Test / Exam Name: Phy Electro Magnetic Induction Standard: 12th Science Subject: Physics

Instructions

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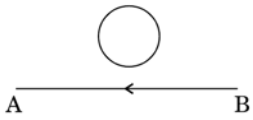
Q1. A long straight current carrying wire passes normally through the centre of circular loop. If the current through the wire increases, will there be an induced emf in the loop? Justify. **1 Mark**

Q2. A photocell connected in an electrical circuit is placed at a distance 'd' from a source of light. As a result, current I flows in the circuit. What will be the current in the circuit, when the distance is reduced to $\frac{d}{3}$? **1**

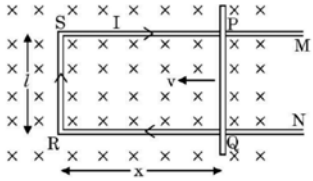
A I
B 6I
C 9I
D $\frac{I}{3}I$

Q3. Write the mathematical form of Ampere-Maxwell circuital law. **1**

Q4. 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. **1**

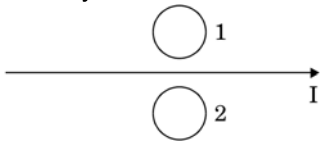


Q5. Figure shows a rectangular conductor PSRQ in which movable arm PQ has a resistance 'r' and resistance of PSRQ is negligible. The magnitude of emf induced when PQ is moved with a velocity $\vec{v}$ does not depend on: **1**

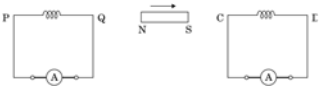


A magnetic field $(\vec{B})$
B velocity $(\vec{v})$
C resistance (r)
D length of PQ

Q6. What is the direction of induced currents in metal rings 1 and 2 when current I in the wire is increasing steadily? **1**



Q7. 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. **1 Mark**



Q8. Write the underlying principle of a moving coil galvanometer. **1 Mark**

Q9. 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. **1 Mark**

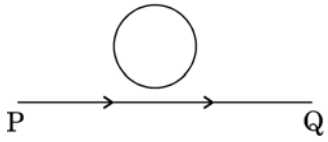
Q10. Mention the two characteristic properties of the material suitable for making core of a transformer. **1 Mark**

Q11. Define self-inductance of a coil. Write its S.I. unit. **1 Mark**

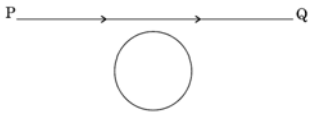
Q12. A conducting rod of length l is kept parallel to a uniform magnetic field $\vec{B}$. It is moved along the magnetic field with a velocity $\vec{v}$. What is the value of emf induced in the conductor? **1 Mark**

Q13. Draw the graph showing variation of the value of the induced emf as a function of rate of change of current flowing through an ideal inductor. **1 Mark**

Q14. A conducting loop is held above a current carrying wire 'PQ' as shown in the figure. Depict the direction of the current induced in the loop when the current in the wire PQ is constantly increasing. **1 Mark**

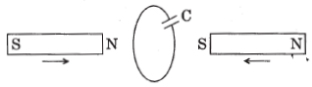


Q15. A conducting loop is held below a current carrying wire PQ as shown. Predict the direction of the induced current in the loop when the current in the wire is constantly increasing. **1**



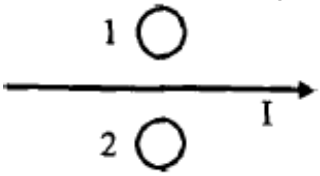
Q16. The number of turns of a solenoid are doubled without changing its length and area of cross-section. The self-inductance of the solenoid will become _____ times. **1**

