CHAPTER 6

# Electromagnetic Induction

## Magnetic Flux, Faraday's Law of E.M.F.

**1.** A square loop of side 1 m and resistance 1 Ω is placed in a magnetic field of 0.5T. If the plane of loop of perpendicular to the direction of a magnetic field, the magnetic flux through the loop is: *(2022)*

a. zero weber  b. 2 weber

c. 0.5 weber  d. 1 weber

**2.** The magnetic flux linked with a coil (in Wb) is given by the equation

$\phi = 5t^2 + 3t + 16$

The magnitude of induced emf in the coil at the fourth second will be *(2020-Covid)*

a. 43 V  b. 108 V

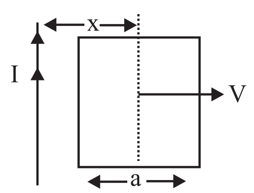
c. 10 V  d. 33 V

**3.** A 800 turn coil of effective area 0.05 $m^2$ is kept perpendicular to a magnetic field of $5 \times 10^{-5}$ T. When the plane of the coil is rotated by 90° around any of its coplanar axis in 0.1 s, the emf induced in the coil will be: *(2019)*

a. 2 V  b. 0.2 V

c. $2 \times 10^{-3}$ V  d. 0.02 V

**4.** A conducting square frame of side a and a long straight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity V. The emf induced in the frame will be proportional to: *(2015)*

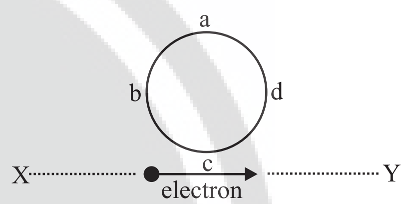



a. $\frac{1}{(2x-a)^2}$  b. $\frac{1}{(2x-a)(2x+a)}$

c. $\frac{1}{(2x+2a)(2x+a)}$  d. $\frac{1}{x^2}$

## Lenz's Law

**5.** An electron moves on a straight line path XY as shown. The *abcd* is a coil adjacent to the path of electron. What will be the direction of current, if any, induced in the coil? *(2015 Pre)*




a. No current induced

b. abcd

c. adcd

d. The current will reverse its direction as the electron goes past the coil

**6.** A wire loop is rotated in a magnetic field. The frequency of change of direction of the induced e.m.f. is: *(2013)*

a. Six times per revolution

b. Once per revolution

c. Twice per revolution

d. Four times per revolution

## Motional E.M.F.

**7.** A big circular coil of 100 turns and average radius 10 m is rotating about its horizontal diameter at 2 rad $s^{-1}$. If the vertical component of earth's magnetic field at that place is $2 \times 10^{-5}$ T and electrical resistance of the coil is 12.56 Ω, then the maximum induced current in the coil will be : *(2022)*

a. 2A  b. 0.25 A

c. 1.5 A  d. 1 A

**8.** A wheel with 20 metallic spokes each 1 m long is rotated with a speed of 120 rpm in a plane perpendicular to a magnetic field of 0.4 G. The induced emf between the axle and rim of the wheel will be. (1 G = $10^{-4}$ T) *(2020-Covid)*

a. $2.51 \times 10^{-5}$ V  b. $4.0 \times 10^{-5}$ V

c. 2.51 V  d. $2.51 \times 10^{-4}$ V

**9.** A metallic rod of mass per unit length 0.5 kg $m^{-1}$ is lying horizontally on a smooth inclined plane which makes an angle of 30° with the horizontal. The rod is not allowed to slide down by flowing a current through it when a magnetic field of induction 0.25 T is acting on it in the vertical direction. The current flowing in the rod to keep it stationary is *(2018)*

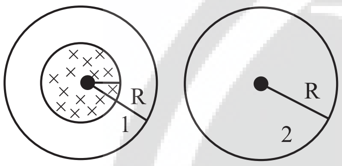
a. 14.76 A

b. 5.98 A

c. 7.14 A

d. 11.32 A

**10.** A uniform magnetic field is restricted within a region of radius r. The magnetic field changes with time at a rate $\frac{d\vec{B}}{dt}$. Loop 1 of radius R > r encloses the region r and loop 2 of radius R is outside the region of magnetic field as shown in the figure below. Then the e.m.f generated is: *(2016-II)*



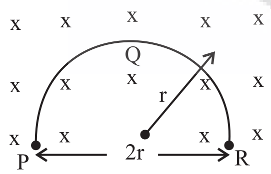

a. $-\frac{d\vec{B}}{dt}\pi R^2$ in loop 1 and zero in loop 2

b. $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 1 and zero in loop 2

c. Zero in loop 1 and zero in loop 2

d. $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 1 and $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 2

**11.** 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: *(2014)*




a. Zero

b. $Bv\pi r^2/2$ and P is at higher potential

c. $\pi rBv$ and R is at higher potential

d. 2rBv and R is at higher potential

## Eddy Currents

**12.** In which of the following devices, the eddy current effect is not used? *(2019)*

a. Induction furnace

b. Magnetic braking in train

c. Electromagnet

d. Electric heater

## Self Induction

**13.** A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn of the solenoid is $4 \times 10^{-3}$ Wb. The self inductance of the solenoid is: *(2016-I)*

a. 4 H

b. 3 H

c. 2 H

d. 1 H

## Energy Stored or Work Done in Inductor

**14.** The magnetic potential energy stored in a certain inductor is 25 mJ, when the current in the inductor is 60 mA. This inductor is of inductance: *(2018)*

a. 1.389 H

b. 138.88 H

c. 0.138 H

d. 13.89 H

## Mutual Induction

**15.** Two conducting circular loops of radii $R_1$ and $R_2$ are placed in the same plane with their centres coinciding. If $R_1 >> R_2$, the mutual inductance M between them will be directly proportional to: *(2021)*

a. $\frac{R_2}{R_1}$

b. $\frac{R_1^2}{R_2}$

c. $\frac{R_2^2}{R_1}$

d. $\frac{R_1}{R_2}$

**16.** A long solenoid of diameter 0.1 m has $2 \times 10^4$ turns per metre. At the centre of solenoid, a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0 A from 4 A in 0.05 s. If the resistance of the coil is $10\pi^2\Omega$, the total charge flowing through the coil during this time is: *(2017-Delhi)*

a. 16 μC

b. 32 μC

c. 16π μC

d. 32π μC

# Answer Key

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c | a | d | b | d | c | d | d | d | b | d | d | d | d | c | b |