Chapter- 6

Electromagnetic Induction

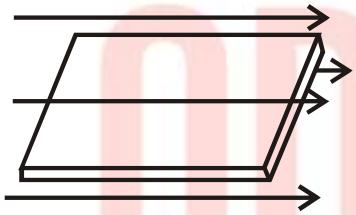
I. Very short answer type questions (1 mark each):

01. What is the basic cause of emf?

02. Why is induced emf called as back emf?

03. Show that emf and (potential) have the same dimensional formula.

04. What is the direction of emf in a conductor when it is moved parallel to the Magnetic field?



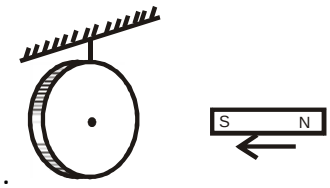
05Lenzs law is essential for

(a)Conservation of energy (b)Conservation of mass

(c)Conservation of momentum(d)Conservation of charge

II. Short answer type questions (2 marks each):

06 Give the direction in which the induced current flows in the wire loop when the magnet moves towards it



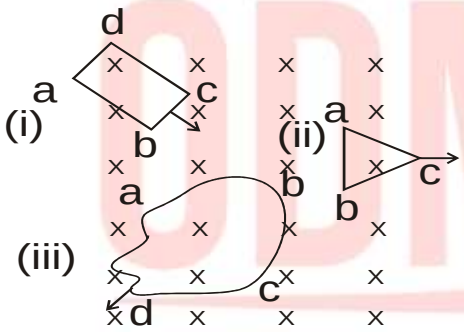
07. A circular coil of radius 10 cm, 500 turns, and resistance 2Ω is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180 degrees in 0.25 seconds.

Estimate the magnitudes of

(i) the emf induced in the coil

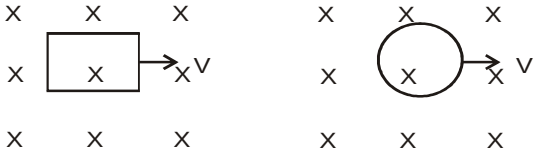
(ii) the current induced in the coil. The horizontal component of the earth's magnetic field is 3.0×10^{-5} T.

08. In the fig. shown, planar loops of different shapes moving out or into a region of the magnetic field which is directed normal to the plane of the loop away from the reader. Determine the direction of induced current in each loop using Lenz's law.

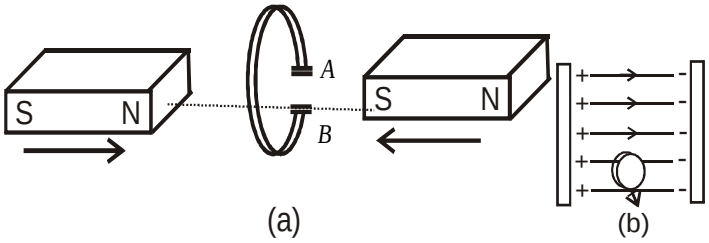


09.(a) A close loop is held stationary in the magnetic field between the north and south poles of two permanent magnets held fixed. Can we hope the generate current in the loop by using very strong magnets?

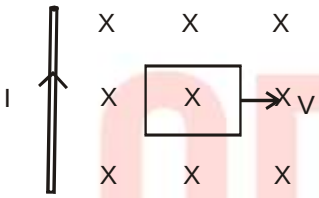
(c) A rectangular loop and a circular loop are moving out of a uniform magnetic field region to a field with a constant velocity V. In which loop do you expect the induced emf to be constant during the passage out of the field region? The field is normal to the loops.



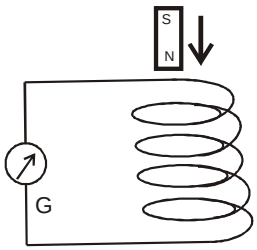
d) Predict the polarity of the capacitor in the situation described by the fig.



10. A rectangular loop of wire is pulled to right away from the long straight wire through which a steady current 'I' flows upwards. Does the current induce in the loop in the clockwise sense or anticlockwise sense?



