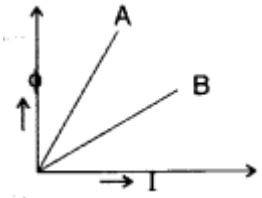
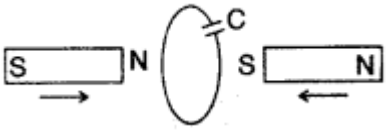
CLASS 12 PHYSICS PREVIOUS YEAR QUESTIONS
ELECTRO MAGNETIC INDUCTION

Question 1. A plot of magnetic flux (ϕ) versus current (I) is shown in the figure for two inductors A and B. Which of the two has larger value of self inductance? (Delhi 2010)

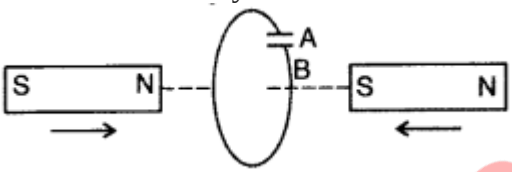


Question 2. Define self-inductance of a coil. Write its S.I. unit. (All India 2010)

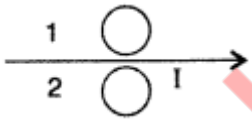
Question 3. Two bar magnets are quickly moved towards a metallic loop connected across a capacitor 'C' as shown in the figure. Predict the polarity of the capacitor. (All India 2013)



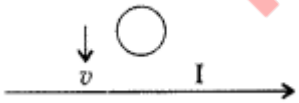
Question 4. Predict the polarity of the capacitor when the two magnets are quickly moved in the directions marked by arrows.



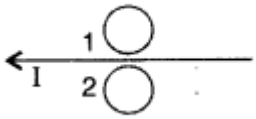
Question 5. Predict the directions of induced currents in metal rings 1 and 2 lying in the same plane where current I in the wire is increasing steadily.



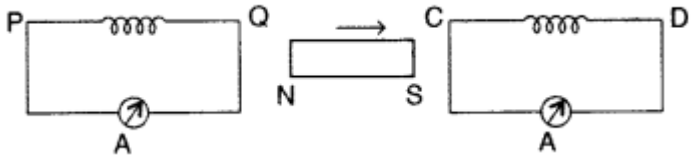
Question 6. Predict the direction of induced current in a metal ring when the ring is moved towards a conductor is carrying current I in the direction shown in the figure.



Question 7. Predict the directions of induced current in metal rings 1 and 2 when current I in the wire is steadily decreasing?

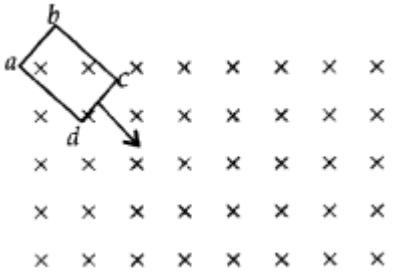


Question 8. A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the directions of induced current in each coil. (All India 2012)



Question 9. State Lenz's law. (Comptt. All India 2012)

Question 10. Predict the direction of the induced current in the rectangular loop abed as it is moved into the region of a uniform magnetic field *[Math Processing Error]* directed normal to the plane of the loop. (Comptt. All India 2012)



Question 11. State Faraday's law of electromagnetic induction. (Comptt. All India 2012)

Question 12. How does the mutual inductance of a pair of coils change when
(i) distance between the coils is increased and
(ii) number of turns in the coils is increased (All India 2013)

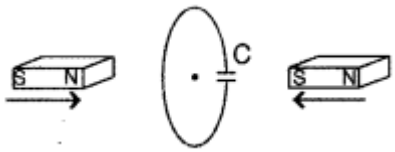
Question 13. A light metal disc on the top of an electromagnet is thrown up as the current is switched on. Why? Give reason. (All India 2013)

Question 14. The motion of copper plate is damped when it is allowed to oscillate between the two poles of a magnet. What do the cause of this damping? (All India 2013)

Question 15. The motion of copper plates is damped when it is allowed to oscillate between the two poles of a magnet. If slots are cut in the plate, how will the damping be affected? (All India 2013)

