N.B.Navale

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PHYSICS

12.ELECTROMAGNETIC INDUCTION,7.ELECROMAGNETIC INDUCTION

Single Correct Answer Type

1. In a region of uniform magnetic induction $B = 10^{-2}$ tesla, a circular coil of radius 30 cm and resistance π^2 ohm is rotated about an axis which is perpendicular to the direction of B and which forms a diameter of the coil. If the coil rotates at 200 r.p.m. the amplitude of the alternating current induced in the coil is
   a) $4\pi^2$ mA b) 30 mA c) 6 mA d) 200 mA
2. Which of the following is not an application of eddy current?
   a) induction furnace
   b) speedometer of automobiles
   c) galvanometer damping
   d) X-ray crystallography
3. The e. m. f. and the current of an A.C. circuit are $e = 5 \cos \omega t$ volt and $I = 2 \sin \omega t$ ampere respectively. The power consumed in the circuit is
   a) Zero b) 10 W c) 5 W d) 2.5 W
4. The r. m. s. value of alternating e. m. f is
   a) Twice peak value
   b) $\sqrt{2}$ times greater than peak value
   c) Equal to peak value
   d) Less than peak value
5. When a conductor is moved in a steady magnetic field or is kept in a changing magnetic field, the currents developed in it are called as
   a) Faraday's currents b) Foucault currents
   c) Ampere's currents d) Fleming's currents
6. When 100 V D.C. flows in a solenoid, the current is 1.0 A. When 100 V A.C. flows, the current drops to 0.5 A. If the frequency of A.C. be 50 Hz, then the impedance and the inductance of the solenoid are
   a) 200 Ω, 0.55 H b) 100 Ω, 0.86 H
   c) 200 Ω, 1.0 H d) 100 Ω, 0.93 H
7. How much mutual inductance will be produced (in joule), if the change in magnetic flux in any coil Y due to current of 4 A in any associated coil X is given by 0.4 Wb ?
   a) 0.2 J b) 0.4 J
   c) 0.6 J d) 0.1 J
8. When a coil is rotated in a magnetic field, with steady speed then
   a) no emf is induced
   b) a periodic emf is induced
   c) unidirectional emf is induced
   d) multidirectional emf is induced
9. A square coil of side 25 cm having 1000 turns is rotated with a uniform speed in a magnetic field about an axis perpendicular to the direction of the field. At an instant t, the e. m. f. induced in the coil is $e = 200 \sin 100 \pi t$. The magnetic induction is
   a) 0.50 T b) 0.01 T c) 10^{-3}T d) 0.1 T
10. Eddy currents are produced when
    a) A thick metal plate is kept in a steady magnetic field
    b) A circular coil is placed in a magnetic field
    c) A steady current is passed through a coil
    d) A thick metal plate is kept in a varying magnetic field
11. The r. m. s value of an A.C. of 50 Hz is 10 A. The time taken by the alternating current in reaching from zero to maximum value and the peak value of current will be
    a) 2×10^{-2}s and 14.14 A
    b) 1×10^{-2}s and 7.07 A
    c) 5×10^{-3}s and 7.07 A
    d) 5×10^{-3}s and 14.14 A
12. A transformer is used to light a 100 W and 110 V lamp from a 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is approximately
    a) 30% b) 50%
    c) 90% d) 10%
13. According to phenomenon of mutual inductance,
    a) the mutual inductance does not depend on the geometry of the two coils involved
    b) the mutual inductance depends on the intrinsic magnetic property like relative permeability of the

material

c) the mutual inductance is independent of the magnetic property of the material

d) ratio of magnetic flux produced by the coil 1 at the place of the coil 2 and the current in the coil 2 will be different from that of the ratio defined by interchanging the coils

14. In series resonance, LCR circuit, below the resonant frequency, the circuit is
a) Inductive
b) Capacitive
c) Resistive
d) Both resistive and inductive

15. A rectangular coil of 100 turns and dimensions of 10 cm $\times$ 5 cm is placed perpendicular to a uniform magnetic field of induction 0.1 T. If the magnetic induction drops to 0.05 T in 0.05 s, then the e. m. f. induced in the coil is
a) 0.005 V b) 0.05 V c) 0.5 V d) 5 V

16. If N is the number of turns in a coil, the value of self inductance varies as
a) N° b) N^1 c) N^2 d) N^{-2}

17. The number of turns in a coil of wire of fixed radius is 600 and its self inductance is 108 mH. The self inductance of a coil of 500 turns will be
a) 74 mH b) 75 mH c) 76 mH d) 77 mH

18. What is the r. m. s. value of an alternating current which when passed through a resistor produces heat which is thrice of that produced by a direct current of 2 ampere in the same resistor?
a) 6 A b) 2 A c) 3.46 A d) 0.66 A

19. A conducting circular loop is placed in uniform magnetic field, $B = 0.025$ T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1 mms^{-1}. The induced e. m. f. when radius is 2 cm, is
a) 2 μV b) 2 π μV c) π μV d) $\frac{\pi}{2}$ μV

20. The reactance of capacitor at 50 Hz is 10 Ω. What will be its reactance at 200 Hz?
a) 10 Ω b) 40 Ω c) 2.5 Ω d) 20 Ω

21. A voltmeter reads V volts in an A.C. circuit then V is
a) peak value of the voltage
b) peak value of the current
c) r.m.s. value of the current
d) r.m.s. value of the voltage

22. Flux passes through coil changes from 2×10^{-3}Wb to 3×10^{-3}Wb during 25 s. The induced e. m. f. is
a) 0.02 mV b) 0.03 mV c) 0.05 mV d) 0.04 mV

23. Eddy currents do not produce________
a) Heat
b) A loss of energy
c) Spark
d) Damping of motion

24. Ohm is not the unit of
a) Reactance
b) Inductive reactance
c) Impedance
d) Magnetic flux

25. A certain A.C voltage is represented by $e = 100 \sin(100\pi t + 0.6)$. The peak value of A.C is
a) 100 volt b) 50 volt c) 141 volt d) 150 volt

26. In Hertz's experiment, the rods connected with an induction coil behave as
a) an inductor
b) capacitor
c) resistor
d) an induction coil

27. In the induction coil, across secondary coil, the output voltage is practically
a) unidirectional, high, intermittent
b) unidirectional, low, intermittent
c) unidirectional, high, constant
d) unidirectional, low, constant

28. Self inductance of a coil is equal to induced emf in to oppose
a) steady current in the coil
b) change of current in the coil
c) the rate of change of current
d) change in magnetic induction

29. In an A.C. circuit, the instantaneous values of e. m. f. and current are $e = 200 \sin 314\,t$ volt and $I = \sin\left(314t + \frac{\pi}{3}\right)$ ampere. The average power consumed in watt is
a) 200 b) 100 c) 50 d) 25

30. The ratio of secondary to primary turns is 4: 5. If power input is P, then the ratio of power output to power input is
a) 4: 9
b) 9: 4
c) 5: 4
d) 1: 1

31. Eddy currents are produced when
a) a metal is kept in varying magnetic field
b) a metal is kept in steady magnetic field
c) a circular coil is placed in a magnetic field
d) through a circular coil, current is passed

32. In resonant circuits at resonance the phase difference between current and emf is
a) 0 b) π c) π/4 d) π/2

33. The rate of change of magnetic flux density through a circular coil of area $10^{-2} m^2$ and number of turns 100 is $10^3 Wb/m^2 s$. The value of induced e. m. f. will be
a) 10^{-2}V b) 10^{-3}V c) 10 V d) 10^3V

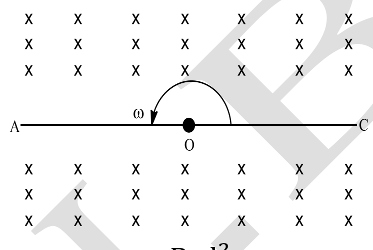
34. If the magnetic flux linked with a coil through which a current of x A is set up is y Wb, then the coefficient of self inductance of the coil is
a) (x − y) henry b) $\frac{x}{y}$ henry
c) $\frac{y}{x}$ henry d) x y henry

35. The average power dissipated in an A.C. circuit containing a resistance alone is
a) $e_{rms} I_{rms}$ b) $e_{rms} I_{rms} \cos \emptyset$
c) 0 d) none of these

36. In AC series circuit, the resistance, inductive reactance and capacitive are 3 Ω, 10 Ω and 14 Ω respectively. The impedance of the circuit is
a) 5 Ω b) 4 Ω c) 7 Ω d) 10 Ω

37. The current in a coil of inductance 5H decrease at the rate of 2 A/s. The induced emf is
a) 2 V b) 5 V
c) 10 V d) −10 V

38. A conducting rod AC of length 4/ is rotated about a point O in a uniform magnetic field B directed into the paper. If AO = I and OC = 31, then



a) $V_A - V_0 = \frac{B\omega l^2}{2}$ b) $V_O - V_c = \frac{7}{2} B\omega l^2$
c) $V_A - V_C = 4B\omega l^2$ d) $V_c - V_0 = \frac{7}{2} B\omega l^2$

39. The reactance of a capacitor in an A.C. circuit is 10 Ω. If the frequency of A.C. is doubled, its reactance will become
a) 5 Ω b) 10 Ω c) 15 Ω d) 20 Ω

40. The impedance of LCR series circuit is
a) $\sqrt{R^2 + (x_L - x_c)^2}$ b) $\sqrt{R^2 + (X_L + X_C)^2}$
c) $\sqrt{R + (X_L + X_C)^2}$ d) $\sqrt{X_L - X_C + R}$

41. In a series LCR circuit, the voltage across the inductance and capacitance are not
a) out of phase with voltage across resistance by 90°
b) equal in magnitude at resonance
c) out of phase with each other by 180°
d) in phase with the source voltage

42. The pointer of a dead-beat galvanometer gives a steady deflection because
a) Eddy currents are produced in the conducting frame over which the coil is wound
b) Its magnet is very strong
c) Its pointer is very light
d) Its frame is made of ebonite

43. A.C. voltmeter shows.........value of alternating voltage.
a) peak value b) average value
c) virtual value d) steady value

44. In series resonance LCR circuit below resonant frequency circuit is
a) inductive
b) capacitive
c) resistive
d) both resistive and inductive

45. An alternating e. m. f. of 100 V (rms) is applied to a series LCR circuit. At resonance, the potential difference across the inductance and across the capacitance is 400 V each. The potential difference across the resistance will be
a) 100 V b) 400 V c) 800 V d) Zero

46. An induced e. m. f. is produced when a magnet is plunged into a coil. The strength of the induced e. m. f. is independent of
a) The strength of the magnet
b) Number of turns of the coil
c) The resistivity of the wire of the coil
d) Speed with which the magnet is moved

47. The transformation ration in the step-up transformer is
a) one
b) greater than one
c) less than one
d) the ratio greater or less than one depends on the other factor

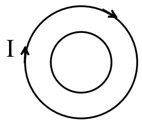
48. In a simple A.C. circuit containing resistance, the current
a) Lags behind the e. m. f by π/2
b) Is in phase with applied e. m. f
c) Leads the applied e. m. f by π/2
d) None of these