Q17. 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. **1**

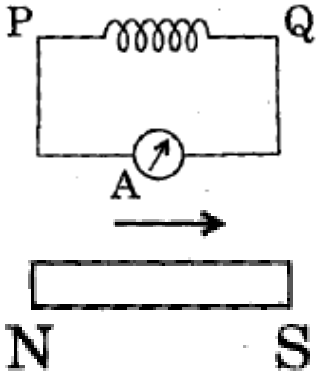


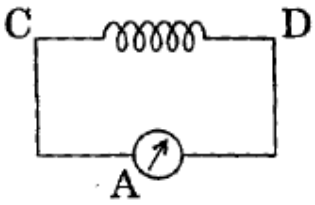
Q18. Laminated iron sheets are used to minimize _____ currents in the core of a transformer. **1**

Q19. 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. **1**



Q20. 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. **1**





Q21. Two identical coils, one of copper and the other of aluminium are rotated with the same angular speed in an external magnetic field. In which of the two coils will the induced current be more? **1 Mark**

Q22. Give one example of use of eddy currents. **1 Mark**

Q23. How does the mutual inductance of a pair of coils change when **1 Mark**

1. Distance between the coils is increased and
2. Number of turns in the coils is increased?

Q24. For Questions two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below. **1**

Assertion (A): The mutual inductance between two coils is maximum when the coils are wound on each other.

Reason (R): The flux linkage between two coils is maximum when they are wound on each other.

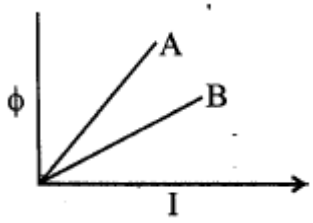
A Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

B Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

C Assertion (A) is true, but Reason (R) is false.

D Assertion (A) is false and Reason (R) is also false.

Q25. 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? **1**



Q26. Plot a graph showing variation of induced e.m.f. with the rate of change of current flowing through a coil. **1**

Q27. What happens when a block of metal is kept in a varying magnetic field? **1**

Q28. State Lenz's Law. **2**

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.

Q29. What are eddy currents? Write any two applications of eddy currents. **2 Marks**

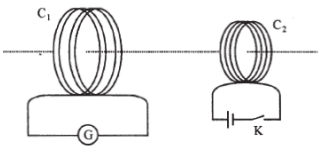
Q30. How is an emf generated by a solar cell due to the three basic processes involved ? Explain. **2 Marks**

Q31. 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. **2 Marks**

Q32. State the underlying principle of a transformer.How is the large scale transmission of electric energy over long distances done with the use of transformers? **2 Marks**

Q33. **2 Marks**

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.



Q34. A circular coil of N turns and radius R carries a current I. It is unwound and rewound to make another coil of radius R/2, current I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil. **2 Marks**

Q35. Consider an induced magnetic field due to changing electric field and an induced electric field due to changing magnetic field. Which one is more easily observed? Justify your answer. **2 Marks**

Q36. Two coils P and Q of radius R and 2R respectively are lying in perpendicular planes having a common centre. Find the magnitude and direction of the resultant magnetic field at the common centre, if they carry the currents I and $2\sqrt{3}I$ respectively. **2**

Q37. The energy stored in a solenoid of inductance L is U. The number of turns per unit length of the solenoid is doubled. Keeping the current and all other factors same, find: **2**

1. Change in inductance of the solenoid.
2. The final energy stored in the inductor.

Q38. How is the equation for Ampere's circuital law modified in the presence of displacement current? Explain. **2**

Q39. 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 $\frac{1}{2}LI^2$. **2**

Q40. **2**

1. Define the SI unit of self-inductance.
2. The self-inductance of a solenoid is L. If the number of turns per unit length in it is doubled and the area of cross-section is halved, find the new inductance of the solenoid.