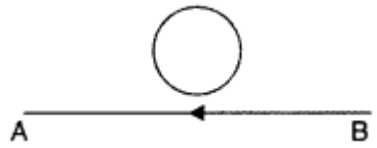
Question 16. How does the mutual inductance of a pair of coils change when
(i) distance between the coils is decreased and
(ii) number of turns in the coils is decreased? (All India 2013)

Question 17. Predict the polarity of the capacitor in the situation described in the figure. (Comptt. Delhi 2013)

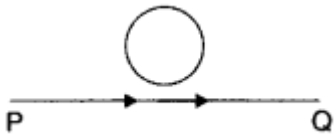


Question 18. Two spherical bobs, one metallic and the other of glass, of the same size are allowed to fall freely from the same height above the ground. Which of the two would reach earlier and why? (Delhi 2014)

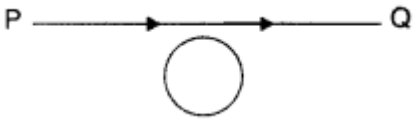
Question 19. The electric current flowing in a wire in the direction from B to A is decreasing. Find out the direction of the induced current in the metallic loop kept above the wire as shown. (All India 2014)



Question 20. A conducting loop is held above a current carrying figure. Depict the direction of the current induced in the loop when the current in the wire PQ is constantly increasing. (All India 2014)

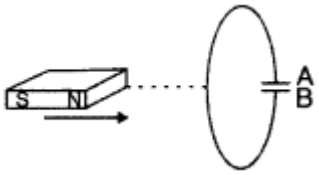


Question 21. A conducting loop is held below a P current carrying wire PQ as shown. Predict the direction of the induced current in the loop when the current in the wire is constantly increasing. (All India 2014)



Question 22. A metallic piece gets hot when surrounded by a coil carrying high frequency alternating current. Why? (Comptt. Delhi 2014)

Question 23. Predict the polarity of the plate A of the capacitor, when a magnet is moved ff' towards it, as shown in the figure. (Comptt. All India)



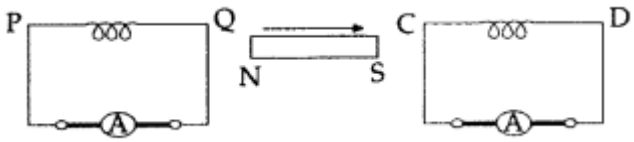
Question 24. Define the term 'self-inductance' of a coil. Write its S.I. Unit. (All India 2015)

Question 25. Name any two applications where eddy currents are used to advantage. (Comptt. Delhi 2015)

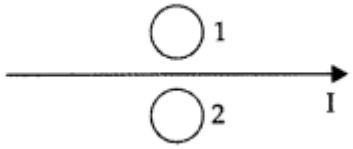
Question 26. A long straight current carrying wire passes normally through the centre of a circular loop. If the current through the wire increases, will there be an induced emf in the. loop? Justify. (Delhi 2015)

Question 27. Predict the polarity of the capacitor in the situation described in the given diagram. (All India 2017)

Question 28. A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the direction of the induced current in each coil (All India 2017)



Question 29. What is the direction of induced currents in metal rings 1 and 2 when current I in the wire is increasing steadily? (All India 2017)

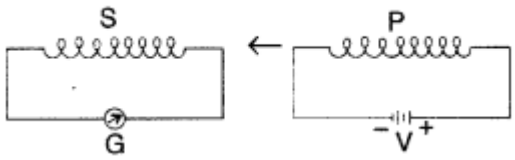


Question 30. In the figure given, mark the polarity of plates A and B of a capacitor when the magnets are quickly moved towards the coil. (Comptt. All India 2017)

Short Answer Type-II

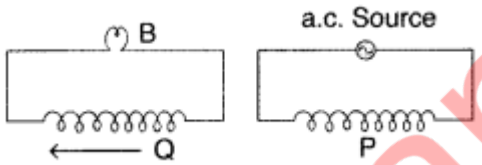
Question 31. Derive an expression for the self-inductance of a long air-cored solenoid of length l and number of turns N. (Delhi 2008)

Question 32. (i) When primary coil P is moved towards secondary coil S (as shown in the figure) the galvanometer shows momentary deflection. What can be done to have larger deflection in the galvanometer with the same battery?