49. A boat is moving due east in a region where

the earth's magnetic field is $5.0 \times 10^{-5} NA^{-1}m^{-1}$ due north and horizontal. The boat carries a vertical aerial 2 m long. If the speed of the boat is $1.50 \, ms^{-1}$, the magnitude of the induced e. m. f. in the wire of aerial is

a) 1 mV b) 0.75 mV c) 0.50 mV d) 0.15 mV

50. If rotational velocity of a dynamo armature is doubled, then induced e. m. f. will become
 a) Half b) Two times
 c) Four times d) Unchanged
51. Alternating currents can be produced by a
 a) dynamo b) choke coil
 c) transformer d) electric motor
52. Three identical rings move with the same speed on a horizontal surface in a uniform horizontal'. magnetic field normal to the planes of the rings the first (A)slips without rolling, the second (B)rolls without slipping and the third rolls with slipping:
 a) The same emf is induced in all the three rings
 b) no emf is induced in any of the rings
 c) in each ring, all points are at the same potential
 d) B develops the maximum induced emf, and A the least
53. A series RLC circuit has the following values $R = 20\,\Omega, X_L = 10\,\Omega. E = 50\text{ V (rms) at } \omega = 400\text{ rad/s}$. Current 2A leads the applied voltage. The value of the capactative reactance X_C is
 a) 5 Ω b) 25 Ω c) 10 Ω d) 15 Ω
54. Eddy current are induced in a conductor when the conductor is kept in:
 a) an electric field
 b) varying magnetic field
 c) a weak magnetic field
 d) a strong magnetic field
55. The instantaneous magnetic flux ϕ in a circuit is $\phi = 4t^2 - 4t + 1$. The total resistance of circuit is 10 Ω. At $t = \frac{1}{2}$ s, the induced current in circuit is
 a) 0 A b) 0.6 A c) 0.4 A d) 0.2 A
56. Eddy current do not cause
 a) damping b) Heating
 c) Sparking d) loss of energy
57. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon
 a) the rates at which currents are changing in the two coils
 b) relative position and orientation of the two coils
 c) the materials of the wires of the coils
 d) the currents in the two coils
58. Concept of displacement current was introduced by
 a) Ampere b) Maxwell c) Faraday d) Lamy
59. Two coils A and B have 200 and 400 turns, respectively. A current of 1 A in coil A causes a flux per turn of 10^{-3} Wb to link with A and a flux per turn of 0.8×10^{-3} Wb through B. The ratio of mutual inductance of A and B is
 a) 0.625 b) 1.25
 c) 1.5 d) 1.625
60. Henry is the S.I. unit of
 a) resistance b) Capacity
 c) Inductance d) Current
61. A step-down transformer, transforms a supply line voltage of 2200 V into 220 V. The primary coil has 5000 turns. The efficiency and power transmitted by the transformer are 90% and 8 kW, respectively. Then, the power supplied is
 a) 9.89 kW b) 8.89 kW
 c) 88.9 kW d) 889 kW
62. Lenz's law provides a relation between
 a) Current and magnetic field
 b) Induced e. m. f. and the magnetic flux
 c) Force on a conductor in magnetic field
 d) Current and induced e. m. f.
63. Negative sign appearing in Faraday' slaw of electromagnetic induction indicate that
 a) the induced e.m.f.is produced only when magnetic flux decreases
 b) the induced emf opposite to the direction of magnetic flux
 c) the induced emf opposes the changes in magnetic flux
 d) none of these
64. The natural frequency of a L-C circuit is equal to
 a) $\frac{1}{2\pi}\sqrt{LC}$ b) $\frac{1}{2\pi\sqrt{LC}}$ c) $\frac{1}{2\pi}\sqrt{\frac{L}{C}}$ d) $\frac{1}{2\pi}\sqrt{\frac{C}{L}}$
65. What increased in step-down transformer
 a) Voltage b) Current
 c) power d) current density
66. Two different wire loops are concentric and lie in the same plane. The current in the outer loop (I) is clockwise and increases with time. The induced current in the inner loop

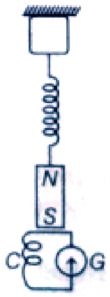


a) Is clockwise
b) Is zero
c) Is counter clockwise
d) Has a direction that depends on the ratio of the loop radii

67. Displacement current is produced
a) When electric field or electric flux varies with time
b) When magnetic field varies with time
c) When electric field and magnetic field both vary with time
d) When D.C. source produce high current

68. Two identical circular loops of metal wire are lying on a table without touching each other. Loop-A carries a current which increases with time. In response, the loop-B
a) Remains stationary
b) Is attracted by the loop-A
c) Is repelled by the loop-A
d) Rotates about its CM, with CM fixed. (CM is the centre of mass)

69. A magnet N − S is suspended from a spring and when it oscillates, the magnet moves in and out of the coil C. Then, as magnet oscillates,

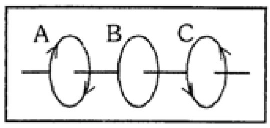


a) G shows no deflection but the amplitude steadily decreases
b) G shows deflection to the left and right with decreasing amplitude
c) G shows deflection to the left and right with constant amplitude
d) G shows deflection on one side

70. Magnetic flux of 10 microweber is linked with a coil. When current of 2.5 mA flows through it, the self inductance of the coil is
a) 4 kH b) 4 mH c) 4 μH d) 4 H

71. When a coil is rotated in a magnitude field, with steady speed, then
a) No e. m. f. is induced
b) A periodic e. m. f. is induced
c) Unidirectional e. m. f. is induced
d) Multidirectional e. m. f. is induced

72. Three identical coils, A,B and C are placed with their planes parallel to one another. Coils A and C carry currents as shown in figure. Coils B and C are fixed in position and coil A is moved towards B. then, current induced in B is in :



a) Clockwise current
b) anticlockwise current
c) no current is induced in B
d) current is induced only when both coils move

73. A transmitter transmits at a wavelength of 300 m. A condenser of capacitance 2.4 μF is being used. The value of the inductance for the resonant circuit is approximately
a) 10^{-4} H b) 10^{-6} H c) 10^{-8} H d) 10^{-10} H

74. A step-down transformer has 50 turns on secondary and 1000 turns on primary winding. If a transformer is connected to 220 V, 1 A A.C. source, what is output current of the transformer?
a) A b) 20 A c) 100 A d) 2 A

75. the average power in LCR series circuit is
a) $e_{rms}I_{rms}\cos\emptyset$ b) $e_{rms}I_{rms}\sin\emptyset$
c) $e_{rms}I_{r}ms$ d) $e_{rms}I_{rms}\tan\emptyset$

76. With increase in frequency of an a.c. supply the impendence of the parallel resonate circuit
a) remains constant
b) increases
c) decreases
d) increases at first, becomes maximum and then decreases

77. The output power in step-up transformer used in practice is
a) greater than the input power
b) equal to the input power
c) less than the input power
d) None of the above

78. when a magnet is moved with its south pole towards the coil, then the nearer face of the coil behaves as a
a) N-pole b) S-pole
c) +ve charge d) -ve charge

79. Which of the following represents correct modified formula for Ampere's circuital law?

a) $\oint \vec{B}.\vec{d}l = \left[1 + \frac{d\phi_E}{dt}\right]$

b) $\oint \vec{B} \cdot \vec{d}l = I\left[\mu_0 + \varepsilon_0 \frac{d\phi_E}{dt}\right]$

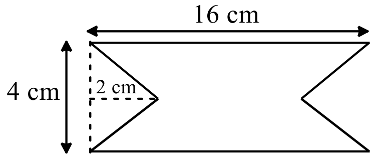
c) $\oint \vec{B} \times \vec{d}l = \mu_0 \left[I + \frac{d\phi_E}{dt}\right]$

d) $\oint \vec{B} \cdot \vec{d}l = \mu_0 \left[I + \varepsilon_0 \frac{d\phi_E}{dt}\right]$

80. The inductive reactance of a coil is 1000 Ω. If its inductance and the frequency of A.C. supply are both doubled, then the reactance will become

a) 2000 Ω b) 4000 Ω c) 8000 Ω d) 16,000 Ω

81. At time $t = 0$, magnetic field of 1000G is passing perpendicularly through the area defined by the closed loop shown in the figure. If the magnetic field reduces linearly to 500G, in the next 5 s, then induced emf in the loop is



a) 48μV b) 28μV

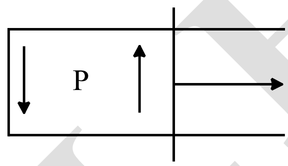
c) 56μV d) 36μV

82. A solenoid of inductance 2H carries a current 1A. What is the magnetic energy stored in a solenoid?

a) 2 J b) 1 J

c) 4 J d) 5 J

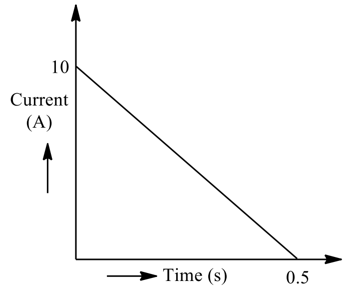
83. A movable wire is moved to the right crossing an anti-clockwise induced current as shown in figure. The direction of magnetic induction in the region point P



a) to the right b) to the left

c) upwards the paper d) downwards into the paper

84. In a coil of resistance100Ω, a current is induced by changing the magnetic flux through it as shown in the figure. The magnitude of change in flux through the coil is



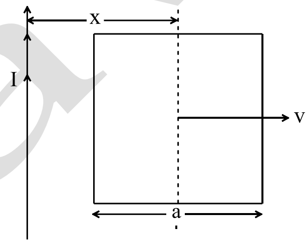
a) 225 Wb b) 250 Wb

c) 275 Wb d) 200 Wb

85. An average induced e. m. f. of 1V appears in a coil when the current in it is changed from 10 V in one direction to 10 A in opposite direction in 0.5 s. Self-inductance of the coil is

a) 25 mH b) 50 mH c) 75 mH d) 100 mH

86. A conducting square frame of side a and a long straight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity v. The emf induced in the frame will be proportional to



a) $\frac{1}{x^2}$ b) $\frac{1}{(2x-a)^2}$

c) $\frac{1}{(2x+a)^2}$ d) $\frac{1}{(2x-a)(2x+a)}$

87. A step-down transformer has 50 turns on secondary and 1000 turns on primary winding. If a transformer is connected to 220 V and 1 AAC source, what is output current of the transformer?

a) $\frac{1}{20}$ A b) 20 A

c) 100 A d) 2 A

88. In an A.C. circuit the electrical energy is consumed in

a) L b) C c) R d) 'L' and 'c'

89. An alternating e. m. f. of frequency $f = \frac{1}{2\pi\sqrt{LC}}$ is applied to a series LCR circuit. For this frequency of the applied e. m. f.

a) The circuit is at resonance and its impedance is made up only of a reactive part

The current in the circuit is in phase with the

b) applied e. m. f. and the voltage across R equals this applied e. m. f.

c) The sum of the potential differences across the inductance and capacitance equals the applied e. m. f. which is 180° ahead of phase of the current in the circuit

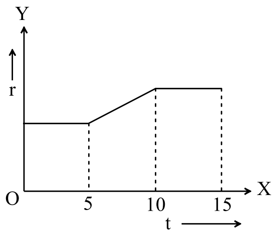
d) The quality factor of the circuit is ω/LR and is a measure of the voltage magnification produced by the circuit at resonance

