RAVI MATHS TUITION & TEST PAPERS , WHATSAPP 8056206308

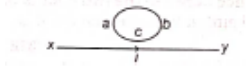
6 Electromagnetic Induction previously asked

12th Standard

Physics

Multiple Choice Question 4 x 1 = 4

1) The direction of induced current in the loop abc is



(a) along abc if I decreases (b) along acb if I increases (c) along abc if I is constant (d) along abc if I increases

2) A rectangular, a square, a circular and an elliptical loop, all in the X-Y plane, are moving out of a uniform magnetic field with a constant velocity vi. The magnetic field is directed along the negative Z-axis direction. The induced emf, during the passage of these loops, out of the field region, will not remain constant for

(a) any of the four loops (b) the circular and elliptical loops (c) the rectangular, circular and elliptical loops (d) only the elliptical loops

3) The self-inductance of a solenoid of 600 turns is 108 mH. The self-inductance of a coil having 500 turns with the same length, the same radius and the same medium will be

(a) 95 mH (b) 90 mH (c) 85 mH (d) 75 mH

4) There is a pair of concentric and coplanar conducting loops of radii R_1 and R_2 such that $R_2 = 0.01\ R_1$. To which of the following is the mutual inductance M for this pair directly proportional?

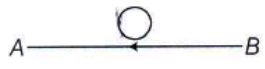
(a) $1/R_1^2$ (b) R_1^2 (c) $1/R_1$ (d) R_1

2 Marks 72 x 2 = 144

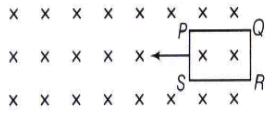
5) How days the mutual inductance of a pair of coils hange when
(i) distance between the coils is increased
(ii) an iron sheet is placed between the two coils ?

6) An inductor is connected in series with a bulb to an a.c. source. What happens to brightness of bulb when number of turns in the inductor is reduced?

7) 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 near the wire as shown in the figure below

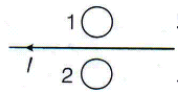


8) The closed loop PQRS of wire is moved into a uniform magnetic field at right angles to the plane of the paper as shown in the figure. Predict the direction of the induced current in the loop.



9) How does the mutual inductance of a pair of coil change when
(i) the distance between the coil is increased and
(ii)the number of turns in the coil is increased?

10) Predict the direction of induced current in metal rings 1 and 2, when current I in the wire is steadily decreasing.



11) Calculate the quality factor of a series L-C-R circuit with L = 2.0 H, $C = 2\mu F$ and $R = 10\Omega$. Mention the significance of quality factor in L-C-R circuit.

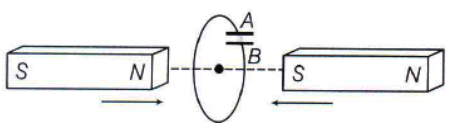
12) A light metal disc on the top of an electromagnet is Thrown up as the current is switched ON. Why? Give reason.

13) A source of emf e is used to establish a current I through a coil of self-inductance L. Show that the work done by the source to build up the current I is $\frac{1}{2}LI^2$

14) Two concentric circular coils, one of radius r and the other of radius R are placed coaxially with their centres coinciding. For R > > > r, obtain an expression for mutual inductance of the arrangement.

15) A long solenoid with 15 turns per cm has a small loop of area $2.0cm^2$ placed inside, normal to the axis of solenoid. If the current carried by the solenoid changes steadily from 2 A to 4A in 0.1s, what is the induced voltage in the loop, while the current is changing?

16) Predict the polarity of the capacitor in the situation described by adjoining figure.Explain the reason too



17) Why is the coil of dead beat galvanometer wound on a metal frame?

18) A horizontal staright 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 e.m.f induced in the wire.
(ii) What is the direction of the e.m.f ?
(iii) Which ned of the wire is at the higher potential?

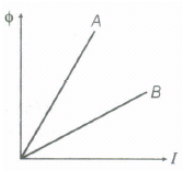
19) State the underlying principle of a transformer. How is the large scale transmission of electric energy long distances done with the use of transformers?

