $\text{emf} - ?$

Given:

$$N=20$$

$$A=9\times10^{-2} \text{ m}^2$$

$$B=0.5 \text{ T}$$

$$\omega=150/3.14 \text{ s}^{-1}$$

$$R=15 \Omega$$

Solution:

Law of electromagnetic induction:

$$\text{emf} = -N \frac{\Delta\Phi}{\Delta t} \quad (1),$$

where N – number of turns of wire,

$\Delta\Phi$ – change of magnetic flux that passes through the area,

Δt – time for which a change happens

$$\frac{\Delta\Phi}{\Delta t} - \text{derivative}$$

Magnetic flux:

$$\Phi = BA \cos \omega t \quad (2).$$

$$(2) \text{ in } (1): \text{emf} = NBA\omega \sin \omega t \quad (3)$$

$$\text{The general expression: } \text{emf} = \text{emf}_{\text{max}} \sin \omega t \quad (4)$$

$$\text{Of (3) and (4)} \Rightarrow \text{emf}_{\text{max}} = NBA\omega \quad (5)$$

$$\text{Of (5)} \Rightarrow \text{emf}_{\text{max}} = 43 \text{ V}$$

The average value for the period of oscillations: $\text{emf}=0 \text{ V}$

Answer:

$$\text{emf}_{\text{max}} = 43 \text{ V}$$

$$\text{emf} = 0 \text{ V}$$