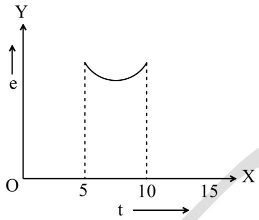
90. A small loop of area of cross-section 10^{-4} m^2 is lying concentrically and coplanar inside a bigger loop of radius 0.628 m. A current of 10 A is passed in the bigger loop. The smaller loop is rotated about its diameter with an angular velocity ω. The magnetic flux linked with the smaller loop will be

a) $10^{-7}\sin\omega t$ b) $10^{-7}\cos\omega t$

c) $10^{-9}\sin\omega t$ d) $10^{-9}\cos\omega t$

91. A circular wire as placed in a uniform magnetic field perpendicular to the plane of coil. If the radius of coil changes with time as shown in the figure, then the magnitude of the induced e. m. f. in the loop is



a)


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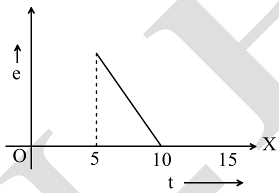

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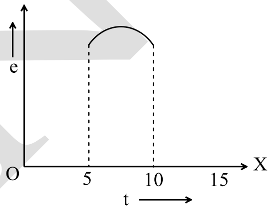
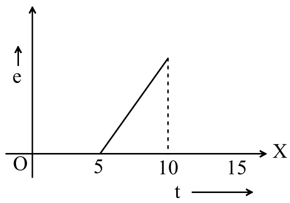


d)


92. At what frequency will the inductive reactance of 2 H inductance be equal to the capacitive reactance of 2 μF capacitance?

a) 80 Hz b) 40 Hz c) 60 Hz d) 20 Hz

93. For a coil of unit area, induction is doubled in 0.2 s. Then, the induced e. m. f. is

a) 5B b) 10B c) 8B d) 4B

94. Two identical induction coils each of inductance L joined in series are placed very close to each other such that the winding direction of one is exactly opposite to that of other, what is the net inductance?

a) L^2 b) 2L

c) L/2 d) Zero

95. In a transformer, 220 A.C. voltage is increased to 2200 volts. If the number of turns in the secondary are 2000, then the number of turns in the primary will be

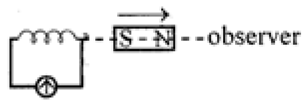
a) 200 b) 100 c) 50 d) 20

96. If an e.m.f.of 1A/s then the inductances is

a) a Henry b) a farad

c) a ohm d) none of these

97. A coil of number turns is placed perpendicular to an axis of magnetic dipole near its S-pole. if coil is
moved away from magnetic dipole, the magnetic polarity of face of coil towards the dipole polarity
of face of coil towards the dipole and direction of current rate are:



a) N-pole and clockwise

b) N-pole and anticlockwise

c) S-pole and clockwise

d) S-pole and anticlockwise

98. A resistance R draws power P when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedance of the circuit becomes Z, the power drawn will be

a) $P\left(\frac{R}{Z}\right)^2$ b) $P\sqrt{\frac{R}{Z}}$ c) $P\left(\frac{R}{Z}\right)$ d) P

99. A coil of self inductance $\frac{1}{\pi}$ henry is connected in series with a 300 Ω resistance. A voltage of 200 volt at frequency 200 Hz is supplied to this combination. The phase difference between the voltage and the current will be

a) $\tan^{-1}\left(\frac{4}{3}\right)$ b) $\tan^{-1}\left(\frac{3}{4}\right)$ c) $\tan^{-1}\left(\frac{1}{4}\right)$ d) $\tan^{-1}\left(\frac{5}{4}\right)$

100. For a solenoid having a primary coil of N_1 turns and a secondary coil of N_2 turns, the coeificient of mutual inductance is

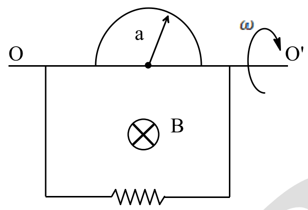
a) $\mu_0\mu_r\frac{N_1N_2}{l}$ b) $\frac{\mu_0\mu_t, N_1N_2}{Al}$

c) $\mu_0\mu_rN_1N_2Al$ d) $\frac{\mu_0\mu_rN_1N_2A}{l}$

101. A lamp consumes only 50% of maximum power applied in an A.C. Circuit. What will be the phase difference between applied voltage and circuit current?

a) $\frac{\pi}{6}$ rad   b) $\frac{\pi}{3}$ rad   c) $\frac{\pi}{4}$ rad   d) $\frac{\pi}{2}$ rad

102. A wire shaped as a semi-circle of radius 'a' rotates about an axis OO' with an angular velocity ω in a uniform magnetic field of induction B (shown in figure). The axis of rotation is perpendicular to the field direction. The total resistance of the circuit is equal to R. Neglecting the magnetic field of induced current, calculate the mean amount of thermal power being generated in the loop during one rotation period and express it in the form: $P_{mean} = B^m\ a^n\ \omega^p \times$ constant. Find the value of p



a) 2   b) 4   c) 6   d) 8

103. A 220-volt input is supplied to transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80%, the current drawn by the primary windings of the transformer is

a) 5.0 ampere   b) 3.6 ampere
c) 2.8 ampere   d) 2.5 ampere

104. A long solenoid has 500 turns. When a current of 2 ampre is passed through it, the resulting magnetic flux linked with each turn of the solenoid is 4×10^{-3} Wb. The self-inductance of the solenoid is

a) 1.0 henry   b) 4.0 henry   c) 2.5 henry   d) 2.0 henry

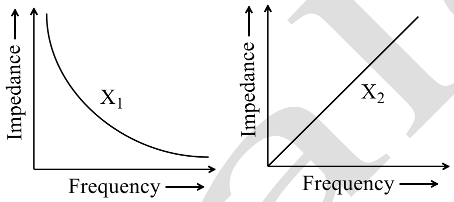
105. The reactance of a circuit is zero. It is possible that the circuit contains

a) A resistor
b) An inductor and a capacitor
c) A capacitor but no inductor
d) An inductor but no capacitor

106. The value of impedance in parallel LC circuit at resonance is (assuming inductor and capacitor to be ideal):

a) Minimum   b) Maximum
c) Infinite   d) Zero

107. The graphs given below depict the dependence of two reactive impedance X_1 and X_2 on the frequency of the alternating e. m. f. applied individually to them. We can then say that



a) X_1 is an inductor and X_2 is a capacitor
b) X_1 is a resistor and X_2 is capacitor
c) X_1 is a capacitor and X_2 is an inductor
d) X_1 is an inductor and X_2 is a resistor

108. In an LCR series a.c. circuit, the current is

a) always in phase with the voltage
b) lags the generator voltage
c) leads the generator voltage
d) none of these

109. A conducting coil having 500 turns cross-sectional area 0.15 m^2. A magnetic field of strength 0.2 T linked perpendicular to this area changes to 1.0 T in 0.4 sec. The induced emf produced in the coil will be _________ volt

a) 10.0   b) 15.0   c) 75.0   d) 150.0

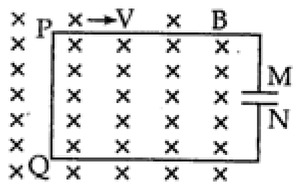
110. Power consumed in an A.C. circuit is zero if it is purely

a) resistive circuit   b) inductive circuit
c) capacitive circuit   d) both 'b' and 'c'

111. A generator produces a voltage that is given by $e = 240 \sin 120\ t$, where t is in seconds. The frequency and r.m.s. voltage are

a) 60 Hz and 240 V   b) 19 Hz and 120 V
c) 19 Hz and 170 V   d) 754 Hz and 70 V

112. A rod PQ is connected to the capacitor plates. The rod is placed in a magnetic field B directed downward perpendicular to the plane of the paper. If the rod is pulled out of the magnetic field with velocity v as shown in figure



a) plate M will be positively charged
b) plate N will be positively charged
c) both plate will be similarly charged
d) no charge will be collected on plates

113. The ratio of voltage across inductor/condenser to the voltage across resistor in a series resonant
circuit is
a) voltage magnification factor
b) Q factor
c) Both' a' and' b'
d) neither a nor b

114. In electro, magnetic induction the induced charge is independent of
a) change of flux b) Time
c) resistance of the coil d) none of these

115. If coil is opened, then L and R become
a) $\infty, 0$ b) $0, \infty$
c) ∞, ∞ d) 0,0

116. A coil of wire of radius r has 600 turns and a self-inductance of 108mH. The self-inductance of a coil with same radius and 500 turns is
a) 80mH b) 75mH
c) 108mH d) 90mH

117. Impedance of A.C. circuit is the opposition offered by
a) Ohmic components only
b) Non – ohmic component only
c) Ohmic and non – ohmic components both
d) The components other than ohmic and non ohmic

118. The r.m.s. value of an alternating current is
a) less than zero
b) equal to its peak value
c) less than its peak value
d) greater than its peak value

119. A coil has an inductance of 0.7 henry and is joined in series with a resistance of 220 Ω. When an alternating e. m. f. of 220 V at 50 cycles per second is applied to it, then wattless component of current in the circuit is
a) 7 A b) 5 A c) 0.7 A d) 0.5 A

120. A copper rod moves parallel to the horizontal direction. the emf induced will be maximum at the
a) equator b) lattitude 30°
c) lattitude 60° d) Poles

121. The product $e_{rms}I_{rms}$ is called as
a) true power b) apparent power
c) power factor d) Q factor

122. Whenever the magnetic flux linked with a coil changes, an induced e. m. f. is produced in the circuit. This e. m. f. is present
a) For a short time
b) For a long time
c) So long as the change in flux takes place
d) Forever

123. In parallel resonant circuit at resonance
a) current is maximum and impendence is maximum
b) current is maximum and impedance is minimum
c) current is minimum and impedance is maximum
d) current is minimum and impedance is minimum

124. When the current changes from +2 A to −2 A in 0.05 second, an e. m. f. of 8 volt is induced in a coil. The coefficient of self induction of the coil is
a) 0.1 H b) 0.2 H c) 0.4 H d) 0.6 H

125. A loop made of straight edges six corners at A(0,0,0), B(L, 0,0), C(L, L, 0), D(0, L, 0), E(0, L, L) and F(0,0, L). A magnetic field $B = B_0(\hat{i} + \hat{k})T$ is present in the region. The flux passing through the loop ABCDEFA is
a) B_0L^2Wb b) $2B_0L^2Wb$
c) $\sqrt{2}B_0L^2Wb$ d) $4B_0L^2Wb$

126. The LCR series circuit resonance is called as
a) series resonant b) parallel resonant
c) reactive circuit d) none of these

127. In parallel resonance. the current will be minimum, when
a) impedance is maximum
b) impedance is less than resistance
c) impedance is equal to resistance
d) impedance is zero

128. A metal wire of area of cross-section 1.8×10^{-7} m² and specific resistance $9 \times 10^{-6}\Omega - m$ is bent into a square loop and moved with a constant speed in a uniform magnetic field of induction 2 Wb/m². What should be the speed of loop so that a current of 3 mA passes through it?
a) 7.5 m/s b) 0.5×10^{-3}m/s
c) 7.5×10^{-2}m/s d) 1.9×10^{-2}m/s

129. A step-down transformer reduces the voltage of a transmission line from 2200 V to 220 V. The power delivered by it is 880 W and its efficiency is 88%. The input current is
a) 4.65 mA b) 0.045 A

c) 0.45 A　　d) 4.65 A

130. A resistance of 10 Ω, an inductance of $\left(\frac{2}{\pi}\right)$ henry and a capacitor of $\left(\frac{1}{\pi}\right)$ μF are connected in series with mains line of 110 V and 50 Hz. The phase difference between the voltage and current will be
a) ≈ −90°　b) ≈ +90°　c) 0°　d) 180°