20) Define self-inductance of a coil Write its S.I. unit

21) Show a plot of variation of alternating emf versus time generated by a loop of wire rotating in a magnetic field.

22) What are eddy currents? write any two applications of eddy current.

23) 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?



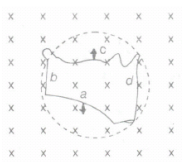
24) Give an example each of a molecular solid and an ionic solid

25) How many atoms per unit cell are present in bcc unit cell?

26) How many atoms constitute one unit cell of a face centered cubic crystal?

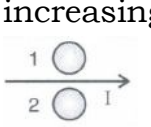
27) Two spherical bobs, one metallic and the other of glass, of the same size are allowed to fall freely from the same height above the ground. Which of the two would reach earlier and why?

28) A flexible wire of irregular shape, abcd, as shown in the figure, turns into a circular shape when placed in a region of magnetic field which is directed normal to the plane of the loop away from the reader. Predict the direction of the induced current in the wire.



29) State the steady value of the reading of the ammeter in the circuit shown below :

30) 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 continuously.

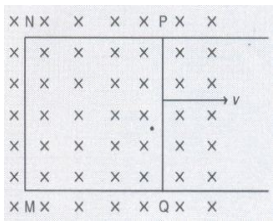


31) Two bar magnets are quickly moved towards a metallic loop connected across a capacitor 'C' as shown in the figure. Predict the polarity of the capacitor.

32) A rectangular loop PQMN with movable arm PQMN of length 10 em and resistance 2 Ω is placed in a uniform magnetic field of 0.1 Tesla perpendicular to the plane of the loop as shown in the figure. The resistance, pf the arms MN, NP, and MQ are negligible. Calculate the

(i) emf induced in the arm PQ and

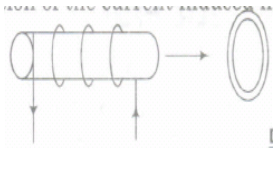
(ii) current induced in the loop when arm PQ is moved with velocity 20 m/s.



33) Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always 1 such that it tends to produce a current which opposes the change e of magnetic flux that produces it.

34) 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.

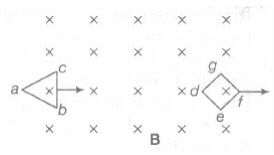
35) The figure shows a current-carrying solenoid moving towards conducting loop. Find the direction of the current include in the loop.



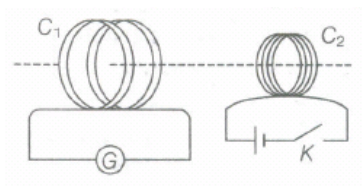
36) On what factors does the magnitude of the emf induced in the circuit due to magnetic flux depend?

37) State the Faraday's law of electromagnetic induction.

38) Two loops of different shapes are moved into a region of uniform magnetic field in the directions marked by arrows as shown in the figure. What is the direction of the induced current in each loop?



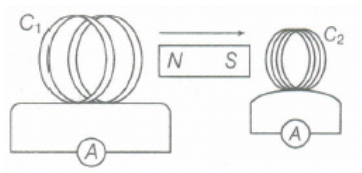
39) A current is induced in coil C_1 due to the motion of current-carrying coil C_2.



(i) Write any two ways by which a large deflection can be obtained in the galvanometer G.

(ii) Suggest an alternative device to demonstrate the induced current in place of a galvanometer.

40) 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.

41) State the law that gives the polarity of the induced emf.

42) 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.

43) Define mutual inductance. Give its SI unit.

44) Mention any two useful applications of eddy currents.

45) The power factor of an AC circuit is 0.5. What is the phase difference between voltage and current the circuit?

46) Plot a graph showing variation of capacitive reactance with the change in the frequency of the AC source.

47) Why is the use of AC voltage preferred over DC voltage? Give two reasons.

48) Define mutual inductance between two long coaxial solenoids. Find out the expression for the mutual inductance of inner solenoid of length I 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.