(ii) State the related law. (Delhi 2010)

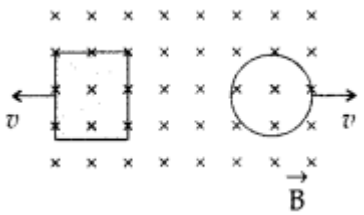
Question 33. A coil Q is connected to low voltage bulb B and placed near another coil P as shown in the figure. Give reasons to explain the following observations :



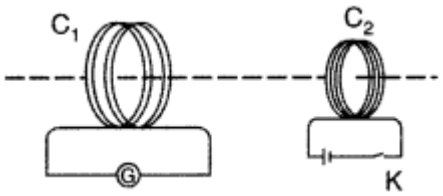
(a) The bulb 'B' lights.
(b) Bulb gets dimmer if the coil Q is moved towards left. (Delhi 2010)

Question 34. Two identical loops, one of copper and the other of aluminium, are rotated with the same angular speed in the same magnetic field. Compare
(i) the induced emf and
(ii) the current produced in the two coils. Justify your answer.(All India 2010)

Question 35. A rectangular loop and a circular loop are moving out of a uniform magnetic field to a field-free region with a constant velocity 'v' as shown in the figure. Explain in which loop do you expect the induced emf to be constant during the passage out of the field region. The magnetic field is normal to the loops. (All India 2010)

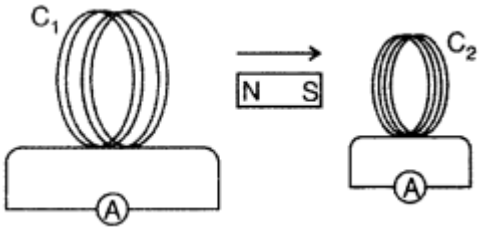


Question 36. A current is induced in coil C_1 due to the motion of current carrying coil C_2.



(a) Write any two ways by which a large deflection can be obtained in the galvanometer G.
(b) Suggest an alternative device to demonstrate the induced current in place of a galvanometer .

Question 37. A magnet is quickly moved in the direction indicated by an arrow between two coils C_1 and C_2 as shown in the figure. What will be the direction of induced current in each coil as seen from the magnet? Justify your answer. (Delhi 2011)



Question 38. What are eddy currents? Write any two applications of eddy currents. (All India 2011)

Question 39. Define self-inductance of a coil. Show that magnetic energy required to build up the current I in a coil of self inductance L is given by – *[Math Processing Error]*I^2. (Delhi 2011)

Question 40. Define mutual inductance between two long coaxial solenoids. Find out the expression for the mutual inductance of inner solenoid of length l having the radius r_1 and the number of turns n_1 per unit length due to the second outer solenoid of same length and n_2 number of turns per unit length. (Delhi 2011)

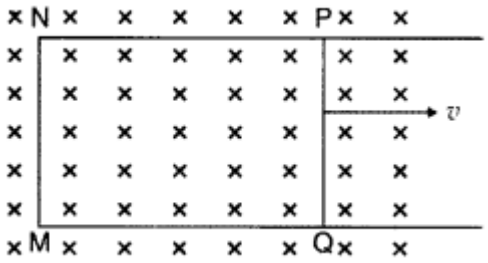
Question 41. A metallic rod of 'L' length is rotated with angular frequency of 'ω' with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius L, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field B parallel to the axis is present everywhere. Deduce the expression for the emf between the centre and the metallic ring. (Delhi 2012)

Question 42. Derive the expression for the self inductance of a long solenoid of cross sectional area A and. length l, having n turns per unit length.(Delhi 2012)

Question 43. State Lenz's Law.
A metallic rod held horizontally along east-west direction, is allowed to fall under gravity. Will there be an emf induced at its ends? Justify your answer. (Delhi 2012)

Question 44. A rectangular loop PQMN with movable arm PQ of length 10 cm and resistance 2 Ω is placed in a uniform magnetic field of 0.1 T acting perpendicular to the plane of the loop as is shown in the figure. The resistances of the arms MN, NP and MQ are negligible. Calculate the
(i) emf induced in the arm PQ and
(ii) current induced in the loop when arm PQ is moved with velocity 20 m/s. (Comptt. Delhi 2014)

Question 45. A rectangular loop PQMN with movable arm PQ of length 20 cm and resistance 5 Ω is placed in a uniform magnetic field of 0.2 T acting perpendicular to the plane of the loop as is shown in the figure.