131. One Henry is equal to
a) 1 Weber/ampere　b) 1 Weber/volt
c) 1 Weber ampere　d) 1 Weber volt

132. In a purely capacitive circuit, the current
a) Leads the applied e. m. f. by π/2
b) Is in phase with applied e. m. f.
c) Lags behind the applied e. m. f. by π/2
d) Lags behind the applied e. m. f. by π^c

133. A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6 A, the voltage across the secondary coil and the current in the primary coil respectively are
a) 300 V, 15 A　b) 450 V, 15 A
c) 450 V, 13.5 A　d) 600 V, 15 A

134. In parallel resonant circuit, the current through inductor by
a) 0°　b) 90°　c) 180°　d) 270°

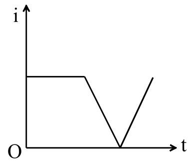
135. With an increase in the frequency of an A.C. supply, the inductive reactance
a) Increases　b) Remains constant
c) Decreases　d) Decreases sharply

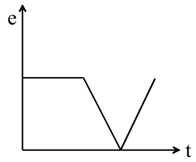
136. A rectangular coil of 300 turns has an average area of 25 cm × 10 cm. The coil rotates with a speed of 50cps in a uniform magnetic field of strength 4×10^{-2} T about an axis perpendicular to the field. The peak value of the induced emf (in volt) is
a) 300π　b) 3000π
c) 3π　d) 30π

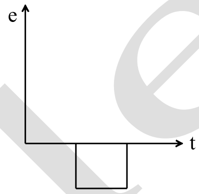
137. An electric current has both D.C. and A.C. components. D.C. component of 8 A and A.C. component is given as $I = 6 \sin \omega t$ A. So I_{rms} value of resultant current is ________
a) 8.05 A　b) 9.05 A　c) 11.58 A　d) 13.58 A

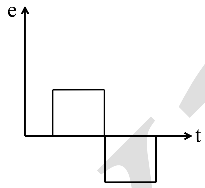
138. A conducting circular loop is placed in a uniform magnetic field 0.04 T with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at 2 mm/s. The induced e. m. f. in the loop when the radius is 2 cm will be
a) 3.2 π μV　b) 4.8 π μV
c) 0.8 π μV　d) 1.6 π μV

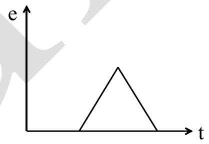
139. The current in an induction coil varies with time t according to graph shown in the figure. Which of the following graphs shows variation of induced e. m. f. (e) in coil with time?



a) 

b) 

c) 

d) 

140. A coil of copper having 1000 turns is placed in a magnetic field $B = 4 \times 10^{-3}$ T perpendicular to its plane. The cross-sectional area of the coil is 0.05 m^2. If it turns through 180° in 0.01 s, then the e. m. f. induced in the coil is
a) 0.4 V　b) 40 V　c) 0.2 V　d) 4 V

141. In an ideal transformer, the primary and the secondary voltages always have
a) Equal magnitude
b) The same phase
c) A phase difference of 90°
d) A phase difference of 180°

142. A circular wire of radius r rotates about its own axis with angular speed ω in a magnetic field B perpendicular to its plane, then the induced e. m. f. is
a) $\frac{1}{2}B r \omega^2$　b) $B r \omega^2$　c) $2 B r \omega^2$　d) Zero

143. Eddy current are also known as ………………current
a) Alternating　b) Focault
c) Direct　d) Peak

144. In a step-up transformer, if the voltage in the secondary is increased, then the current in the primary
a) Increases　b) Decreases
c) Does not change　d) Becomes zero

145. A magnetic field of 2×10^{-2} T acts at right angles to a coil of area 100 cm^2 with 50 turns. The average e. m. f. induced in the coil is 0.1 V, when it is removed from the field in time t. The value of t is

a) 0.1 s b) 0.01 s c) 1 s d) 20 s

146. In a region of a uniform magnetic induction $B = 10^{-2}$T, a circular coil of radius 30 cm and resistance π^2 Ω is rotated about an axis which is perpendicular to the direction of $\vec{B}$ and which forms a diameter of the coil. If the coil rotates at 200 r. p. m., the amplitude of the alternating current induced in the coil is

a) $4\pi^2$ mA b) 30 mA c) 6 mA d) 200 mA

147. Eddy currents are also known as _______ currents

a) Alternating b) Focault
c) Direct d) Peak

148. The charge which will flow through a 200Ω galvanometer connected to a 400Ω circular coil of 1000 turns wound on a wooden stick 20 mm in diameter, if a magnetic field B = 0.012 T parallel to the axis of the stick decreased suddenly to zero is

a) 6.3μC b) 63μC
c) 0.63μC d) 630μC

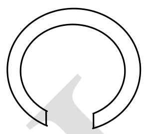
149. The basic requirement for the operation of a transformer is that its input voltage must be

a) Pulsating D.C. voltage b) Rectified
c) Alternating d) Amplified

150. A.C. voltmeter is connected to a source of $e_0 = 141.4$ volt, then it will read

a) 10 V b) 100 V c) 1000 V d) 1 V

151. A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The reading of A.C. voltmeter is 200 V, if the copper ring has a cut such as not to form a complete loop, then the acceleration of the falling magnet is



a) Equal to 'g' b) Less than 'g'
c) Greater than 'g' d) Zero

152. Induction coil is an instrument based on the principle of

a) Electromagnetic induction
b) Mutual induction
c) Self induction
d) Induction furnace

153. A coil has resistance 30 ohm and inductive reactance 20 ohm at 50 Hz frequency. If an A.C. source, of 200 volt, 100 Hz is connected across the coil, the current in the coil will be

a) $\frac{20}{\sqrt{13}}$A b) 2.0 A c) 4.0 A d) 8.0 A

154. In rejector circuit, above resonant frequency the circuit is

a) Both capacitive as well as inductive
b) Only capacitive
c) Only inductive
d) Only ohmic resistance contained

155. The general equation for the instantaneous e. m. f. of a generator (frequency 50 cycles/s), whose peak voltage is 200 V will be

a) $e = 200\sqrt{2}\sin(50\pi t)$
b) $e = 200\sin(50\pi t)$
c) $e = 200\sin(100\pi t)$
d) $e = 200\sqrt{2}\sin(100\pi t)$

156. The average power dissipated in a pure inductor is

a) $\frac{VI^2}{4}$ b) $\frac{1}{2}VI$ c) Zero d) VI^2

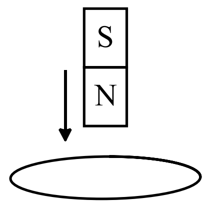
157. A current carrying coil is subjected to a uniform magnetic field. The coil will orient so that its plane becomes

a) Inclined at 45° to the magnetic field
b) Inclined at any arbitary angle to the magnetic field
c) Parallel to the magnetic field
d) Perpendicular to the magnetic field

158. A transformer which

a) transformer energy
b) transformer voltage
c) transformer frequency
d) generates e.m.f.

159. The North pole of a magnet is falling on a metallic ring as shown in the figure. The direction of induced current, if looked from upside in the ring will be



a) clockwise or anti-clockwise depending on metal of the ring b) no induced current
c) anti-clockwise d) clockwise

160. Eddy current do not produce

a) Heating b) a loss od energy
c) sparking d) damping of motion

161. Which of the following is an application of eddy currents?

a) Lux meter b) Speedometer
c) Exposure meter d) Galvanometer

162. Whenever the magnetic flux linked, with a coil changes, then an induced e.m.f is produced in the circuit. This e.m.f. lasts
a) for ever
b) for a long time
c) for a short time
d) so long as the change in flux take place

163. A coil is wound on a core of rectangular cross-section. If all the linear dimensions of core are increased by a factor 2 and number of turns per unit length of coil remains same, the self-inductance increases by a factor of
a) 16 b) 8
c) 4 d) 2

164. two coils i.e. primary and secondary in an ideal transformer have one of the following constant or the same is
a) current b) Power
c) Voltage d) Resistance

165. When a current of 2 A is passed through a coil of 100 turns, flux associated with it is 5×10^{-5} Wb. Find the self-inductance of the coil.
a) 4×10^{-3}H b) 4×10^{-2}H
c) 2.5×10^{-3}H d) 10^{-3}H

166. If the flux associated with a coil changes at the rate of 240 weber in every 2 minutes, then the induced e. m. f. is
a) 2 volt b) 0.20 volt c) 3 volt d) 6 volt

167. In rejector circuit above resonant frequency the circuit is
a) both capacitive as well as inductive
b) only capacitive
c) only inductive
d) only Ohmic resistance contained

168. Mutual induction is the phenomenon of generation of induced emf in one coil due to the
a) change of current in the same coil
b) change of current in neighboring coil
c) steady current in neighboring coil
d) steady current in the same coil

169. Lenz's law is consequence of the law of conservation of
a) Charge b) Momentum
c) Mass d) Energy

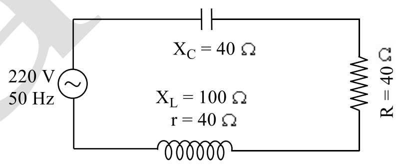
170. The flux linked with a coil of self inductance 2 H, when there is a current of 5.8 A flowing through it is
a) 11.6 Wb
b) 2.9 Wb
c) 8.7 Wb
d) Independent of orientation of coil

171. A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6 A, the voltage across the secondary coil and the current in the primary coil respectively are
a) 300 V, 15 A b) 450 V, 15 A
c) 450 V, 13.5 A d) 600 V, 15 A

172. Energy required to establish a current of 4 A in a coil of self-inductance $L = 200$mH is
a) 0.16 J b) 0.18 J
c) 0.40 J d) 1.6 J

173. The self inductance of a coil is 5 mH. If a current of 2 A is flowing in it, then the magnetic flux produced in the coil will be
a) 0.01 weber b) 10 weber
c) Zero d) 1 weber

174. The power factor of the circuit shown in figure is



a) 0.2 b) 0.4 c) 0.8 d) 0.6

175. A coil of self-inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when
a) Frequency of the AC source is decreased
b) Number of turns in the coil is reduced
c) A capacitance of reactance $X_C = X_L$ is included in the same circuit
d) An iron rod is inserted in the coil

176. A transformer connected to 220 volt line shows an output 2 A at 11000 volt. The efficiency is 100%. The current drawn from the line is
a) 100 A b) 200 A c) 22 A d) 11 A

177. A hot wire ammeter reads 10 A in A.C. circuit. The peak value of the current is
a) $10\sqrt{2}$ A b) $\frac{10}{\sqrt{2}}$A c) 5π A d) $\frac{20}{\pi}$A

178. The number of turns of primary and secondary coils of a transformer are 5 and 10 respectively and mutual inductance of the transformer is 25H. Now, number of turns in primary and secondary are made 10 and 5, respectively. Mutual inductance of transformer will be