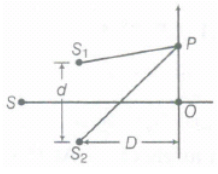
49) Two concentric circular coils $C_1$and C_2, radius r_1 and r_2 ($r_1 << r_2$) respectively are kept coaxially. If current is passed through C_2, then find an expression for mutual inductance between the two coils.

50) When an AC source is connected across an inductor, show on a graph the nature of variation of the voltage and the current over one complete cycle.

51) The current flowing through a pure inductance 2mR is, 1 = (15 cos 300t)A. What is the
(i) rms and
(ii) average value of current for a complete cycle?

52) A reactive element in an AC circuit causes the current flowing
to lead in phase by $\pi/2$
to lag in phase by $\pi/2$
w.r.t. the applied voltage. Identify the element in each case.

53) The figure shows a double-slit experimental set up for observing interference fringes due to different interference component colors of white light. What would be the predominant color of the fringes observed at the point

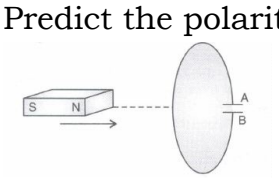


O (the central point)
P, where, S_2 P - S_1 P = $\frac{\lambda_b}{2}$? (Here, λ_b is the wavelength of the blue colour).

54) State which of the two a capacitor or an inductor, tends to become SHORT when the frequency of the applied alternating voltage has a high value

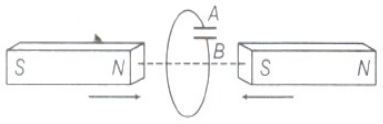
55) For an ideal conductor, connected across a sinusoidal ac voltage source. State which one of the following quantity is zero:
(i) Instantaneous power
(ii) Average power over full cycle of the ac voltage source

56) Predict the polarity of the plate A of the capacitor, when a magnet is moved towards it, as shown in the figure.

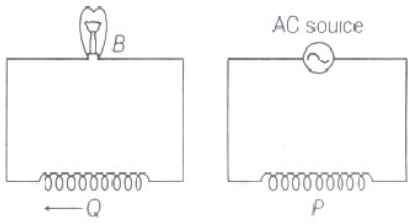


57) What is the direction of induced currents in metal rings 1 and 2, when current I in the wire is increasing steadily?

58) In the figure given, mark the polarity of plates A and B of a capacitor when the magnets are quickly moved towards the coil.



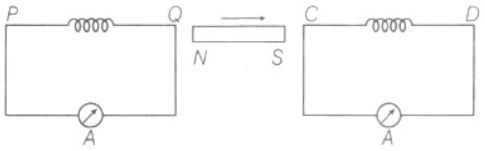
59) A coil Q is connected to low voltage bulb B and placed near another coil P as shown in the figure. Give reasons to explain the following observations
(i) The bulb B lights.
(ii) Bulb gets dimmer, if the coil Q is moved towards left



60) 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.

61) 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.

62) 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.



63) A metallic rod of length L 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 a uniform magnetic field B parallel to the axis is present everywhere. Deduce the expression for the emf between the centre and the metallic ring.

64) Define the term self-inductance of a coil. Write its SI unit.

65) Define mutual inductance. Write its SI unit.

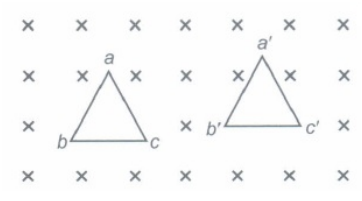
66) How does the mutual inductance of a pair of coils change when
(i) distance between the coils is increased and
(ii) number of turns in the coils is increased?

67) Self-induction of an air core inductor increases from 0.01 mH to 10mH on introducing an iron core into it. What is the relative permeability of the core used?

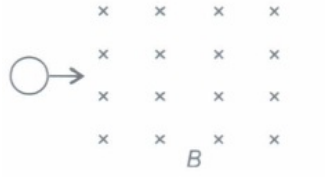
68) Along solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside, normal to the axis of solenoid. If the current carried by the solenoid changes steadily from 2A to 4A in 0.1s, what is the induced voltage in the loop, while the current is changing?