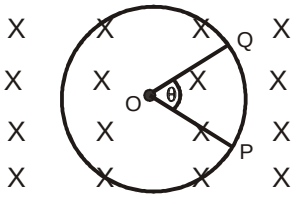
11. A bar magnet with the north pole towards the coil is falling freely through the coil.
(i) Draw the graph showing the variation of emf with time. (ii) What area of such a graph represents?



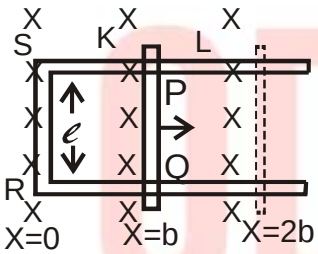
Numerical of Motional emf

12. A metallic rod of 1m length is rotated with a frequency of 50 revs/s, with one end hanged at the center and the other end at the circumference of a circular metallic ring of radius 1m, about an axis passing through the center and perpendicular to the plane of the ring.

A constant and uniform magnetic field of 1T parallel to the axis presents everywhere. What is the emf between the center and the metallic ring?



13. A Jetplane is traveling towards the west at speed of 1800 km/hr. What is the voltage difference developed between the ends of the wing, having a span of 25m if the earth's magnetic field at the location has a magnitude of $5x10^{-4}T$ and dip angle 30^0?



14. Refer to the fig. The arm of the rectangular conductor is moved from x=0, outwards. The uniform magnetic field is 1r to the plane and extends from x=0 to x=b and is zero for x>b. Only the arm PQ possesses substantial resistance r. Consider the situation when the arm PQ is pulled outward from x=0 to x=2b and is then moved back to x=0 with a constant speed V. Obtain expression back to x=0 with a constant speed V. Obtain the expression for the

(i) flux (ii) The induced emf (iii) The force necessary to pull the arm. (iv) The power dissipated as Joule heat.

Sketch the variation of these quantities with distance

15 Differentiate between field produced by static charge and induced electric field.

SELF INDUCTANCE:

16. State the relation between Henry and Weber.

17 Derive the dimensional formula for Self-Inductance.

18. (a) Obtain the expression for magnetic energy stored in a solenoid in terms of the magnetic field (B), area (A), length (l) of the solenoid.

(b) How does the magnetic energy compare with the electrostatic energy stored in a capacitor?

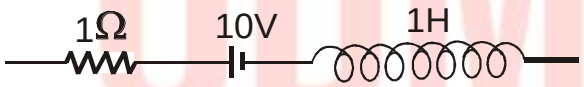
19. A solenoid with an iron core and a bulb is connected to the d.c source. How does the brightness of the bulb change when the iron core is removed from the solenoid?

20. Establish the expression for energy associated with self-inductance.

21. A 12H inductor carries a steady current of 2A. How can a 60V seif induced emf be made to appear in the inductor?

22. A resistor of 1Ω and an inductor of 1H are connected in series across a source of 10V. Suppose the current in the circuit is changing by the added device.

Find the net emf of the circuit when $\frac{dI}{dt} = 5A/s$.



COEFFICIENT OF MUTUAL INDUCTION:

23 (a) Derive an expression for the mutual inductance of two long co-axial solenoids.

(b) State the factors on which mutual inductance depends.

24. Two concentric circular coils one of small radius 'r_1' and other of large radius 'r_2' such that '$r_1 << r_2$' are placed co-axially with center coinciding. Obtain the mutual inductance of the arrangement.

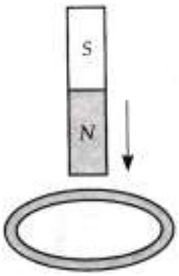
25. In Faraday's experiment

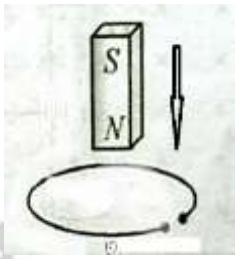
(a) What would you do to obtain a large deflection of the galvanometer?

(b) How would you demonstrate the presence of induced current in the absence of a galvanometer

26. A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring as shown in the following diagrams. State whether its

acceleration a is equal to greater than or less than the acceleration due to gravity g.





27. The current flowing through an inductor of self-inductance L is continuously increasing. Plot a graph showing the variation of

(a) Magnetic flux ~ current (b) Induced emf ~ dI/dt (c) Magnetic P.E ~ current