The resistances of the arms MN, NP and MQ are negligible. Calculate the
(i) emf induced in the arm PQ and
(ii) current induced in the loop when arm PQ is moved with velocity 15m/s (Comptt. Delhi 2014)

Short Answer Type – II SA – II

Question 46. A metallic rod of length l is rotated at a constant angular speed to, normal to a uniform magnetic field B. Derive an expression for the current induced in the rod, if the resistance of the rod is R. (Delhi 2008)

Question 47.
An inductor 200 mH, capacitor 500 μF, resistor 10 Ω are connected in series with a 100 V variable frequency a.c. source. Calculate the
(i) frequency at which the power factor of the circuit is unity
(ii) current amplitude at this frequency
(iii) Q-factor (Delhi 2008)

Question 48. A coil of number of turns N, area A, is rotated at a constant angular speed ω, in a uniform magnetic field B, and connected to a resistor R. Deduce expressions for :
(i) Maximum emf induced in the coil.
(ii) Power dissipation in the coil. (Delhi 2008)

Question 49. (a) Define self inductance. Write its S.I. units.
(b) Derive an expression for self inductance of a long solenoid of length l, cross-sectional area A having N number of turns. (Delhi 2009)

Question 50. (i) State Faraday's law of electromagnetic induction.
(ii) A jet plane is travelling towards west at a speed of 1800 km/h. What is the voltage difference developed between the ends of the wing having a span of 25 m, if the Earth's magnetic field at the location has a magnitude of 5×10^{-4} T and the dip angle is 30°? (All India)

Question 51. State the law that gives the polarity of the induced emf. (All India 2009)

Question 52. A metallic rod of length 'l' is rotated with a frequency v with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius r, about an axis passing through the centre and perpendicular to the plane of the ring. A constant uniform magnetic field B parallel to the axis is present every where. Using Lorentz force, explain how emf is induced between the centre and the metallic ring and hence obtain the expression for it. (Delhi 2013)

Question 53. Starting from the expression for the energy w = *[Math Processing Error]*, stored in a solenoid of self-inductance L to build up the current I, obtain the expression for the magnetic energy in terms of the magnetic field B, area A and length l of the solenoid having n number of turns per unit length. Hence show that the energy density is given by $B^2/2\mu_0$. (Comptt. Delhi 2013)

Question 54. A metallic rod of length 'l' is rotated with a uniform angular speed ω, with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius R = l, about an

axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field B parallel to the axis is present eveywhere. Deduce the expression for the emf induced in the rod.
If r is the resistance of the rod and the metallic ring has negligible resistance, obtain the expression for the power generated. (Comptt. All India 2013)

Question 55. Write its SI unit for self-inductance of a coil. Derive the expression for self-inductance of a long solenoid of cross-sectional area 'A', length 'l' having 'n' turns per unit length. (Comptt. All India 2013)

Question 56. A wheel with 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the Earth's magnetic field. The Earth's magnetic field at the place is 0.4 G and the angle of dip is 60°. Calculate the emf induced between the axle and the rim of the wheel. How will the value of emf be affected if the number of spokes were increased? (All India 2013)

Question 57. Define the term 'mutual inductance' between the two coils.
Obtain the expression for mutual inductance of a pair of long coaxial solenoids each of length l and radii r_1 and r_2 ($r_2 >> r_1$). Total number of turns in the two solenoids are N_1 and N_2 respectively. (All India 2013)

Question 58. Define the term self-inductance of a solenoid. Obtain the expression for the magnetic energy stored in an inductor of self-inductance L to build up a current I through it. (All India 2014)

Question 59. (a) A rod of length l is moved horizontally with a uniform velocity 'v' in a direction perpendicular to its length through a region in which a uniform magnetic field is acting vertically downward. Derive the expression for the emf induced across the ends of the rod.
(b) How does one understand this motional emf by invoking the Lorentz force acting on the free charge carriers of the conductor? Explain. (All India 2014)

Question 60. Derive the expression for the magnetic energy stored in a solenoid in terms of magnetic field B, area A and length l of the solenoid carrying a steady current I. How does this magnetic energy per unit volume compare with the electrostatic energy density stored in a parallel plate capacitor? (Comptt. Delhi 2015)

Question 61. (i) Define mutual inductance.
(ii) A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil? (Delhi 2015)