69) A solenoid of radius 3 cm and length 1m has 600 turns per metre. Calculate its self-inductance.

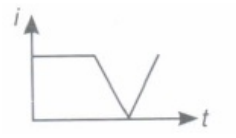
70) A triangular loop of wire placed at abc is moved completely inside a magnetic field which is directed normal to the plane of the loop away from the reader to a new position a'b'c', What is the direction of the current induced in the loop? Give reason.



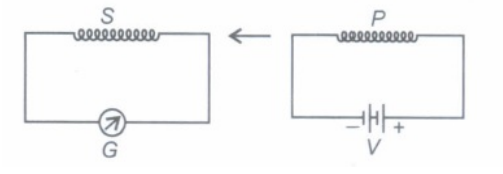
71) A circular loop is moved through the region of uniform magnetic field. Find the direction of induced current (clockwise or anticlockwise) when the loop moves (i) into the field, and (ii) out of the field.



72) The current i in an induction coil varies with time t according to the adjoining graph. Draw the graph of induced emf with time.



73) (i) When primary coil P is moved towards secondary coil S(as shown in the figure below) 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.

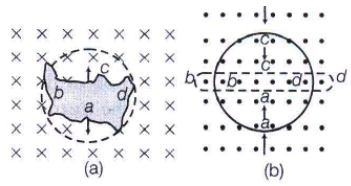
74) State Lenz's Law.
A metallic rod held horizontally along east-west direction, is allowed to fall under gravity. Will there be an emf induced at its ends? Justify your answer

75) What is meant by the term 'mutual inductance' of a pair of coils? Obtain an expression for the mutual inductance of two long coaxial solenoids, each of length but having difterent number of terms N_1 and N_2 and radii r_1 and r_2 ($r_2 > r_1$).

76) State the basic principle behind the working of an AC generator. Briefly describe its working and obtain the expression for the instantaneous value of emf induced.

3 Marks 40 x 3 = 120

77) Use Lenz's law to determine the direction of induced current in the situations described by Fig.
(a) A wire of irregular shape turning into a circular shape;
(b) A circular loop being deformed into a narrow straight wire



78) 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?

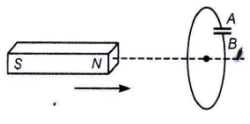
79) A metre gauge train is running due north with a constant speed of $90 kmh^{-1}$ on a horizontal track. If the vertical component of earth's magnetic field is $3 \times 10^{-5} Wb\, m^{-2}$, calculate the e.m.f. induced across the axle of the train of length 1.25m.

80) The self inductance of an inductance coil having 100 turns is 20 mH. Calculate the magnetic flux through the cross section of the coil corresponding to a current of 4 milliampere. Also, find the total flux.

81) A series LCR circuit with $C = 80\ \mu F,\ L = 5.0\ H$ and $R = 40\Omega$ is connected to a variable frequency 240 V a.c. source. Calculate
(i) angular frequency of the source which drives the circuit in resonance.
(ii) current at the resonating frequency.
(iii) rms pot. drop across the capacitor.

82) A pair of adjacent coils has a mutal inductance of 1.5H. If the current in one coil changes from 0 to 20A in 0.5s, what is the change in flux linkage with the other coil?

83) In the given figure, a bar magnet is quickly moved towards a conducting loop having a capacitor. Predict the polarity of the plates A and B of the capacitor.



84) What is the self-inductance of a solenoid of length 40 cm, area of cross-section 20 cm^2 and total number of turns is 800?

85) The current flowing in the two coil of self-inductance $L_1 = 16\ mH$ and $L_2 = 12\ mH$ are increasing at the same rate. If the power supplied to the two coils are equal, find the ratio of
(i) induced voltages
(ii) the currents and
(iii) the energies stored in the coil at a given instant.

