QB365 Question Bank Software

12th Physics Case study Questions Electromagnetic Induction For - 2024

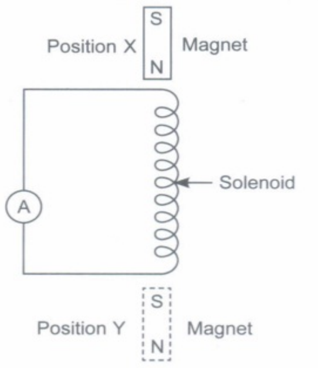
12th Standard

Physics

SECTION - A

2 x 4 = 8

1) A solenoid is held in a vertical position. The solenoid is connected to a sensitive, centre-zero ammeter. A vertical bar magnet is held stationary at position X just above the upper end ofthe solenoid as shown.



The magnet is released and it falls through the solenoid. During the initial stage of the fall, the sensitive ammeter shows a small deflection to the left

(i) Explain why the ammeter shows a deflection.

(ii) The magnet passes the middle point of the solenoid and continues to fall. It reaches position Y. Describe and explain what is observed on the ammeter as the magnet falls from the middle point of the solenoid to position Y.

(iii) Suggest two changes in the apparatus that would increase the initial deflection of the ammeter

Answer : (i) As magnet approaches solenoid, magnetic flux linked with the solenoid increases and emf is induced.

(ii) Ammeter will show larger deflection in opposite direction as change in magnetic flux is faster.

(iii) Any two

(a) By using stronger magnet.

(b) By using solenoid of same length with more turns.

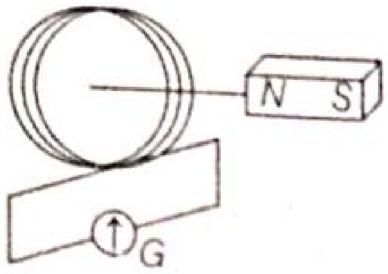
(c) By dropping from further up.

(d) By using solenoid wire of smaller resistance.

2) According the Faraday's first law, whenever the amount of magnetic flux linked with a circuit changes, an emf is induced in it. Induced current is determined by the rate at which the magnetic flux changes. Mathematically, the magnitude of the induced emf in a circuit is equal to the rate of change of magnetic flux through the circuit.

Induced emf ∞ Rate of change of magnetic flux

(i) On the basis of Faraday's law, current in the coil is larger



(a) when the magnet is pushed towards the coil faster

(b) when the magnet is pulled away the coil faster

(c) Both (a) and (b)

(d) Neither (a) nor (b)

(ii) The flux linked with a circuit is given by $\phi = t^3 + 3t - 7$. The graph between time (X-axis) and induced emf (Y-axis) will be a

(a) straight line through the origin

(b) straight line with positive intercept

(c) straight line with negative intercept

(d) parabola not through the origin

(iii) Wire loop is rotated in a magnetic field. The frequency of change of direction of the induced emf is
(a) once per revolution
(b) twice per revolution
(c) four times per revolution
(d) six times per revolution
(iv) The instantaneous magnetic flux linked with a coil is given by $\phi = (5t^3 - 100t + 300)$ Wb. the emf induced in the coil at time t = 2 s is
(a) - 40 V (b) 40 V (c) 140 V (d) 300 V
(v) A copper disc of radius 0.1 m is rotated about its centre with 20 rev/s in a uniform magnetic field of 0.1T with its plane perpendicular to the field. The emf induced across the radius of the disc is
(a) $\frac{\pi}{20}V$ (b) $\frac{\pi}{10}$ V (c) 20 πmV (d) None of these

Answer : (i) (c) Current will be larger, when the magnet is pushed faster towards the coil, also current is large when magnet is pulled faster away but now it is in opposite direction.
(ii) (d) $\phi = t^3 + 3t - 7$

$$\therefore \quad \text{Induced emf, } e = -\frac{d\phi}{dt} = -\left(3t^2 + 3\right)$$

$= - 3t^2 - 3$
At t = 0; e = -3V
Therefore, shape of graph will be a parabola not through origin. ($\because e \propto t^2$)
(iii) (b) If a wire loop is rotated in a magnetic field, the frequency of change in the direction of the induced emf is twice per revolution.
(iv) (b) Given, $\phi = (5t^3 - 100t + 300)$, t = 2 s
Induced electromotive force,

$$e = -\frac{d\phi}{dt} = -\frac{d}{dt}\left(5t^3 - 100t + 300\right)$$

$e = -5 \times 3t^2 + 100 = -5 \times 3(2)^2 + 100$
$= -5 \times 12 + 100 = -60 + 100 = 40$ V
(v) (c) From Faraday's law of electromagnetic induction,

$$e = -\frac{d\phi}{dt} = -BAN \ (\because dt = 1s)$$

Given, B = 0.1 T, N = 20, $A = \pi r^2 = \pi(0.1)^2$
$\therefore e = 0.1 \times 20 \times \pi(0.1)^2 = 20\pi$ mV