Q41. 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. **2**

Q42. Two coils P and Q of radius R and 2R are lying in the same plane with their centres coinciding. Find the magnitude and direction of the resultant magnetic field at the common centre if they respectively carry currents 3I and 2I in opposite directions. **2**

Q43. Two coplanar and concentric coils 1 and 2 have respectively the number of turns N_1 and N_2 and radii r_1 and r_2 ($r_2 >> r_1$). Deduce the expression for mutual inductance of this system. **2**

Q44. How does Ampere-Maxwell law explain the flow of current through a capacitor when it is being charged by a battery? Write the expression for the displacement current in terms of the rate of change of electric flux. **2 Marks**

Q45. Calculate the current drawn by the primary of a transformer which steps down 200 V to 20 V to operate a device of resistance 20Ω. Assume the efficiency of the transformer to be 80%. **2 Marks**

Q46. Draw magnetic field lines when a (i) diamagnetic, (ii) paramagnetic substance is placed in an external magnetic field. Which magnetic property distinguishes this behaviour of the field lines due to the two substances? **2 Marks**

Q47. **2 Marks**

A small flat search coil of area 5cm^2 with 140 closely wound turns is placed between the poles of a powerful magnet producing magnetic field 0·09T and then quickly removed out of the field region. Calculate

1. Change of magnetic flux through the coil.
2. emf induced in the coil.

Q48. An iron ring of relative permeability μ_r has windings of insulated copper wire of n turns per metre. When the current in the windings is I, find the expression for the magnetic field in the ring. **2 Marks**

Q49. A 0.5m long solenoid of 10 turns/ cm has area of cross-section 1cm^2. Calculate the voltage induced across its ends if the current in the solenoid is changed from 1A to 2A in 0.1s. **2 Marks**

Q50. A metallic rod of length l is rotated at a constant angular speed ω, 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. **3 Marks**

Q51. 3

1. Differentiate between self inductance and mutual inductance.
2. The mutual inductance of two coaxial coils is 2H. The current in one coil is changed uniformly from zero to 0.5A in 100ms. Find the:

1. Change in magnetic flux through the other coil.
2. emf induced in the other coil during the change.

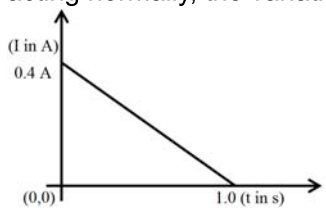
Q52. Draw the circuit diagram of a full wave rectifier using two p-n junction diodes. Explain its working and show input and output voltage variations. 3

Q53. Explain the principle of the device with diagram, which is used to provide electricity at the proper voltage for household purposes. Briefly discuss loss of energy in it due to flux leakage and its minimization. 3

Q54. 3

1. Define self-inductance. Write its SI units.
2. A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 A to 4.0 A in 0.1 s, what is the induced emf in the loop while the current is changing?

Q55. When a conducting loop of resistance 10Ω and area 10cm^2 is removed from an external magnetic field acting normally, the variation of induced current in the loop with time is shown in the figure. 3



Find the:

1. Total charge passed through the loop.
2. Change in magnetic flux through the loop.
3. Magnitude of the magnetic field applied.

Q56. Draw the labelled diagram of an AC generator. Briefly explain its working and obtain the expression for the emf produced in the coil. **3 Marks**

Q57. A group of students while coming from the school noticed a box marked "Danger H.T. 2200 V" at a substation in the main street. They did not understand the utility of such a high voltage, while they argued, the supply was only 220 V.They asked their teacher this question the next day. The teacher thought it to be an important question and therefore explained to the whole class. **3 Marks**

Answer the following questions:

1. What device is used to bring the high voltage down to low voltage of a.c. Current and what is the principle of its working?
2. Is it possible to use this device for bringing down the high d.c. Voltage to the low voltage? Explain.
3. Write the values displayed by the students and the teacher.

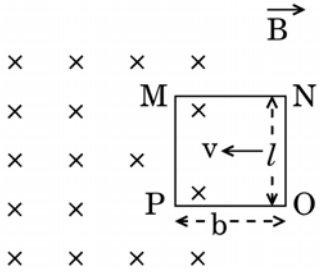
Q58. **3 Marks**

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 rinig. 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.