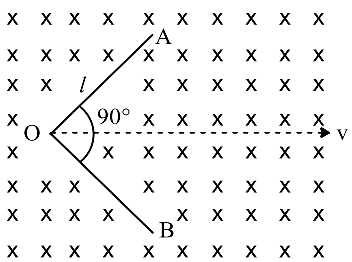
a) 25H b) 12.5H
c) 50H d) 6.25H

179. The unit of inductance is
a) Volt/ampere b) Joule/ampere
c) Volt-s/ampere d) Volt-ampere/s

180. The instantaneous values of current and e. m. f. in an A.C. circuit are $I = \frac{1}{\sqrt{2}}\sin(314t)$ A and $e = \sqrt{2}\sin\left(314\,t - \frac{\pi}{6}\right)$ V respectively. The phase difference between E and I will be
a) $-\frac{\pi}{6}$ rad b) $-\frac{\pi}{3}$ rad c) $\frac{\pi}{6}$ rad d) $\frac{\pi}{3}$ rad

181. If the magnetic field linked with the coil is reduced to half, the e. m. f induced in coil will be ________
a) Half b) Same
c) Double d) Four times

182. An ∠AOB made of a conducting wire moves along its bisector through a magnetic field B as suggested by figure. Find the emf induced between A and B, if the magnetic field is perpendicular to the plane of the paper. (where, AO = BO = l)



a) $\frac{Bvl}{\sqrt{2}}$ b) Bv
c) $\sqrt{2}$Blv d) Blv

183. Two pure inductors each of self inductance L are connected in series, the net inductance is
a) L b) 2L c) L/2 d) L/4

184. Energy stored in a current carrying coil in the form of
a) electrical field b) magnetic field
c) heat d) Light

185. In electric brakes used to stop a train, the eddy currents are produced in:
a) the rotating axle of the wheels
b) the rotating wheels
c) the rotating drum fixed to the axle
d) electric motor

186. The opposition offered by ohmic and non ohmic components is
a) inductive reactance b) capacitive reactance
c) impedance d) all of these

187. In an ideal transformer,
a) $P_{output} < P_{input}$ b) $P_{output} > P_{input}$
c) $P_{output} \geq P_{input}$ d) $P_{output} = P_{input}$

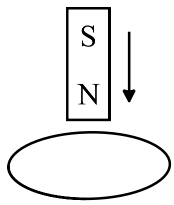
188. In a step-up transformer, the input voltage is 300 V and the output voltage is 15 kV. Then the ratio of the number of turns in the primary to that in the secondary is
a) 1 : 20 b) 1 : 30 c) 1 : 40 d) 1 : 50

189. Choke coil works on the principle of
a) Transient current b) Self induction
c) Mutual induction d) Wattless current

190. The cos ∅, in an electric circuit, is called
a) phase factor b) power factor
c) frequency factor d) resonance factor

191. An A.C. voltage source of variable angular frequency ω and fixed amplitude V connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When ω is increased
a) The bulb glows dimmer
b) The bulb glows brighter
c) Total impedance of the circuit is unchanged
d) Total impedance of the circuit increases

192. A copper ring having a cut such as not to form a complete loop is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring shown the figure. The acceleration of the falling magnet is



a) g b) less than g
c) more than g d) zero

193. If two coils have self-inductance L_1 and L_2, then coefficient of mutual induction will be
a) $M \propto \sqrt{L_1 L_2}$ b) $M \propto \sqrt{\left(\frac{L_1}{L_2}\right)}$
c) $M \propto \sqrt{\left(\frac{L_2}{4}\right)}$ d) None of these

194. When the frequency of A.C. is doubled, the impedance of an LCR, circuit is
a) Halved b) Doubled
c) Increases d) Decreases

195. The ratio of secondary to the primary turns in a transformer is 3:2. If the power output be P, then the input power neglecting all loses must be equal to

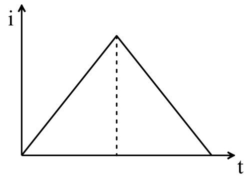
a) 5 P b) 1.5 P c) P d) $\frac{2}{5}$ P

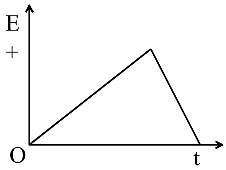
196. The self inductance associated with a coil is independent of ________
a) Current b) Induced voltage
c) Time d) Resistance of a coil

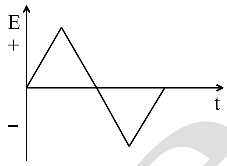
197. A magnet drops down a long vertical copper tube its velocity as it fall down the tube:
a) increase
b) decrease
c) remains constant
d) first increase and then decreases

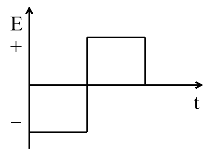
198. In LCR series circuit, an alternating e. m. f. 'e' and current 't' are given by the equations $e = 100\sin(100\,t)$ volt and
$$i = 100\sin\left(100t + \frac{\pi}{3}\right)\ \text{mA}$$
The average power dissipated in the circuit will be
a) 100 W b) 10 W c) 5 W d) 2.5 W

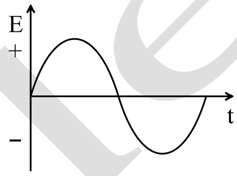
199. The current i in an inductance coil varies with time, t according to the graph shown in fig. Which one of the following plots shows the variation of voltage in the coil with time?



a) 

b) 

c) 

d) 

200. For series LCR circuit, the wrong statement is
a) Applied e. m. f. and potential difference across resistance are in same phase
b) Applied e. m. f. and potential difference at inductor coil have phase difference of $\frac{\pi}{2}$
c) Potential difference at capacitor and inductor have phase difference of $\frac{\pi}{2}$
d) Potential difference across resistance and capacitor have phase difference of $\frac{\pi}{2}$

N.B.Navale

Date : 28.03.2025 **TEST ID: 58**
Time : 03:00:00 **PHYSICS**
Marks : 200

12.ELECTROMAGNETIC INDUCTION,7.ELECROMAGNETIC INDUCTION

: ANSWER KEY :

1)	c	2)	d	3)	a	4)	d	105)	b	106)	c	107)	c	108)	d
5)	b	6)	a	7)	d	8)	b	109)	d	110)	d	111)	c	112)	a
9)	b	10)	d	11)	d	12)	c	113)	c	114)	b	115)	b	116)	b
13)	b	14)	b	15)	c	16)	c	117)	c	118)	c	119)	c	120)	d
17)	b	18)	c	19)	c	20)	c	121)	b	122)	c	123)	c	124)	a
21)	d	22)	d	23)	c	24)	d	125)	b	126)	a	127)	a	128)	c
25)	a	26)	a	27)	a	28)	c	129)	c	130)	a	131)	a	132)	a
29)	c	30)	d	31)	a	32)	a	133)	b	134)	c	135)	a	136)	d
33)	d	34)	c	35)	a	36)	a	137)	b	138)	a	139)	c	140)	b
37)	d	38)	c	39)	a	40)	a	141)	b	142)	d	143)	b	144)	a
41)	d	42)	a	43)	c	44)	b	145)	a	146)	c	147)	b	148)	a
45)	a	46)	c	47)	b	48)	b	149)	c	150)	b	151)	a	152)	b
49)	d	50)	b	51)	a	52)	a	153)	c	154)	b	155)	c	156)	c
53)	b	54)	b	55)	a	56)	c	157)	d	158)	b	159)	c	160)	c
57)	b	58)	b	59)	a	60)	c	161)	b	162)	d	163)	c	164)	c
61)	b	62)	b	63)	c	64)	b	165)	c	166)	a	167)	b	168)	b
65)	b	66)	c	67)	a	68)	c	169)	d	170)	a	171)	b	172)	d
69)	b	70)	b	71)	b	72)	b	173)	a	174)	c	175)	d	176)	a
73)	c	74)	b	75)	a	76)	d	177)	a	178)	a	179)	c	180)	a
77)	c	78)	b	79)	d	80)	b	181)	a	182)	c	183)	b	184)	b
81)	c	82)	b	83)	d	84)	b	185)	c	186)	c	187)	d	188)	d
85)	a	86)	d	87)	b	88)	c	189)	b	190)	b	191)	b	192)	a
89)	b	90)	d	91)	d	92)	a	193)	a	194)	c	195)	c	196)	d
93)	a	94)	d	95)	a	96)	a	197)	c	198)	d	199)	c	200)	c
97)	b	98)	a	99)	a	100)	d								
101)	b	102)	a	103)	a	104)	a								

N.B.Navale

Date : 28.03.2025 **TEST ID: 58**
Time : 03:00:00 **PHYSICS**
Marks : 200

12.ELECTROMAGNETIC INDUCTION,7.ELECROMAGNETIC INDUCTION

: HINTS AND SOLUTIONS :

Single Correct Answer Type

1 **(c)**

Using, $I_0 = \frac{e_0}{R} = \frac{\omega nBA}{R} = \frac{2\pi fnB(\pi r^2)}{R}$

$I_0 = \frac{2\pi \times \left(\frac{200}{60}\right) \times 1 \times 10^{-2} \times \pi(0.3)^2}{\pi^2}$

$= 6 \times 10^{-3} A = 6\ mA$

3 **(a)**

$e = 5\sin(\omega t + 90)$ and

$I = 2\sin\omega t$

There is phase difference of $\frac{\pi}{2}$ between E and I ⇒

$P = 0$

6 **(a)**

For D. C., $R = \frac{100}{1} = 100\ \Omega$

For A. C. $Z = \frac{100}{0.5} = 200\ \Omega$

Now, $Z^2 = R^2 + X_L^2$

$\therefore X_L^2 = (200)^2 - (100)^2$

$= 40000 - 10000$

$= 30000$

$\therefore X_L = \sqrt{30000} = 173.2\ \Omega$

$X_L = 2\pi fL$

$\therefore L = \frac{X_L}{2\pi f}$

$= \frac{173.2}{2 \times 3.14 \times 50}$

$= 0.55\ H$

7 **(d)**

We know that, the magnetic flux associated with coil Y is directly proportional to current flowing in X coil, i.e. $\phi_Y \propto i_X$ Here, ϕ_Y = change in magnetic flux in coil Y.

i_X = change in current in coil X and M = mutual inductance.

$\Rightarrow \phi_y = Mi_x$ ....(i)

Given, $i_X = 4\ A_1 \phi_Y = 0.4\ Wb$

Then from Eq, (i), we get

$0.4 = M \times 4$

$\Rightarrow M = \frac{0.4}{4} = 0.1\ J$

9 **(b)**

Comparing given equation with the standard form,

$e = e_0 \sin\omega t$ we get,

$e = 200\sin 100\pi$

$e_0 = 200, \omega = 100\pi$

Now, $e_0 = nAB\omega$

$\therefore B = \frac{e_0}{An\omega}$

$= \frac{200}{(0.25 \times 0.25) \times 1000 \times 100\pi} = 0.01\ T$

11 **(d)**

Time taken by the current to reach the Maximum value $t = \frac{T}{4} = \frac{1}{4f} = \frac{1}{4 \times 50} = 5 \times 10^{-3} s$

and $I_0 = I_{rms}\sqrt{2} = 10\sqrt{2} = 14.14\ A$

12 **(c)**

The efficiency of transformer

Energy obtained from the secondary coil = $\frac{\text{Energy obtained trom the secondary coil}}{\text{Energy given to the primary coil}}$

or $\eta = \frac{\text{Output power}}{\text{Input power}}$ or $\eta = \frac{V_s j_s}{V_p j_p}$

Given, $V_{s_s} = 100\ W, V_p = 220\ V_1 i_\rho = 0.5\ A$

Hence, $\eta = \frac{100}{220 \times 0.5} = 0.90 = 90\%$

13 **(b)**

Magnetic induction depends upon the magnetic permeability of medium between the coils (μ_r) or nature of material on which two coils are wound.