Question 62. (a) Define self-inductance of a coil and hence write the definition of 'Henry'.
(b) Write any two factors each on which the following depends :
(i) Self inductance of a coil.
(ii) mutual inductance of a pair of coils. (Comptt. All India 2015)

Question 63. (a) Define the term 'self-inductance' and write its S.I. unit.
(b) Obtain the expression for the mutual inductance of two long co-axial solenoids S_1 and S_2 wound one over the other, each of length L and radii r_1 and r_2 and n_1 and n_2 number of turns per unit length, when a current I is set up in the outer solenoid S_2. (Delhi 2017)

Question 64. Define mutual inductance between a pair of coils. Derive an expression for the mutual inductance of two long coaxial solenoids of same length wound one over the other. (All India 2017)

Question 65. Define self-inductance of a coil. Obtain the expression for the energy stored in an inductor L connected across a source of emf. (All India 2017)

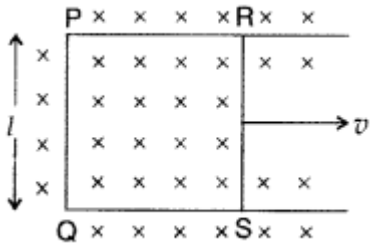
Question 66. State Lenz's law. Explain, by giving examples that Lenz's law is a consequence of conservation of energy. (Comptt. Delhi 2017)

Question 67. The current through two inductors of self-inductance 12 mH and 30 mH is increasing with time at the same rate. Draw graphs showing the variation of the
(a) emf induced with the rate of change of current in each inductor
(b) energy stored in each inductor with the current flowing through it.
Compare the energy stored in the coils, if the power dissipated in the coils is the same. (Comptt. All India 2017)

Question 68. The current through two inductors of self-inductance 15 mH and 25 mH is increasing with time at the same rate. Draw graphs showing the variation of the
(a) emf induced with the rate of change of current
(b) energy stored in each inductor with the current flowing through it.
Compare the energy stored in the coils, if the power dissipated in the coils is the same. (Comptt. All India 2017)

Long Answer Type

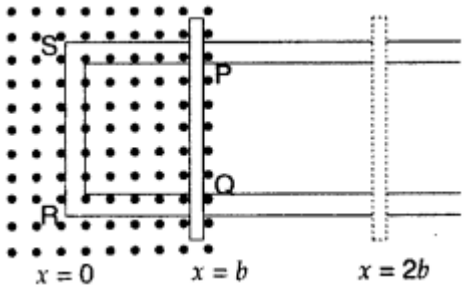
Question 69. (a) What are eddy currents? Write their two applications.
(b) Figure shows a rectangular conducting loop PQSR in which arm RS of length 'l' is movable. The loop is kept in a uniform magnetic field 'W directed downward perpendicular to the plane of the loop. The arm RS is moved with a uniform speed 'v'.



Deduce an expression for
(i) the emf induced across the arm 'RS',
(ii) the external force required to move the arm, and
(iii) the power dissipated as heat. (All India 2009)

Question 70. (a) State Lenz's law. Give one example to illustrate this law. "The Lenz's law is a consequence of the principle of conservation of energy." Justify this statement.
(b) Deduce an expression for the mutual inductance of two long coaxial solenoids but having different radii and different number of turns. (All India 2009)

Question 71. State Faraday's law of electromagnetic induction. Figure shows a rectangular conductor PQRS in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to the plane of the paper. The field extends from x = 0 to x = b and is zero for x > b. Assume that only the arm PQ possesses resistance r.
When the arm PQ is pulled outward from x = 0 to x = 2b and is then moved backward to x = 0 with constant speed v, obtain the expressions for the flux and the induced emf. Sketch the variations of these quantities with distance $0 \leq x \leq 2b$. (All India 2010)



Question 72. (a) Show that in an a.c. circuit containing a pure inductor, the voltage is ahead of current by $\pi/2$ in phase.
(b) A horizontal straight wire of length L extending from east to west is falling with speed v at right angles to the horizontal component of Earth's magnetic field B.
(i) Write the expression for the instantaneous value of the emf induced in the wire.
(ii) What is the direction of the emf?
(iii) Which end of the wire is at the higher potential? (All India 2011)