Q59. 1. How are eddy currents generated in a conductor which is subjected to a magnetic field? **3 Marks**
2. Write two examples of their useful applications.
3. How can the disadvantages of eddy currents be minimized?

Q60. 1. Define mutual inductance. **3 Marks**
2. 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?

Q61. The figure shows a rectangular conducting frame MNOP of resistance R placed partly in a perpendicular magnetic field $\vec{B}$ and moved with velocity $\vec{v}$ as shown in the figure. **3 Marks**



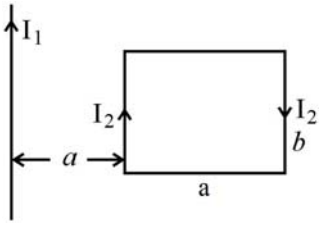
Obtain the expressions for the:
1. Force acting on the arm 'ON' and its direction, and
2. Power required to move the frame to get a steady emf induced between the arms MN and PO.

Q62. Draw a labelled diagram of a full wave rectifier circuit. State its working principle. Show the input-output waveforms. **3**

Q63. Explain with the help of a diagram, the working of a step-down transformer. Why is a laminated iron core used in a transformer? **3**

Q64. 1. Define self inductance. Write its S.I. units. **3**
2. Derive an expression for self inductance of a long, solenoid of length l, cross sectional area A having N number of turns.

Q65. 1. Define the term 'self inductance' of a coil. Write its S.I. unit. **3**
2. A rectangular loop of sides a and b carrying current I_2 is kept at a distance 'a' from an infinitely long straight wire carrying current I_1 as shown in the figure. Obtain an expression for the resultant force acting on the loop.



Q66. 1. State Faraday's law of electromagnetic induction. **3 Marks**
2. 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°?

Q67. The primary and the secondary coils of an ideal step-down transformer consist of 650 and 25 turns respectively. When the primary coil of this transformer is connected to 240 V mains, the current in the primary coil is 1.5A. Calculate: **3 Marks**
1. The voltage across the secondary coil.
2. The current in the secondary coil.

3. The average power delivered to the output circuit.

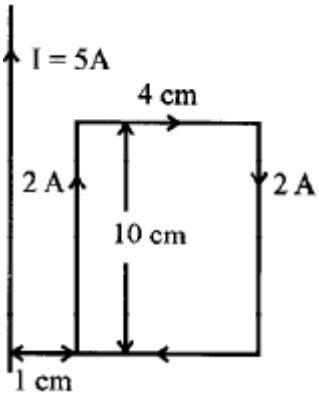
Q68. A long solenoid of radius r consists of n turns per unit length. A current $I = I_0 \sin \omega t$ flows in the solenoid. A coil of N turns is wound tightly around it near its centre. What is: **3 Marks**

1. the induced emf in the coil?
2. the mutual inductance between the solenoid and the coil?

Q69. How is the mutual inductance of a pair of coils affected when: **3 Marks**

1. Separation between the coils is increased?
2. The number of turns of each coil is increased?
3. A thin iron sheet is placed between the two coils, other factors remaining the same? Explain your answer in each case.

Q70. A rectangular loop of wire of size 4cm × 10cm carries a steady current of 2A. A straight long wire carrying 5A current is kept near the loop as shown. If the loop and the wire are coplanar, find **3 Marks**



1. The torque acting on the loop and.
2. The magnitude and direction of the force on the loop due to the current carrying wire.

Q71. What are eddy currents? How are these produced? In what sense are eddy currents considered undesirable in a transformer and how are these reduced in such a device? **3**

Q72.

1. 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. **3**
2. How does one understand this motional emf by invoking the Lorentz force acting on the free charge carriers of the conductor? Explain.

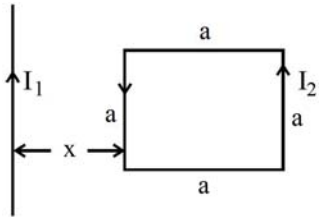
Q73.