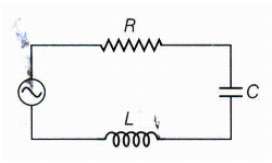
86) A step-up transformer is operated on a 2.5 kV line. It supplies a load with 20 A. The ratio of the primary winding to the secondary is 10:1. If the transformer is 90% efficient, calculate
(i) the power output
(ii) the voltage and
(iii) the currrent in the secondary.

87) An inductor L of inductances X_L is connected in series with a bulb B and an AC source.How would brightness of the bulb change when
(i) number of turns in the inducer is reduced
(ii) an iron rod is reactance $X_C = X_L$ is inserted in series in the circuit. Justify your answer in each case.

88) A rectangular loop an area $20cm \times 30cm$ is placed in magnetic field of 0.3T with its plane
(i) normal to the field
(ii) inclined 30^0 to the field and
(iii) parallel to the field.
Find the flux linked with the coil in each case.

89) (i) When an AC source is connected to an ideal capacitor.Show that the average power supplied by the source over a complete cycle is zero.
(ii) A lamp is connected in series with a capacitor in series with a capacitor. Predict your observation when the system is connected first across a Dc and then an AC source. What happens in each, if the capacitance of the capacitor is reduced?

90) The figure shows a series L-C-R circuit with L = 10.0H, $C = 40\mu F$, $R = 60\Omega$ connected to variable 240V source. Calculate

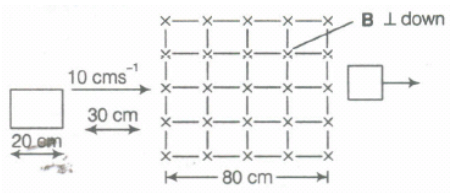


(i) the angular frequency of the source which drives the circuit at resonance.
(ii) the current at the resonating frequency.
(iii) the rms potential drop across the inducer at resonance.

91) Define the term 'mutual inductance' between the two cells 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

92) (i) 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.
(ii)The current flowing through an induction of self inductance L is continuosly 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.

93) 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 0.1Ω.



94) Consider the motion of a charged particle of mass m and charge q moving with velocity v in a magnetic field B.
(i) If v is perpendicular to B, then show that its describes a circular path having angular frequency c.o = qB/ m.
(ii) If the velocity v has a component parallel to the magnetic field B, then trace the path described by the particle. Justify your answer.

95) (i) Define the term 'self-inductance' and write its SI unit.
(ii) 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.

96) 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.

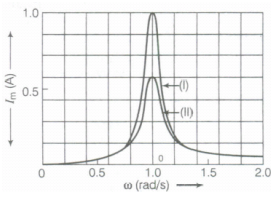
97) Draw a schematic sketch of an AC generator describing its basic elements. State briefly its working principle. Show a plot of variation of
(i) magnetic flux and
(ii) alternating emf versus time generated by a loop of wire rotating in a magnetic field.

98) A voltage $V = V_0 \sin \omega t$ is applied to a series L-C-R circuit. Derive the expression for the average power dissipated over a cycle. Under what conditions is
(i) no power dissipated even through the current flows through the circuit
(ii) maximum power dissipated in the circuit?

99) A series L-C-R circuit is connected to an AC source. Using the phasor diagram, derive the expression for the impedance of the circuit. Plot a graph to show the variation of current with frequency of the source, explaining the nature of its variation.

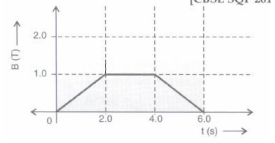
100) An AC voltage, $V = V_0 \sin \omega t$ is applied across a pure capacitor, C. Obtain an expression for the current I in the circuit and hence obtain the capacitive reactance of the circuit and the phase of the current flowering with respect to the applied voltage.

101) The graphs shown here depict the variation of current Irms with angular frequency ωt for two different series L-C-R circuits.



Observe the graphs carefully. State the relation between L and C values of the two circuits when the current in the two circuits is maximum. Indicate the circuit for which power factor is higher quality factor Q is larger. Give the reasons for each case.