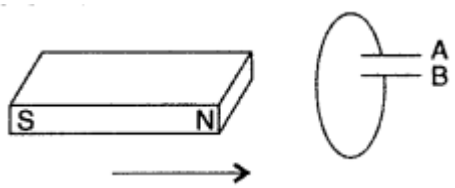
Question 73. (a) Starting from the expression for the Lorentz magnetic force acting on the free charge carriers of a conductor moving in a perpendicular magnetic field, obtain the expression for the motional emf induced.
(b) Hence deduce the expressions for the power delivered by the source and the power dissipated as Joule heat. (Comptt. Delhi 2012)

Question 74. (a) Describe a simple experiment (or activity) to show that the polarity of emf induced in . a coil is always such that it tends to produce a current which opposes the change of magnetic flux that produces it.
(b) The current flowing through an inductor of self inductance L is continuously increasing. Plot a graph showing the variation of
(i) Magnetic flux versus the current
(ii) Induced emf versus dI/dt
(iii) Magnetic potential energy stored versus the current. (Delhi 2014)

Question 75. A metallic rod of length l and resistance R is rotated with a frequency v, with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius l, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field B parallel to the axis is present everywhere.
(a) Derive the expression for the induced emf and the current in the rod.
(b) Due to the presence of the current in the rod and of the magnetic field, find the expression for the magnitude and direction of the force acting on this rod.
(c) Hence obtain the expression for the power required to rotate the rod. (Comptt. All India 2012)

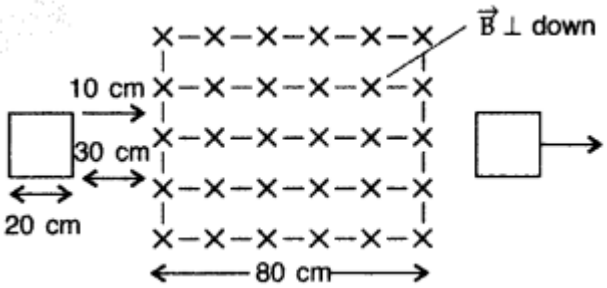
Question 76. (a) Define mutual inductance and write its S.I. units.
(b) Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other.
(c) In an experiment, two coils c_1 and c_2 are placed close to each other. Find out the expression for the emf induced in the coil ct due to a change in the current through the coil c_2. (Delhi)

Question 77. (a) State Lenz's law. Use it to predict the polarity of the capacitor in the situation given below :



(b) A jet plane is travelling towards west at a speed of 1800 km/h.
(i) Estimate voltage difference developed between the ends of the wing having a span of 25 m if the earth's magnetic field at the location has a magnitude of 5×10^{-4} T and dip angle is 30°.
(ii) How will the voltage developed be affected if the jet changes its direction from west to north?
(Comptt. All India)

Question 78. Define mutual inductance of a pair of coils and write on which factors does it depend.
A square loop of side 20 cm is initially kept 30 cm away from a region of uniform magnetic field of 0.1 T as shown in the figure. It is then moved towards the right with a velocity of 10 cm s^{-1} till it goes out of the field.



Plot a graph showing the variation of
(i) magnetic flux (ϕ) through the loop with time (t)
(ii) induced emf (ε) in the loop with time t.
(iii) induced current in the loop if it has resistance of 0.1 Ω. (Comptt. All India 2015)

Question 79. (a) Explain the meaning of the term mutual inductance. Consider two concentric circular coils, one of radius r_1 and the other of radius r_2 ($r_1 < r_2$) placed coaxially with centres coinciding with each other. Obtain the expression for the mutual inductance of the arrangement.
(b) A rectangular coil of area A, having number of turns N is rotated at 'f revolutions per second in a uniform magnetic field B, the field being perpendicular to the coil. Prove that the maximum emf induced in the coil is 2πf. (All India 2016)

Question 80. (a) A metallic rod of length l is moved perpendicular to its length with velocity v in a magnetic field *[Math Processing Error]* acting perpendicular to the plane in which rod moves. Derive the expression for the induced emf.
(b) A wheel with 15 metallic spokes each 60 cm long, is rotated at 360 rev/min in a place normal to the horizontal component of earth's magnetic field. The angle of dip at that place is 60°. If the emf induced between rim of the wheel and the axle is 400 mV, calculate the horizontal component of earth's magnetic field at the place.
How will the induced emf change, if the number of spokes is increased? (Comptt. All India 2016)