1. Derive the expression for the torque acting on a current carrying loop placed in a magnetic field. **3**
2. Explain the significance of a radial magnetic field when a current carrying coil is kept in it.

Q74. Define the term 'mutual inductance' between the two coils. **3**
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.

Q75.

1. Define mutual inductance and write its S.I. unit. **3 Marks**
2. A square loop of side 'a' carrying a current I_2 is kept at distance x from an infinitely long straight wire carrying a current I_1 as shown in the figure. Obtain the expression for the resultant force acting on the loop.



Q76.

1. Derive, with the help of a diagram, the expression for the magnetic field inside a very long solenoid having n turns per unit length carrying a current I. **3 Marks**

2. How is a toroid different from a solenoid?

Q77. Draw the circuit diagram of a full wave rectifier. Explain its working showing its input and output waveforms. **3 Marks**

Q78. Define self-inductance of a coil. Obtain the expression for the energy stored in an inductor L connected across a source of emf. **3 Marks**

Q79.
1. Define the term 'self-inductance' and write its S.I. unit. **3 Marks**
2. Obtain the expression for the 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.

Q80.
1. Monochromatic light is incident on a surface separating two media. The frequency of the light after refraction remains unaffected but its wavelength changes. Why? **3 Marks**
2. The frequency of an electromagnetic radiation is 1.0×10^{11} Hz. Identify the radiation and mention its two uses.

Q81. 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 plane 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? **3**

Q82. 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. **3**

Q83. Draw the circuit diagram of a full wave rectifier and explain its working. Also, give the input and output waveforms. **3**

Q84. Sunita and her friends visited an exhibition. The policeman asked them to pass through a metal detector. Sunita's friends were initially scared of it. Sunita, however, explained to them the purpose and working of the metal detector. **4**

Answer the following questions:
1. On what principle does a metal detector work?
2. Why does the detector emit sound when a person carrying any metallic object walks through it?
3. State any two qualities which Sunita displayed while explaining the purpose of walking through the detector.

Q85. Ram is a student of class X in a village school. His uncle gifted him a bicycle with a dynamo fitted in it. He was very excited to get it. While cycling during night, he could light the bulb and see the objects on the road. He however, did not know this device works. He asked this question to his teacher. the teacher considered it an opportunity to explain the working to the whole class. **4**

Answer the following question:
1. State the principle and working of a dynamo.
2. Write two values each displayed by Ram and his school teacher.

Q86.
1. Describe, with the help of a suitable diagram, the working principle of a step-up transformer. Obtain the relation between input and output voltages in terms of the number of turns of primary and secondary windings and the currents in the input and output circuits. **5 Marks**
2. Given the input current 15 A and the input voltage of 100 V for a step-up transformer having 90% efficiency, find the output power and the voltage in the secondary if the output current is 3 A.

Q87.
1. Draw a labelled diagram of a step-up transformer and describe its working principle. Explain any three causes for energy losses in a real transformer. **5 Marks**
2. A step-up transformer converts a low voltage into high voltage. Does it violate the principle of conservation of energy? Explain.
3. A step-up transformer has 200 and 3000 turns in its primary and secondary coils respectively. The input voltage given to the primary coil is 90V. Calculate:

- The output voltage across the secondary coil

- The current in the primary coil if the current in the secondary coil is 2·0 A.

Q88. 1. 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. **5 Marks**
2. A rectangular coil of area A, having number of turns N is rotated at 'f' revolution per second in a uniform magnetic field B, the field being perpendicular to the coil. prove that maximum emf induced in the coil is 2π f NBA

Q89. 1. Draw a labelled diagram of a step-down transformer. State the principle of its working. **5 Marks**
2. Express the turn ratio in terms of voltages.
3. Find the ratio of primary and secondary currents in terms of turn ratio in an ideal transformer.
4. How much current is drawn by the primary of a transformer connected to 220V supply when it delivers power to a 110V - 550W refrigerator?