15 **(c)**

$|e| = nA\frac{dB}{dt}$

$= 100 \times 50 \times 10^{-4} \times \frac{(0.1 - 0.05)}{0.05}$

$= 0.5\ V$

17 **(b)**

$L = \frac{\mu_0 N^2 A}{l}$ or $L \propto N^2$

$\therefore \frac{L_1}{L_2} = \left(\frac{N_1}{N_2}\right)^2$

$\therefore \frac{108}{L_2} = \left(\frac{600}{500}\right)^2$

$\therefore L_2 = 75$ mH

18 **(c)**

Heat produced by A.C. = 3 × Heat produced by D.C.

$\therefore I_{rms}^2 Rt = 3 \times I^2 Rt$

$I_{rms}^2 = 3 \times 2^2$

$\therefore I_{rms} = 2\sqrt{3} = 3.46$ A

19 **(c)**

$\phi = BA$

$\phi = (B)(\pi r^2)$

$\therefore e = \frac{d\phi}{dt} = (B)(2\pi r)\left(\frac{dr}{dt}\right)$

$= (0.025)(2\pi)(2 \times 10^{-2})(10^{-3})$

$= \pi\,\mu$ V

20 **(c)**

$X_C = \frac{1}{2\pi f C} \Rightarrow X_C \propto \frac{1}{f}$

$\therefore \frac{X_C'}{X_C} = \frac{f}{f'} = \frac{50}{200} = \frac{1}{4}$

$\therefore X_C' = \frac{X_C}{4} = \frac{10}{4} = 2.5\ \Omega$

22 **(d)**

$|e| = \frac{d\phi}{dt} = \frac{3 \times 10^{-3} - 2 \times 10^{-3}}{25}$

$= 0.04 \times 10^{-3} = 0.04$ mV

25 **(a)**

$e = 100 \sin(100\,\pi t + 0.6)$

Comparing with the standard from,

$e = e_0 \sin(\omega t + \theta)$ we get,

Peak volt $= e_0 = 100$ V

26 **(a)**

In Hertz's experiment, the rods connected with an inductor coil behaves as an inductor.

27 **(a)**

In the induction coil, current dies out and iron core is demagnetised and rate of withdrawal of flux becomes very large and consequently large emf is induced in the secondary. Hence, the current in the secondary is intermittent but unidirectional and has been used for the production of cathode rays and X-rays.

29 **(c)**

Comparing given equations with the standard forms,

$e = e_0 \sin \omega t$ and $I = I_0 \sin(\omega t + \alpha)$

$e_0 = 200$ v, we get, $I = 1$A, $\phi = \frac{\pi}{3}$ rad

$e_{rms} = \frac{200}{\sqrt{2}}, I_{rms} = \frac{1}{\sqrt{2}}$

$\therefore P = e_{rms} I_{rms} \cos\phi$

$= \frac{200}{\sqrt{2}} \times \frac{1}{\sqrt{2}} \cos\frac{\pi}{3} = 50$ watt

30 **(d)**

In an ideal transformer, there is no energy loss and flux is completely confined with the magnetic core, i.θ. perfectly coupled $\frac{P_{out}}{P_{in}} = 1$ or 1: 1

31 **(a)**

Eddy currents are produced when a metal is kept in varying magnetic field.

33 **(d)**

$|e| = nA\frac{dB}{dt} = 100 \times 10^{-2} \times 10^3 = 10^3$ volt

34 **(c)**

$\phi = LI \Rightarrow L = \frac{\phi}{I} = \frac{y}{x}$ henry

36 **(a)**

$Z = \sqrt{R^2 + (X_C - X_L)^2}$

$= \sqrt{(3)^2 + (14 - 10)^2}$

$\therefore Z = 5\ \Omega$

37 **(d)**

Induced emf, $\theta = -L\frac{di}{dt}$

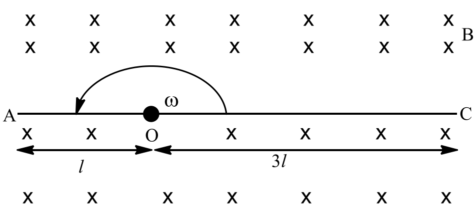
Here,

$L = 5H, \frac{di}{dt} = 2$ A/s

$e = -5 \times \frac{2}{1} = -10$ V

38 **(c)**

When a conducting rod of length — is rotated in uniform magnetic field B with angular velocity ω, then emf induced across its ends is given as $v = \frac{1}{2} \cdot B\omega l^2$



Potential difference induced between points A and O is

$$V_O - V_A = \frac{1}{2} \cdot B\omega \cdot (AO)^2 = \frac{1}{2} B\omega \Big|^2$$

Similarly, $V_O - V_C = \frac{1}{2} B\omega (OC)^2 + \frac{1}{2} B\omega (3)^2$

$$\Rightarrow V_0 - V_C = \frac{9B\omega|^2}{2}$$

$$\therefore V_A - V_C = V_A - V_O + V_O - V_C$$

$$\Rightarrow V_A - V_C = -(V_O - V_A) + (V_O - V_C)$$

$$\Rightarrow V_A - V_C = -\frac{1}{2} B\omega l^2 + \frac{9}{2} B\omega \Big|^2 = \frac{8}{2} B\omega l^2$$
$$= 4B\omega I^2$$

39 **(a)**

$X_C \propto \frac{1}{f}$

$\therefore \frac{X_{C_2}}{X_{C_1}} = \frac{f_1}{f_2} = \frac{1}{2}$

$\therefore X_{C_2} = \frac{10}{2} = 5\ \Omega$

43 **(c)**

T

45 **(a)**

At resonance, $V_L = V_C$

$\therefore V_T = V_R = 100\ V$

49 **(d)**

$e = B \times v \times l$

$= 5.0 \times 10^{-5} \times 1.50 \times 2$

$= 10.0 \times 10^{-5} \times 1.5$

$= 15 \times 10^{-5} = 0.15\ mV$

50 **(b)**

$e \propto \omega$

53 **(b)**

$I = \frac{E}{Z}$

$\therefore Z = \frac{E}{I} = \frac{50}{2} = 25$

$Z^2 = R^2 + (X_C \sim X_L)^2$

$\therefore 25^2 = 20^2 + (X_C - X_L)^2$

$\therefore (X_C - X_L)^2 = 625 - 400 = 225$

$\therefore X_C - X_L = 15$

$\therefore X_C = X_L + 15 = 10 + 15 = 25\ \Omega$

55 **(a)**

$$I = \frac{e}{R} = \frac{\left(\frac{d\phi}{dt}\right)}{R} = \frac{1}{R}\frac{d}{dt}(4t^2 - 4t + 1)$$

$$\therefore I = \frac{8t - 4}{R} = \frac{8 \times (1/2) - 4}{10} = 0$$

57 **(b)**

Mutual inductance of the pair of coils depends on distance between two coils, relative position, orientation and geometry of two coils.

59 **(a)**

From $\phi = Mi$,

$$\frac{M_1}{M_2} = \frac{\phi_1}{\phi_2} = \frac{10^{-3} \times 200}{0.8 \times 10^{-3} \times 400} = \frac{10}{16} = 0.625$$

61 **(b)**

Efficiency of a transformer is defined as the ratio of output power to the input power. A transformer which decreases the AC voltage is called a step-down transformer. Transformer is essentially an AC device. It cannot work on DC. A transformer changes AC voltage/currents. Efficiency of transformer is given by

$$\eta = \frac{\text{Output power}}{\text{Input power}} = \frac{E_{c_s}}{E_p i_p}$$

Here, $P_{oulput} = 8\ kW, n = 90\%$

$$P_{reut} = \frac{8 \times 100}{90} = \frac{80}{9}\ kW = 8.89\ kW$$

66 **(c)**

As I increases, ϕ increases

$\therefore I_i$ is such that it opposes the increase in ϕ.

Hence ϕ decreases (By Right Hand Rule) The induced current will be counterclockwise

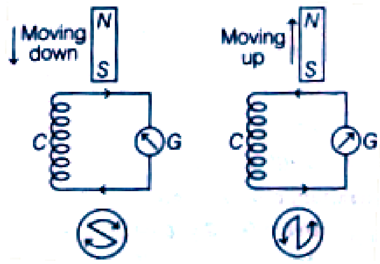
68 **(c)**

If the current increases with time in loop A, then magnetic flux in B will increase. By Lenz's law, loop-B will be repelled by loop-A

69 **(b)**

When the S-pole of a magnet is moved towards the coil, then by Lenz's law, the face of coil towards magnet becomes S-pole. Thus, the current flows in clockwise direction to oppose the change in the magnetic flux. So, the galvanometer shows deflection to the left as shown in figure. Now, when the S-pole is moved away, current flows in anti-clockwise direction to make the face of the coil towards magnet, a N-pole.

Thus, the coil will try to attract the magnet. So, the galvanometer shows the deflection to the right as shown below.



Since, flux varies, so the amplitude of deflection will not be constant and the deflection will decrease.

70 **(b)**

$L = \frac{\phi}{I} = \frac{10 \times 10^{-6}}{2.5 \times 10^{-3}} = 4 \times 10^{-3}H = 4\ mH$

73 **(c)**

$f = \frac{c}{\lambda} = \frac{3 \times 10^8}{300} = 10^6 Hz$

Now, $f_r = \frac{1}{2\pi\sqrt{LC}} \Rightarrow \sqrt{LC} = \frac{1}{2\pi f_r}$

$\therefore L = \frac{1}{4\pi^2 f_r^2 C}$

$\therefore L = \frac{1}{4\pi^2(10^6)^2 \times 2.4 \times 10^{-6}} \approx 10^{-8}H$

74 **(b)**

$\frac{N_s}{N_p} = \frac{V_s}{V_p}$

$\therefore \frac{50}{1000} = \frac{V_s}{220}$

$\Rightarrow V_s = 11\ V$

Now, $V_s I_s = V_p I_p$

$\therefore 11 \times I_s = 220 \times 1$

$\Rightarrow I_s = 20\ A$

77 **(c)**

The output power in step-up transformer used in practice is less than the input power due to transformer losses.

80 **(b)**

$X_L \propto f_L \Rightarrow \frac{X_{L_2}}{X_{L_1}} = \frac{f_2 L_2}{f_1 L_1} = \frac{2f \times 2L_1}{f_1 L_1} = 4$

$\therefore X_{L_2} = 4 \times 1000 = 4000\ \Omega$

81 **(c)**

Induced emf in the loop,

$e = -\frac{\Delta\phi}{\Delta t} = -\left(\frac{\Delta B}{\Delta t}\right)(A)\ (\because \phi = BA)$

$= -\left(\frac{B_2 - B_1}{\Delta t}\right)A$

Here, $B_2 = 500G = 500 \times 10^{-4}$ T,

$B_1 = 1000G = 1000 \times 10^{-4}$ T,

$\Delta t = 5$ s

A = Area of loop

= Area of rectangle − Area of two triangles

$= \left(16 \times 4 - 2 \times \frac{1}{2} \times 4 \times 2\right) cm^2$

$= 56 \times 10^{-4}\ m^2$

Using Eq. (i), we get

$e = \frac{(1000 - 500) \times 10^{-4} \times 56 \times 10^{-4}}{5}$

$= 56 \times 10^{-6}\ V = 56\mu V$

82 **(b)**

By energy stored in an inductor,

$U = \frac{1}{2} L i_0^2$

(Here, L = inductance of inductor and i_0 = current)

Given, $L = 2, H, i_0 = 1\ A$

$U = \frac{1}{2} \times 2 \times t^2 = 1\ J$

83 **(d)**

Using Fleming's right hand rule, the direction of magnetic induction B in the region at point P is downwards into the paper.