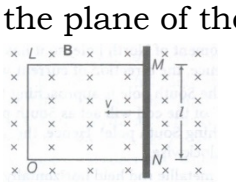
102) The magnetic field through a single loop of wire, 12 cm in radius and 8.5Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Plot induced current as a function of time



103) (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

104) A metallic rod of length I 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 everywhere. Using Lorentz force, explain how emf is induced between the centre and the metallic ring and hence obtain the expression for it?

105) A rectangular conductor LMNO is placed in a uniform magnetic field of 0.5 T. The field is directed perpendicular to the plane of the conductor.



When the arm MN of length 20 cm is moved towards left with a velocity of $10 ms^{-1}$, calculate the emf induced in the arm. Given, the resistance of the arm to be 5Ω (assuming that other arms are of negligible resistance), find the value of the current in the arm.

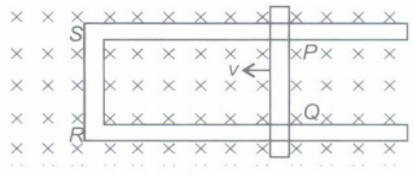
106) Starting from the expression for the energy, $W = \frac{1}{2}LI^2$ stored in a solenoid of self-inductance. L to build up the current I, obtain the expression for the magnetic energy in terms of the magnetic field B, area A and length I of the solenoid having n number of turns per unit length. Hence, show that the energy density is given by $B^2/2\mu_0$

107) The current through two inductors of self-inductance 12mH and 30 mH is increasing with time at the same rate. Draw graphs showing the variation of the
(i) emf induced with the rate of change of current in each inductor.
(ii) 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.

108) (ii) Why is choke coil needed in the use of fluorescent tubes with AC mains?

109) 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 to in a magnetic field (B), directed perpendicular to the axis of rotation.

110) Figure shows a rectangular loop conducting PQRS in which the arm PQ is free to move. A uniform magnetic field acts in the direction perpendicular to the plane of the loop. Arm PQ is moved with a velocity v towards the arm RS. Assuming that the arms QR, RS and SP have negligible resistances and the moving arm PQ has the resistance r, obtain the expression for (i) the current in the loop (ii) the force and (UI) the power required to move arm PQ.



111) An aeroplane is flying horizontally from west to east with a velocity of 900 kml/hour. Calculate the potential difference developed between the ends of its wings having a span of 20 m. The horizontal component of the Earth's magnetic field is 5×10^{-4} T and the angle of dip is 30°.

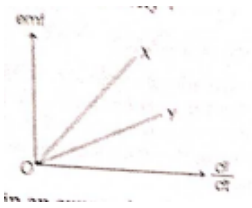
112) A circular coil of cross-sectional area 200 cm^2 and 20 turns is rotated about the vertical diameter with angular speed of 50 rad s^{-1} in a uniform magnetic field of magnitude 3.0×10^{-2} T. Calculate the maximum value of the current in the coil

113) 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 x 10-4 Wb m^{-2}. Find the instantaneous value of the emf induced in the rod.

114) If a rate of change of current of 4 AS^{-1} induces an emf of 20 mV in a solenoid, what is the self-inductance of the solenoid?

115) (i) State the principle on which AC generator works. Draw a labelled diagram and explain its working.
(ii) A conducting rod held horizontally along East-West direction is dropped from rest from a certain height near the Earth's surface. Why should there be an induced emf across the ends of the rod? Draw a plot showing the instantaneous variation of emf as a function of time from the instant it begins to fall.

116) (i) The figure shows the variation of induced emf as a function of rate of change of current for two identical solenoids X and Y. One is air cored and the other is iron cored. Which one of them is iron cored? Why?



(ii) Obtain an expression for self-inductance of a long solenoid of length L. and cross-sectional area A having N turns.

5 Marks 27 x 5 = 135

117) A circular coil of radius 10 cm, 500 turns and resistance 2 Ω 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° in 0.25 s. Estimate the magnitudes of the emf and current induced in the coil. Horizontal component of the earth's magnetic field at the place is 3.0×10^{-5} T.