Q90. Write the function of a transformer. State its principle of working with the help of a diagram. Mention various energy losses in this device. **5**
The primary coil of an ideal step up transformer has 100 turns and transformation ratio is also 100. The input voltage and power are respectively 220 V and 1100 W. Calculate:
1. Number of turns in secondary.
2. Current in primary.
3. Voltage across secondary.
4. Current in secondary.
5. Power in secondary.

Q91. Write the function of a transformer. State its principle of working with the help of a diagram. Mention various energy losses in this device. **5**
The primary coil of an ideal step up transformer has 100 turns and transformation ratio is also 100. The input voltage and power are respectively 220 V and 1100 W. Calculate
1. Number of turns in secondary.
2. Current in primary.
3. Voltage across secondary.
4. Current in secondary.
5. Power in secondary.

Q92. 1. Draw a labelled diagram of an ac generator. Obtain the expression for the emf induced in the rotating coil of N turns each of cross-sectional area A, in the presence of a magnetic field $\vec{B}$ **5**
2. A horizontal conducting rod 10 m long extending from east to west is falling with a speed 5.0 ms^{-1} at right angles to the horizontal component of the Earth's magnetic field, 0.3 × 10^{-4} Wb m^{-2}. Find the instantaneous value of the emf induced in the rod.

Q93. 1. A conductor of length 'l' is rotated about one of its ends at a constant angular speed $'\omega'$ in a plane perpendicular to a uniform magnetic field B. Plot graphs to show variations of the emf induced across the ends of the conductor with: **5**
1. Angular speed ω.
2. Length of the conductor l.
2. Two concentric circular loops of radius 1cm and 20cm are placed coaxially:
1. Find mutual inductance of the arrangement.
2. If the current passed through the outer loop is changed at a rate of 5A/ ms, find the emf induced in the inner loop. Assume the magnetic field on the inner loop to be uniform.

Q94. 1. State the principle of an ac generator and explain its working with the help of a labelled diagram. Obtain the expression for the emf induced in a coil having N turns each of cross-sectional area A, rotating with a constant angular speed $'\omega'$ in a magnetic field $\vec{B}$, directed perpendicular to the axis of rotation. **5 Marks**
2. An aeroplane is flying horizontally from west to east with a velocity of 900km/ hour. Calculate the potential difference developed between the ends of its wings having a span of 20m. The horizontal component of the Earth's magnetic field is 5 × 10^{-4}T and the angle of dip is 30°.

Q95. 1. Draw the schematic sketch of a cyclotron. Explain the shape of the path on which charged particle moves when the particle is accelerated by it. **5 Marks**

2. To convert a given galvanometer into a voltmeter of ranges 2V, V and $\frac{V}{2}$ volt, resistances R_1, R_2 and R_3 ohm respectively, are required to be connected in series with the galvanometer. Obtain the relationship between R_1, R_2 and R_3.

Q96. 1. What are eddy currents? Write their two applications. **5 Marks**

2. 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 'B' directed downward perpendicular to the plane of the loop. The arm RS is moved with a uniform speed 'v'.

Deduce an expression for:

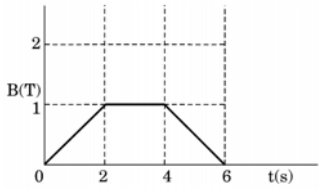
1. The emf induced across the arm 'RS',
2. The external force required to move the arm, and
3. The power dissipated as heat.

Q97. 1. 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. **5**

2. Deduce an expression for the mutual inductance of two long coaxial solenoids but having different radii and different number of turns.

Q98. 1. State Faraday's law of electromagnetic induction. **5**

2. The magnetic field through a circular loop of wire 12 cm in radius and 8.5 Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the induced current in the loop and plot it as a function of time.