84 **(b)**

Induced current, $i = \frac{e}{R}$

Here, e = induced emf $= \frac{d\phi}{dt}$

$i = \frac{e}{R} = \left(\frac{d\phi}{dt}\right) \cdot \frac{1}{R}$

$d\phi = iRdt$

$\phi = \int iRdt$

Here, R is constant.

$\therefore \phi = A\int idt$

$\int i \cdot dt$ = Area under it graph

$= \frac{1}{2} \times 10 \times 0.5 = 25$

$\therefore\ \phi = R \times 2.5 = 100 \times 2.5 = 250$ Wb

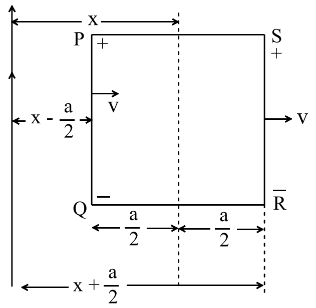
85 **(a)**

$|e| = L\dfrac{dI}{dt}$

$\therefore 1 = \dfrac{L \times [10 - (-10)]}{0.5} \Rightarrow L = 25$ mH

86 **(d)**

Induced emf $e = -Blv$



$\varepsilon_{PQRS} = \varepsilon_{PQ} + \varepsilon_{RS}$

$= \dfrac{\mu_0 I}{2\pi\left(x - \frac{a}{2}\right)} av - \dfrac{\mu_0 I}{2\pi\left(x + \frac{a}{2}\right)} av$

$= \dfrac{\mu_0 Iav}{2\pi}\left[\dfrac{2}{2x - a} - \dfrac{2}{2x + a}\right]$

$= \dfrac{\mu_0 Iav}{\pi}\left[\dfrac{2x + a - 2x + a}{(2x - a)(2x + a)}\right] = \dfrac{2\mu_0 Ia^2 v}{\pi(2x - a)(2x + a)}$

87 **(b)**

We know that, Power in the secondary coil = Power in the primary coil $V_s \times N_p = V_p \times N_s$ or $\frac{N_s}{N_p} = \frac{V_s}{V_p}$ Here, $N_s = 50$ turns, $N_p = 1000$ turns,

But $V_p = 220$ V, $V_s = ?$

$\dfrac{50}{1000} = \dfrac{V_s}{220} \Rightarrow V_s = \dfrac{50 \times 220}{1000} = 11$ V

$V_s i_s = V_p i_p \Rightarrow 11 \times i_s = 220 \times 1$

$i_s = \dfrac{220}{11} = 20$ A

90 **(d)**

$\phi = BA\cos\omega t = \dfrac{\mu_0 IA}{2R}\cos\omega t$

$= \dfrac{4 \times 3.14 \times 10^{-7} \times 10 \times 10^{-4}}{2 \times 0.628}\cos\omega t$

$= 10^{-9}\cos\omega t$

92 **(a)**

$f = \dfrac{1}{2\pi\sqrt{LC}}$

$f = \dfrac{1}{2\pi\sqrt{2 \times 2 \times 10^{-6}}} \approx 80$ Hz

93 **(a)**

$|e| = \dfrac{d\phi}{dt} = \dfrac{d}{dt}(BA) = A.\dfrac{dB}{dt}$

$= 1 \times \dfrac{B}{0.2} = 5B$

94 **(d)**

When the two coils are joined in series, such that the winding of one is opposite to the other, then the emf produced in first coil is 180° out of phase of the emf produced in second coil.
Thus, emf produced in first coil is negative and the emf produced in second coil is positive. The net inductance is

$L = -L_1 + L_2$ ....(i)

From Faraday's law of electromagnetic induction$\phi = Li$, where ϕ is flux and i is the current.

From Eq. (i), we get $L = -\frac{\phi}{i} + \frac{\phi}{i} \Rightarrow L = 0$

95 **(a)**

$\dfrac{V_P}{V_S} = \dfrac{N_P}{N_S}$

$\therefore N_P = \left(\dfrac{220}{2200}\right) \times 2000 = 200$

98 **(a)**

For purely resistive circuit Power (P) $= \frac{e^2_{rms}}{R}$
When inductance is connected in series with resistance

$P' = e_{rms}\, i_{rms}\cos\phi$

$= e_{rms}\left(\dfrac{e_{rms}}{Z}\right)\left(\dfrac{R}{Z}\right)$

$= \dfrac{e^2_{rms}}{Z^2}R$

$P' = \dfrac{(PR)}{Z^2}R \quad (\because e^2_{rms} = PR)$

$P' = \dfrac{PR^2}{Z^2}$

99 **(a)**

$\tan\theta = \dfrac{2\pi fL}{R} = \dfrac{2\pi \times 200 \times 1}{300 \times \pi} = \dfrac{4}{3}$

$\therefore \theta = \tan^{-1}\left(\dfrac{4}{3}\right)$

100 **(d)**

Coefficient of mutual inductance,

$M = \dfrac{\phi}{i_p} = \dfrac{\mu_0\mu_r N_1 N_2 A i_p}{l_p} = \dfrac{\mu_0\mu_r N_1 N_2 A}{I}$

101 **(b)**

$P = e_{rms}I_{rms}\cos\phi$ and $P_{max} = e_{rms}I_{rms}$
Since $P = 50\%\ P_{max} = 0.5\ P_{max}$
$\Rightarrow \cos\phi = 0.5 \Rightarrow \phi = \dfrac{\pi}{3}$

103 **(a)**

$$\eta = \frac{p_{out}}{p_{in}} = \frac{V_s I_s}{V_p I_p} = 0.8$$

$$\therefore I_p = \frac{(440)(2)}{(0.8)(220)} = 5\text{ A}$$

104 **(a)**

$n\phi = LI$

$$\Rightarrow L = \frac{n\phi}{I} = \frac{500 \times 4 \times 10^{-3}}{2}$$

$= 1$ henry

107 **(c)**

We have, $X_C = \frac{1}{C \times 2\pi f}$ and $X_L = L \times 2\pi f$

109 **(d)**

$$e = -NA\frac{dB}{dt} = -500 \times 0.15\left[\frac{0.2 - 1}{0.4}\right] = 150\text{ V}$$

111 **(c)**

Comparing the given equation with standard form,

$e = e_0 \sin \omega t$ we get, $\omega = 120, e_0 = 240$ V

$$\therefore f = \frac{\omega}{2\pi} = \frac{120 \times 7}{2 \times 22} \approx 19\text{ Hz}$$

$$\therefore e_{rms} = \frac{240}{\sqrt{2}} = 120\sqrt{2} \approx 170\text{ V}$$

114 **(b)**

When there is a cut in the ring e.m.f will be induced but no induced current in the ring. Hence no opposition to falling magnet ∴Acceleration is equal to 'g'.

115 **(b)**

When coil is open, there is no current in it, hence no flux is associated with it, i,e. $\phi = 0$. Also, we know that flux linked with the coil is directly proportional to the current in the coil, i.e. $\phi \propto I$ or $\phi = LI$ where, L is proportionality constant known as self-inductance.

$$L = \frac{\phi}{1} = 0$$

Again, since $i = 0$, hence $R = \infty$.

116 **(b)**

Given, $L_1 = 108$mH, $N_1 = 600$ turns, $N_2 = 500$ turns and $L_2 = ?$

By self-inductance of a plane coil,

$$L_1 = \frac{\mu_0 \pi N_1^2 a_1}{2} \quad ....(i)$$

$$L_2 = \frac{\mu_0 \pi N_2^2 a_2}{2} \quad ....(ii)$$

and

On dividing Eq. (i) by Eq. (ii), we get

$$\frac{L_1}{L_2} = \left(\frac{N_1}{N_2}\right)^2 \quad (\because a_1 = a_2)$$

$$\frac{108}{L_2} = \left(\frac{600}{500}\right)^2 \Rightarrow L_2 = \frac{108 \times 25}{36} = 3 \times 25$$

$= 75$mH

119 **(c)**

$X_L = \omega L = 2\pi f L = 2\,\pi \times 50 \times 0.7 \approx 220\ \Omega$

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{220^2 + 220^2} = 220\sqrt{2}\text{ ohm}$$

$$\therefore I_v = \frac{e_v}{Z} = \frac{220}{220\sqrt{2}} = \frac{1}{\sqrt{2}} = 0.707\text{ A}$$

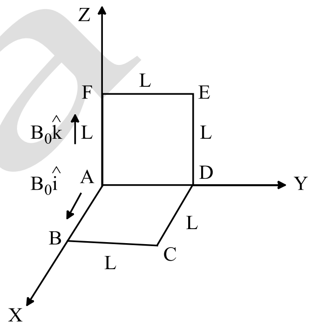
124 **(a)**

$$|e| = L\frac{dI}{dt} \Rightarrow L = e.\frac{dt}{dI}$$

$dI = 2 - (-2) = 4$ A

$$\therefore L = \frac{8 \times 0.05}{4} = 0.1\text{ H}$$

125 **(b)**



Flux passing through loop ABCDEFA = Flux through ABCD

Flux through ADEF

$= (B_0L^2 + B_0L^2)$Wb $= (2B_0L^2)$Wb

128 **(c)**

$e = B/v \Rightarrow IR = B/v$

$$\therefore v = \frac{IR}{Bl}$$

$$= \frac{I\rho l}{BA.\,l} \quad ...\left(R = \frac{\rho l}{A}\right)$$

$$= \frac{I\rho}{BA} = \frac{3 \times 10^{-3} \times 9 \times 10^{-6}}{2 \times 1.8 \times 10^{-7}}$$

$$= \frac{27 \times 10^{-9}}{36 \times 10^{-8}} = \frac{3}{4} \times 10^{-1} = 0.075$$

$\therefore v = 7.5 \times 10^{-2}$m/s

129 **(c)**

Efficiency of transformer, $\eta = \frac{\text{Output power}}{\text{Input power}}$

$\Rightarrow \frac{88}{100} = \frac{880}{P_i} \Rightarrow P_i = 1000 \text{ W}$

Input current, $i_p = \frac{P_i}{V_i} = \frac{1000}{2200} = 0.45 \text{ A}$

130 **(a)**

$\phi = \tan^{-1}\left(\frac{\omega L - \frac{1}{\omega C}}{R}\right)$

$= \tan^{-1}\left(\frac{2\pi fL - \frac{1}{2\pi fC}}{R}\right)$

$= \tan^{-1}\left(\frac{2\pi \times 50 \times \frac{2}{\pi} - \frac{\pi}{2\pi\times 50\times 10^{-6}}}{10}\right)$

$= -90°$ (approx)

