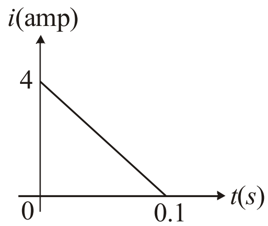
20 Electromagnetic Induction

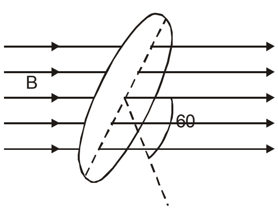
Diagram Based Questions :

1. In a coil of resistance 10 Ω, the induced current developed by changing magnetic flux through it, is shown in figure as a function of time. The magnitude of change in flux through the coil in weber is



(a) 8 (b) 2
(c) 6 (d) 4

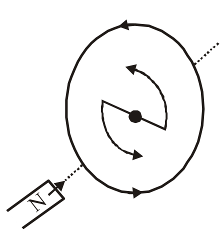
2. Fig shown below represents an area A = 0.5 m^2 situated in a uniform magnetic field B = 2.0 weber/m^2 and making an angle of 60º with respect to magnetic field.



The value of the magnetic flux through the area would be equal to

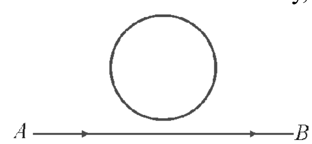
(a) 2.0 weber (b) $\sqrt{3}$ weber
(c) $\sqrt{3}/2$ weber (d) 0.5 weber

3. In the given situation, the bar magnet experinces a ...A... force due to the ... B ... in coil.



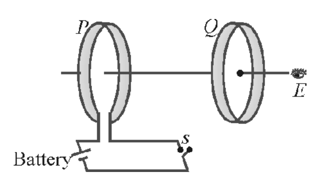
Here, A and B refer to
(a) an attractive, air
(b) an attractive, induced current
(c) repulsive, induced current
(d) attractive, vacuum

4. An electron moves along the line AB, which lies in the same plane as a circular loop of conducting wires as shown in the diagram. What will be the direction of current induced if any, in the loop



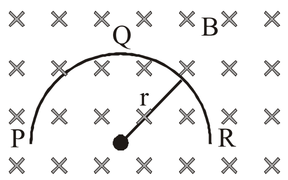
(a) no current will be induced
(b) the current will be clockwise
(c) the current will be anticlockwise
(d) the current will change direction as the electron passes by

5. As shown in the figure, P and Q are two coaxial conducting loops separated by some distance. When the switch S is closed, a clockwise current I_P flows in P (as seen by E) and an induced current I_{Q_1} flows in Q. The switch remains closed for a long time. When S is opened, a current I_{Q_2} flows in Q. Then the directions of I_{Q_1} and I_{Q_2} (as seen by E) are



(a) respectively clockwise and anticlockwise
(b) both clockwise
(c) both anticlockwise
(d) respectively anticlockwise and clockwise

6. A thin semicircular conducting ring (PQR) of radius 'r' is falling with its plane vertical in a horizontal magnetic field B, as shown in figure. The potential difference developed across the ring when its speed is v, is :



(a) Zero
(b) $Bv\pi r^2/2$ and P is at higher potential
(c) πrBv and R is at higher potential
(d) $2rBv$ and R is at higher potential

Solution

1. **(b)** The charge through the coil = area of current-time ($i - t$) graph

$$q = \frac{1}{2} \times 0.1 \times 4 = 0.2 \text{ C}$$

$$q = \frac{\Delta\phi}{R} \quad \because \text{Change in flux } (\Delta\phi) = q \times R$$

$$q = 0.2 = \frac{\Delta\phi}{10}$$

$\Delta\phi = 2$ weber

2. **(d)** $\phi = BA\cos\theta = 2.0 \times 0.5 \times \cos 60^\circ$

$$= \frac{2.0 \times 0.5}{2} = 0.5 \text{ weber.}$$

3. **(c)** In this situation, the bar magent experiences a repulsive force due to the induced current. Therefore, a person has to do work in moving the magnet.

4. **(d)** When electron approaches nearby the loop flux inside loop will increase and when electron recedes from the loop the flux inside loop decreases and so current change in direction.

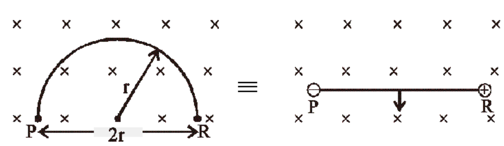
5. **(d)**

6. **(d)** Rate of decreasing of area of semicircular ring

$$= \frac{dA}{dt} = (2r)v$$

From Faraday's law of electromagnetic induction

$$e = -\frac{d\theta}{dt} = -B\frac{dA}{dt} = -B(2rv)$$



As induced current in ring produces magnetic field in upward direction hence R is at higher potential.