3. Show that Lenz's law is a consequence of conservation of energy.

Q99. Derive an expression for the force acting on a current carrying straight conductor kept in a magnetic field. State the rule which is used to find the direction of this force. Give the condition under which this force is (1) maximum, and (2) minimum. Two long parallel straight wires A and B are 2.5cm apart in air. They carry 5.0 A and 2.5 A currents respectively in opposite directions. Calculate the magnitude of the force exerted by wire A on a 10cm length of wire B. **5**

Q100. 1. 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. **5**

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

1. Magnetic flux versus the current.
2. Induced emf versus dI/dt.
3. Magnetic potential energy stored versus the current.

Q101. 1. A rectangular coil rotates in a uniform magnetic field. Obtain an expression for induced emf and current at any instant. Also find their peak values. Show the variation of induced emf versus angle of rotation (ωt) on a graph. **5 Marks**

2. An iron bar falling through the hollow region of a thick cylindrical shell made of copper experiences a retarding force. What can you conclude about the nature of the iron bar? Explain.

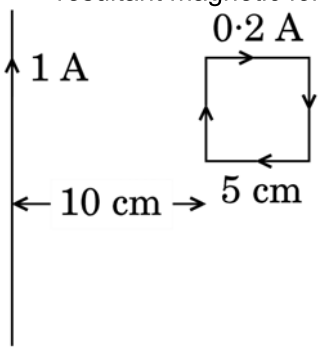
Q102. 1. With the help of a neat and labelled diagram, explain the principle and working of a moving coil galvanometer. **5 Marks**

2. What is the function of uniform radial field and how is it produced?
3. Define current sensitivity of a galvanometer. How is current sensitivity increased?

Q103. 1. State the principle of the working of a moving coil galvanometer, giving its labelled diagram. **5 Marks**
2. "Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity." Justify this statement.
3. Outline the necessary steps to convert a galvanometer of resistance R_G into an ammeter of a given range.

Q104. 1. Draw a schematic sketch of an ac generator describing its basic elements. State briefly its working principle. Show a plot of variation of **5 Marks**
1. Magnetic flux and.
2. Alternating emf versus time generated by a loop of wire rotating in a magnetic field.
2. Why is choke coil needed in the use of fluorescent tubes with ac mains?

Q105. 1. Derive the expression for the magnetic energy stored in an inductor when a current I develops in it. Hence, obtain the expression for the magnetic energy density. **5**
2. A square loop of sides 5cm carrying a current of 0·2A in the clockwise direction is placed at a distance of 10cm from an infinitely long wire carrying a current of 1A as shown. Calculate (i) the resultant magnetic force, and (ii) the torque, if any, acting on the loop.



Q106. 1. Draw a labelled diagram of a step-down transformer. State the principle of its working. **5**
2. Express the turn ratio in terms of voltages.
3. Find the ratio of primary and secondary currents in terms of turn ratio in an ideal transformer.
4. How much current is drawn by the primary of a transformer connected to 220 V supply when it delivers power to a 110 V - 550 W refrigerator?

Q107. 1. With the help of a labelled diagram, describe briefly the underlying principle and working of a step up transformer. **5**
2. Write any two sources of energy loss in a transformer.
3. A step up transformer converts a low input voltage into a high output voltage. Does it violate law of conservation of energy? Explain.

Q108. 1. Draw a schematic sketch of a cyclotron. Explain clearly the role of crossed electric and magnetic field in accelerating the charge. Hence derive the expression for the kinetic energy acquired by the particles. **5**
2. An α–particle and a proton are released from the centre of the cyclotron and made to accelerate.
    1. Can both be accelerated at the same cyclotron frequency? Give reason to justify your answer.
    2. When they are accelerated in turn, which of the two will have higher velocity at the exit slit of the dees?

Q109. 1. Draw the diagram of a device which is used to decrease high ac voltage into a low ac voltage and state its working principle. Write four sources of energy loss in this device. **5 Marks**
2. A small town with a demand of 1200kW of electric power at 220V is situated 20km away from an electric plant generating power at 440V. The resistance of the two wire line carrying power is 0.5Ω per km. The town gets the power from the line through a 4000-220V step-down transformer at a sub-station in the town. Estimate the line power loss in the form of heat.