133 **(b)**

Initial power $= 3000$ W

As, efficiency is 90%, then final power

$= 3000 \times \frac{90}{100} = 2700 \text{ W}$

$\Rightarrow V_1 i_1 = 3000 \text{ W}$

$V_2 i_2 = 2700 \text{ W}$

So, $V_2 = \frac{2700}{6} = \frac{900}{2} = 450 \text{ V}$

and

$i_1 = \frac{3000}{200} = 15 \text{ A}$

136 **(d)**

Peak value of induced emf in a rectangular coil,

$\theta = NBA\omega \sin\theta$

$= 300 \times 4 \times 10^{-2} \times (25 \times 10 \times 10^{-4}) \times (2\pi \times 50) \times \sin 90°$

$= 30\pi V$

137 **(b)**

$I_{rms} = \sqrt{(I^2)} = \sqrt{(8 + 6\sin\omega t)^2}$

$I_{rms} = \sqrt{(64 + 96\sin\omega t + 36\sin^2\omega t)}$

$I_{rms} = \sqrt{(64) + 96(\sin\omega t) + 36(\sin^2\omega t)}$

Since $(\sin^2\omega t) = 0.5$ and $(\sin\omega t) = 0$

$I_{rms} = \sqrt{64 + 0 + 36 \times 0.5} = 9.05$

138 **(a)**

$|e| = \frac{d\phi}{dt} = B\frac{dA}{dt} = B\frac{d}{dt}(\pi r^2) = 2\pi Br\frac{dr}{dt}$

$\therefore |e| = 2\pi \times 0.04 \times 2 \times 10^{-2} \times 2 \times 10^{-3}$

$= 3.2\,\pi\,\mu\,V$

140 **(b)**

$e = \frac{2nAB}{t} = \frac{2 \times 10^3 \times 0.05 \times 4 \times 10^{-3}}{0.01} = 40 \text{ V}$

142 **(d)**

The e. m. f. is induced when there is change of flux. As in this case there is no change of flux, hence no e. m. f. will be induced in the wire

145 **(a)**

$e = -\frac{n(B_2 - B_1)A\cos\theta}{t}$

$\therefore t$

$= \frac{-50 \times (0 - 2 \times 10^{-2}) \times 100 \times 10^{-4} \times \cos 0°}{0.1}$

$\therefore t = 0.1 \text{ s}$

146 **(c)**

$\theta = \omega t = 90°, n = \frac{200}{60} = \frac{20}{6}$ r. p. s.

Alternating current induced in the coil is given by,

$I = I_0 \sin\omega t = \frac{2\pi fnBA}{R} \times \sin 90°$

$= \frac{2 \times \pi \times 20 \times 1 \times 10^{-2} \times \pi(0.3)^2}{6 \times \pi^2} \times 1$

$= 6 \times 10^{-3}\text{A} = 6 \text{ mA}$

148 **(a)**

$q = \frac{\Delta\phi}{R} = \frac{NA(B_2 - B_1)}{R} = \frac{N\pi r^2(B_2 - B_1)}{R}$

$= \frac{1000 \times \pi \times 10^{-4} \times (0.012 - 0)}{(200 + 400)}$

$q = 6.3 \times 10^{-6}\text{C} = 6.3\mu\text{C}$

150 **(b)**

$e_{rms} = \frac{e_0}{\sqrt{2}} = \frac{141.4}{1.414} = 100 \text{ V}$

151 **(a)**

When there is a cut in the ring, e. m. f. will be induced in it but there is no induced current in the ring. Hence there is no opposition to falling magnet. Therefore, acceleration is equal to 'g'

153 **(c)**

Let $\omega_1 = 50 \times 2\pi \Rightarrow \omega L = 20\,\Omega$

$\therefore \omega_2 = 100 \times 2\pi \Rightarrow \omega L = 40\,\Omega$

$\therefore I = \frac{200}{Z} = \frac{200}{\sqrt{R^2 + (\omega' L)^2}}$

$= \frac{200}{\sqrt{(30)^2 + (40)^2}}$

$\therefore I = 4 \text{ A}$

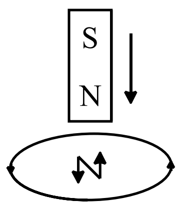
155 **(c)**

General equation for instantaneous e. m. f. is,

$e = e_0 \sin(\omega t + \phi) = 200 \sin(2\pi\, 50t)$
$= 200 \sin(100\, \pi t)$

156 **(c)**
For pure inductor $\phi = \frac{\pi}{2}$
$P_{av} = VI \cos\phi = VI \cos\frac{\pi}{2}$
$\therefore P_{av} = 0$

159 **(c)**
By Lenz's law, the direction of induced current in the ring is such as to oppose the falling of N-pole of the magnet.



So, the direction of induced current will be anti-clockwise, because the induced current makes the ring a magnetic dipole, with its N-pole upward which opposes (repel) the N-pole of falling magnet. Hence, the direction of the current in the ring will be anti-clockwise.

163 **(c)**
$$\text{As, } L = \frac{\mu_0 N^2 A}{I} = \frac{\mu_0 N^2 (a \times b)}{I}$$
where, a and b are length and width of rectangular coil.

Since, N remains same, hence $\frac{L_2}{L_1} = \frac{\mu_{0_2}}{\mu_{0_1}} \times \frac{a_2}{a_1} \times \frac{b_2}{b_1} \times \frac{l_1}{l_2}$
$$= \frac{2\mu_{01}}{\mu_{01}} \times \frac{2a_1}{a_1} \times \frac{2b_1}{b_1} \times \frac{L_1}{2l_1} = 4$$
$L_2 = 4L_1 = 4L \Rightarrow L_2 = 4L_1 = 4L$

165 **(c)**
Self-inductance, $L = \frac{N\varphi}{1} = \frac{100 \times 5 \times 10^{-5}}{2}$
$= 250 \times 10^{-5} = 2.5 \times 10^{-3} H$

166 **(a)**
$$|e| = \frac{d\phi}{dt} = \frac{240}{2 \times 60} = 2\text{ V}$$

169 **(d)**
The energy of the field increases with the magnitude of the field. Lenz's law infers that there is an opposite field created due to increase or decrease of magnetic flux around a conductor so as to hold the law of conservation of energy

170 **(a)**
$\phi = LI = 2 \times 5.8 = 11.6$ Wb

171 **(b)**
Power output $= 3\text{kW} \times \frac{90}{100}$
$= 2.7$ kW
$I_p = 6$ A
$$\therefore V_S = \frac{2.7\text{ kW}}{6\text{ A}} = 450\text{ V and}$$
$$I_p = \frac{3\text{kW}}{200\text{ V}} = 15\text{ A}$$

172 **(d)**
Energy stored in a self-inductor,
$$E = \frac{1}{2} Li^2 = \frac{1}{2} \times 200 \times 10^{-3} \times (4)^2 = 1.6\text{ J}$$

173 **(a)**
$\phi = LI = 5 \times 10^{-3} \times 2 = 0.01$ weber

174 **(c)**
$R = 40 + 40 = 80\ \Omega$
$\therefore X_L - X_C = 100 - 40 = 60\ \Omega$
$Z + \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{80^2 + 60^2} = 100$
$\therefore$ Power factor, $\cos\phi = \frac{R}{Z} = \frac{80}{100} = 0.8$

175 **(d)**
Impedance is given as,
$$Z = \frac{\sqrt{R^2 + X_L^2}}{R^2 + (L \times 2\pi f)^2}$$
$\therefore$ If frequency is decreased, impedance decreases.
If number of turns decreases, self inductance decreases and thus impedance decreases.
At resonance, $X_C = X_L$ and impedance decreases.
When iron rod is inserted, impedance increases.
Hence current decreases. Hence option (D) is correct

176 **(a)**
Using, $\frac{V_s}{V_p} = \frac{I_p}{I_s}$
$$\therefore I_p = \frac{11000 \times 2}{220} = 100\text{ A}$$

177 **(a)**
$I_{rms} = I_0 = I_{r.m.s} \times \sqrt{2} = 10\sqrt{2}$ A

178 **(a)**
Mutual inductance of transformer,
$M \propto N_1 N_2$
$$\frac{M_1}{M_2} = \frac{N_1 N_2}{N_1' N_2'}$$

$\frac{25}{M_2} = \frac{5 \times 10}{10 \times 5} \Rightarrow M_2 = 25H$

179 **(c)**

$e = L\frac{dI}{dt} \Rightarrow L = \text{volt-s/ampere}$

180 **(a)**

Phase difference relative to the current,

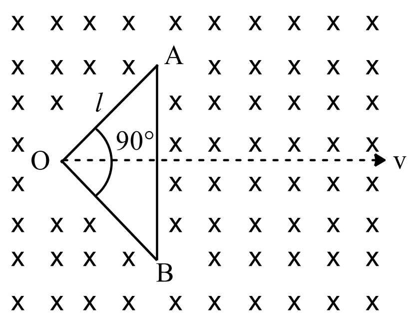
$\phi = \left(314t - \frac{\pi}{6}\right) - 314t = -\frac{\pi}{6}\text{rad}$

181 **(a)**

Since $e \propto B$, so by reducing magnetic field to half, induced e. m. f. will also be reduced to half

182 **(c)**

The emf induced between A and B as shown below is given by



$e = Bv(AB)$

In $\triangle$ AOB, $AB = \sqrt{AO^2 + BO^2} = \sqrt{1^2 + l^2} = \sqrt{2}!$

$e = Bv(\sqrt{2}l) = \sqrt{2}Bvl$

183 **(b)**

$L_s = l_1 + L_2 = L + L = 2L$

187 **(d)**

For an ideal transformer, output power is equal to input power.

Therefore, $P_{output} = P_{input}$

188 **(d)**

$V_P = V_1 = 300$ volt,

$V_S = V_o = 15\text{ kV} = 15 \times 10^3$ volt

$\therefore \frac{N_P}{N_S} = \frac{V_P}{V_S} = \frac{300}{15 \times 10^3} = \frac{2}{100} = \frac{1}{50}$

191 **(b)**

$I_{rms} = \frac{V_{rms}}{\sqrt{R^2 + \frac{1}{\omega^2 C^2}}}$

$\therefore$ As $\omega 0$ increases, I_{rms} increases and hence the bulb glows brighter

192 **(a)**

Though emf is induced in the copper ring. But there is no induced current because of cut in the ring. Hence, nothing opposes the free fall of the magnet.

Therefore, $a = g$.

193 **(a)**

The coefficient of mutual induction is $M \propto \sqrt{L_1 L_2}$.

197 **(c)**

Assuming resistance of copper tube is equal to zero acceleration of falling magnet a=g-g=0 the magnet falls with constant velocity

198 **(d)**

Comparing given equations with the standard forms,

$e = e_0 \sin \omega t$ and $i = i_0 \sin(\omega t + \phi)$ we get,

$e = 100\text{ V}, i_0 = 100\text{ mA}$

$e = 100 \sin(100\,t)$ V and

$i = 100 \sin\left(100t + \frac{\pi}{3}\right)$ mA

$\therefore \text{Power} = \frac{e_0}{\sqrt{2}}.\frac{I_0}{\sqrt{2}}\cos\phi$

$= \frac{100 \times 100}{2} \times \cos\left(\frac{\pi}{3}\right) \times 10^{-3}$

$= \frac{100 \times 100}{2} \times \frac{1}{2} \times 10^{-3}$

$= 2.5$ W

199 **(c)**

According to $i - t$ graph, in the first half, current increases uniformly so a constant negative e. m. f. get induced in the circuit.

In the second half, current decreases uniformly so a constant positive e. m. f. gets induced

Hence graph (C) is correct