Physics

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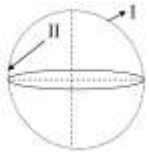
Board -	Class - 12	Topic - EMI

LEVEL-I

1. Two concentric circular coils are perpendicular to each other. Coil I carries a current i. If this current is changed, will this induce a current in the coil II

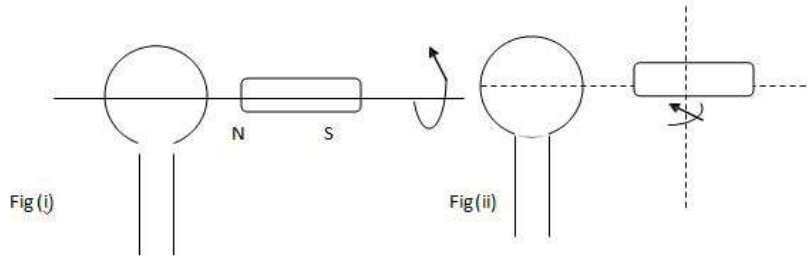


Ans: No field due to one coil is parallel to the plane of the second coil. So flux does not change

2. A closed loop of wire is being moved with constant velocity without changing its orientation inside a uniform magnetic field. Will this induce a current in the loop?

Ans: No there is no change in Φ_B

3. A cylindrical bar magnet is kept along the axis of a circular coil and near it as shown in the fig. Will there be any induced current at the terminals of the coil when the magnet is rotated a) about its own axis b) about an axis perpendicular to the length of the magnet?



Ans: Fig. (i) No e.m.f will be induced, as these is no change in flux.
Fig (ii) Yes, Φ changes continuously. So e.m.f is induced in the coil.

4. A wire is kept along the N→S direction and is allowed to fall freely. Will an e.m.f be induced in the wire?

Ans: No

5. A wire is kept along the E→W direction and is allowed to fall freely. Will an e.m.f be induced in the wire?

Ans: Yes

6. A vertical magnetic pole falls down through the plane of magnetic meridian. Will any e.m.f be induced between its ends?

Ans: No, because the pole intercepts neither B_V or B_H

7. A wheel with a certain number of spokes is rotated in a plane normal to earth's magnetic field so that an emf is induced between the axle and rim of the wheel, keeping all other things same, number of spokes is changed. How is the e.m.f affected?
(Hint: Number of spokes does not affect the net emf)

LEVEL-II

1. Name the various methods of producing induced emf?

2. Explain any two applications of eddy current.

3. The magnetic flux linked with a coil passing perpendicular to the plane of the coil changes with time $\phi = 4t^2 + 2t + 3$, where t is the time in seconds. What is magnitude of e.m.f induced at $t = 1$ second?

   Ans: 10V

4. A wheel fitted with spokes of radius r is rotating at a frequency of n revolutions per second in a plane perpendicular to magnetic field B Tesla. What is the e.m.f induced between the axle and rim of the wheel?

   Ans: $B\pi r^2 n$

5. A conducting circular loop is placed in a uniform magnetic field B = 0.020T with its plane perpendicular to the field. Somehow, the radius of the loop starts shrinking at a constant rate of 1mm/s. Find the induced current in the loop at an instant when the radius is 2cm.

   Ans: 25μV

6. A 12V battery is connected to a 6Ω, 10 H coil through a switch drives a constant current in the circuit. The switch is suddenly opened. Assuming that it took 1ms to open the switch calculate the average e.m.f induced across the coil.

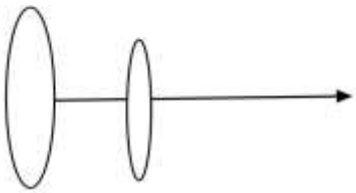
   Ans: 20000V

7. A coil of mean area 500 cm^2 having 1000 turns is held perpendicular to a uniform magnetic field of 0.4 G. The coil is turned through 180° in $\frac{1}{10}$ seconds. Calculate the average induced e.m.f.

   Ans: 0.04 V

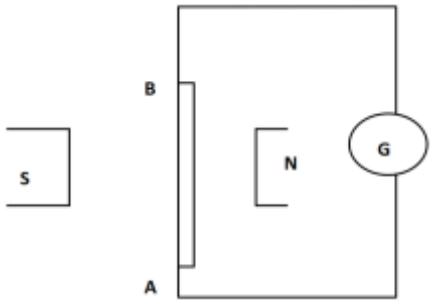
8. A conducting rod of length l with one end pivoted is rotated with a uniform angular speed ω in a vertical plane normal to uniform magnetic field B. Deduce an expression for e.m.f induced in this rod.

9. Two identical co-axial coils carry equal currents. What will happen to the current in each loop if the loops approach each other?



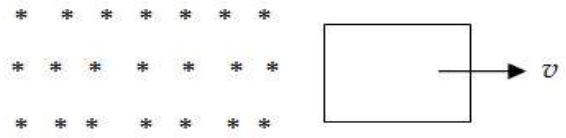
   Ans: According to Lenz's law current in each coil will decrease

10. Obtain the direction of induced current and e.m.f when the conductor AB is moved at right angles to a stationary magnetic field
    a) in the upward direction
    b) in the downward direction



   Ans: (a) B to A (b) A to B

11. Draw a graph showing the variation of power delivered against speed for a conducting loop shown in figure.



Ans: $P = \frac{B^2 l^2 v^2}{r}$

12. Two conducting circular loops of radii R1 and R2 are placed in the same plane with their centres coinciding. Find the mutual inductance between them assuming $R_2 \ll R_1$

Ans: $M = \frac{\mu_0 \pi R_2^2}{R_1}$

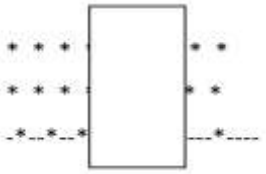
13. Prove that the total inductance of two coils connected in parallel is $\frac{1}{L_T} = \frac{1}{L_2} + \frac{1}{L_2}$

LEVEL-III

1. Two coils have a mutual inductance of 0.005H. The current changes in the first coil according to the equation $I = I_0 \sin \omega t$ where $I_0 = 10A$ and $\omega = 100\pi$ rad/s. Calculate the maximum value of e.m.f in the second coil.

Ans: 5 π volts

2. A long rectangular conducting loop of width L, mass m and resistance R is placed partly above and partly below the dotted line with the lower edge parallel to it. With what velocity it should continue to fall without any acceleration?



Ans: $v = \frac{mgR}{B^2 L^2}$

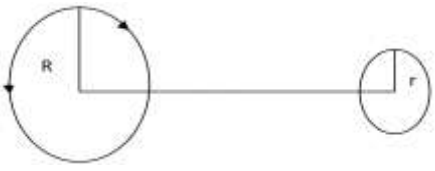
3. Define mutual inductance and derive its expression for mutual inductance between two solenoids

4. Two circular loops are placed with their centers at fixed distance apart. How would you orient the loops to have (i) maximum (ii) minimum mutual inductance?

5. A coil of wire of certain radius has 600 turns and inductance of 108mH. What will be the inductance of another similar coil with 500 turns?

Ans: 75mH

6. Obtain the mutual inductance of a pair of coaxial circular coils kept separated by a distance as shown in figure.



7. Prove that for series connection of two coils $L_T = L_1 + L_2 + 2M$

8. How is the mutual inductance of a pair of coils affected when
   a) Separation between the coils is increased
   b) the number of turns of each coil is increased
   c) A thin sheet of iron is placed between the two coils, other factors remaining the same.

   Explain your answer in each case.