118) (a) Obtain the expression for the magnetic energy stored in a solenoid in terms of magnetic field B, area A and length l of the solenoid.
(b) How does this magnetic energy compare with the electrostatic energy stored in a capacitor?

119) A railway track running north south has two parallel rails 1.0m aprt. Calculate the e.m.f. induced between the rails when a train passes at a speed of 90 km h^{-1}. Horizontal component od earth's magnetic field at that place is 0.3×10^{-4} T and angle of dip is 60°.

120) A wheel with 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to horizontal component field at the place is 0.4 G and angle of dip is 60°. Calculate the emf induced between the axle and rim of the wheel. How is the emf affected if number of spokes is increased?

121) An avarage induced e.m.f. of 0.4V appears in a coil when current in it is changed from 10A in one direction to 10A in opposite direction in 0.40 second. Find the coefficient of the coil.

122) A 60 V-10 W electric lamp is to be run on 100 V-60Hz mains. Calculate the inductance of the choke coil to achieve the same result, calculate its value.

123) A series LCR circuit with L = 4.0H, C = 100μF and R = 60Ω is connected to a variable frequency 240V source. Calculate

(i) angular frequency of the source which drives the circuit in resonance,

(ii) current at the resonating frequency,

(iii) rms potential drop across the inductor at resonance.

124) Ajit had a high tension tower erected erected on his farm land. He kept complaining to the authorities to remove it as it was occupying a large portion of his land. His uncle who was a teacher, explained to him the need for erecting these towers for efficient transmission of power. As Ajit realized its significance, he stopped complaining.

Read the above passage and answer the following questions:

(a) Why is it necessary to transport power at high voltages?

(b) A low power factor implies larger power los. Explain.

(c) Write two values each, displayed by Ajit and his uncle.

125) 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 cucling during night, he could light the bulb and see the objects on the road. He, however did not know how this device works. He asked this question to his teacher. The teacher considered it an opportunity to explain the working to the whole class.

Answer the following questions:

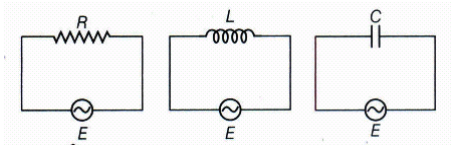
(i) State the principle and working of a dynamo.

(ii) Write two values each displayed by Ram and his shool teacher.

126) (i) What do you understand by sharpness of resonance in a series L-C-R circuit? Derive an expression for Q-factor of the circuit.

(ii) Three electrical circuits having AC sources of variable frequency are shown in the figures. Initally, the current following in each of these is same.If the frequency of the applied AC source is increased, how will the current flowing in these circuits be affected?

Give the reason for your answer.



127) One morning an old man walked bare-foot to replace the fuse wire in kit kat fitted with the power supply mains for his house. Suddenly he screamed and collapsed on the floor. His wife cried loudly for help. His neighbour's son Anil heard the cries and rushed to the place with shoes on. He took a wooden baton and used it to switch OFF the main supply. Answer the following questions:

What is the voltage and frequency of mains supply in India?

These days most of the electrical devices we use require AC voltage. Why?

Can a transformer be used to step-up DC voltage?

Write two qualities displayed by Anil by his action.

128) (a) A series LCR circuit is connected to an a.c. source of variable frequency. Draw a suitable phasor diagram to deduce the expressions for the amplitude of the current and phase angle.

(b) Obtain the condition at resonance. Draw a plot showing the variation of current with the frequency of a.c. source for two resistances R_1 and R_2 ($R_1 > R_2$). Hence define the quality factor, Q and write its role in the tuning of the circuit.

129) (i) Explain the meaning of the term mutual inductance. Consider two concentric circular coils, one of the 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.

(ii) 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 $2\pi fNBA$.

130) Draw a labelled diagram of a step-down transformer. State the principle of its working.

Express the turn ratio in terms of voltages.

Find the ratio of primary and secondary currents in terms of turn ratio in an ideal transformer.