Q110. **5 Marks**

1. Derive the expression for the torque acting on the rectangular current carrying coil of a galvanometer. Why is the magnetic field made radial?
2. An α−particle is accelerated through a potential difference of 10kV and moves along x-axis. It enters in a region of uniform magnetic field B = 2×10^{-3}T acting along y-axis. Find the radius of its path. (Take mass of α−particle = 6.4×10^{-27}kg).

Q111. Describe briefly, with the help of a labelled diagram, the basic elements of an A.C. generator. State its underlying principle. Show diagrammatically how an alternating emf is generated by a loop of wire rotating in a magnetic field. Write the expression for the instantaneous value of the emf induced in the rotating loop. **5 Marks**

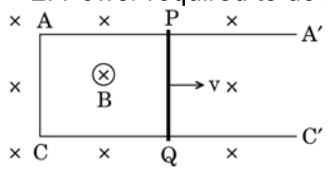
Q112.
1. Derive an expression for the induced emf developed when a coil of N turns, and area of cross-section A, is rotated at a constant angular speed ωω in a uniform magnetic field B. **5 Marks**
2. A wheel with 100 metallic spokes each 0·5m long is rotated with a speed of 120rev/min in a plane normal to the horizontal component of the Earth's magnetic field. If the resultant magnetic field at that place is 4×10^{-4} T and the angle of dip at the place is 30°, find the emf induced between the axle and the rim of the wheel.

Q113.
1. Define mutual inductance and write its S.I. unit. **5**
2. Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other.
3. 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 c_1 due to a change in the current through the coil c_2.

Q114.
1. 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. **5**
1. Derive the expression for the induced emf and the current in the rod.
2. Due to the presence of current in the rod and of the magnetic field, find the expression for the magnitude and direction of the force acting on this rod.
3. Hence, obtain an expression for the power required to rotate the rod.
2. A copper coil is taken out of a magnetic field with a fixed velocity. Will it be easy to remove it from the same field if its ohmic resistance is increased?

Q115.
1. With the help of a labelled diagram, explain the working of a step-up transformer. Give reasons to explain the following: **5**
1. The core of the transformer is laminated.
2. Thick copper wire is used in windings.
2. A conducting rod PQ of length 20cm and resistance 0.1Ω rests on two smooth parallel rails of negligible resistance AA' and CC'. It can slide on the rails and the arrangement is positioned between the poles of a permanent magnet producing uniform magnetic field B = 0.4T. The rails, the rod and the magnetic field are in three mutually perpendicular directions as shown in the figure. If the ends A and C of the rails are short circuited,

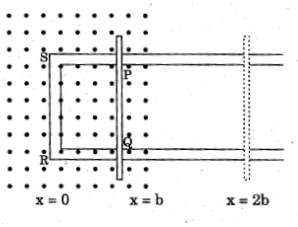
Find:
1. External force required to move the rod with uniform velocity v = 10cm/ s,
2. Power required to do so.



Q116. Draw a schematic diagram of a step-up transformer. Explain its working principle. Deduce the expression for the secondary to primary voltage in terms of the number of turns in the two coils. In an ideal transformer, how is this ratio related to the currents in the two coils? **5 Marks**
How is the transformer used in large scale transmission and distribution of electrical energy over long distances?

Q117. State Faraday's law of electromagnetic induction. **5 Marks**

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 $0 \leqslant x \leqslant 2b$.



Q118. 1. Draw a labelled diagram of AC generator. Derive the expression for the instantaneous value of the emf induced in the coil. **5 Marks**

2. A circular coil of cross-sectional area 200 cm^2 and 20 turns is rotated about the vertical diameter with angular speed of 50 rad s^{-1} in a uniform magnetic field of magnitude 3.0 × 10^{-2}T. Calculate the maximum value of the current in the coil.