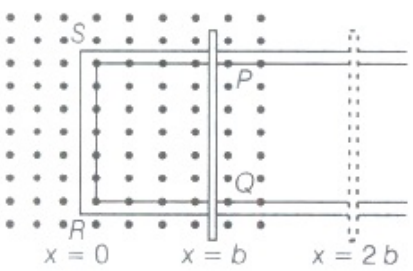
How much current is drawn by the primary of a transformer Connected to 220 V supply when it delivers power to a 110 V-550 W refrigerator?

131) Write the function of a transformer, State its principle of working with the help of a diagram. Mention various energy losses in this device.
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
a. number of turns in secondary
b. current in primary
c. voltage across secondary
d. current in secondary
e. power in secondary

132) Sushil is in the habit of charging his mobile and then leaving the charger connected through the mains with the switch on.
When his sister Asha pointed it out him, he replied there was no harm as the mobile had been disconnected. Asha then explained to him and convinced him, how the energy was still being wasted as the charger was continuously consuming energy. Answer the following questions.
What values did Asha display in convincing her brother?
What measures in your view, should be adopted to minimise the wastage of electric energy in your households?
Imagine an electric appliance of 2 W, left connected to the mains for 20 hours. Estimate the amount of electrical energy wasted.

133) (i) Define mutual inductance and write its S.I. unit.
(ii) Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other.
(iii) In an experiment, two coils C_1 and C_2 are placed close to each other. Find out the expression for the emf induced the coil cl due to a change in the current through the coil C_2.

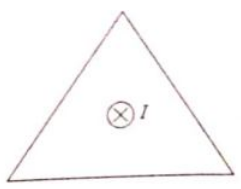
134) State Faraday's law of electromagnetic induction. Figure shows a rectangular conductor PQRS in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to the plane of the paper. The field extends from x = 0 to x = b and is zero for x > b. Assume that only the arm PQ possesses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



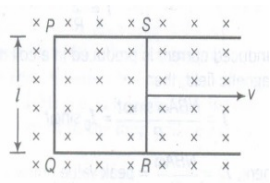
135) A conducting rod held horizontally along East-West direction is dropped from rest from a certain height near the Earth's surface. Why should there be an induced emf across the ends of the rod? Draw a plot showing the instantaneous variation of emf as a function of time from the instant it begins to fall.

136) State the working of AC generator with the help of a labelled diagram. The coil of an AC generator having N turns, each of area A, is rotated with a constant angular velocity ω. Deduce the expression for the alternating emf generated in the coil. What is the source of energy generation in this device?

137) A current carrying straight wire passes inside a triangular coil as shown in figure. The current in the wire is perpendicular to paper inwards. Find the direction of the induced current in the loop, if current in the wire is increased.



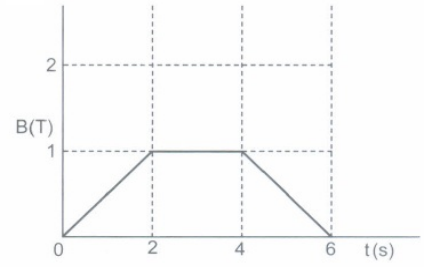
138) Figure shows a rectangular conducting loop PQRS in which arm RS of length I is movable. The loop is kept in a uniform magnetic field B directed downward perpendicular to the plane of the loop. The arm RS is moved with a uniform speed v.



Deduce the expression for
(i) the emf induced across the arm RS
(ii) the external force required to move the arm and
(ill) the power dissipated as heat.

139) Current in a circuit falls steadily from 2.0 A to 0.0 A in 10 ms. If an average emf of 200 V is induced, calculate the self-inductance of the circuit

140) (a) State Faraday's law of electromagnetic induction.
(b) 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.



(c) Show that Lenz's law is a consequence of conservation of energy.

141) What are eddy currents? How are they produced?
Describe briefly three main useful applications of eddy currents.

142) A small flat search coil of area 5 cm^3 with 140 closely wound turns is placed between the poles of a poweful magnet producing magnetic field 0.09T and then quickly removed out of the field region. Calculate
(i) Change of magnetic flux through the coil, and
(ii) emf induced in the coil.

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

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