DCAM classes
Dynamic Classes for Academic Mastery

6.ELECTROMAGNETIC INDUCTION

Single Correct Answer Type

1. A step-down transformer is used on a 1000 V line to deliver 20 A at 120 V at the secondary coil. If the efficiency of the transformer is 80%, the current drawn from the line is
a) 3 A b) 30 A c) 0.3 A d) 2.4 A

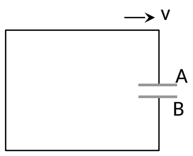
2. When a bar magnet falls through a long hollow metal cylinder fixed with its axis vertical, the final acceleration of the magnet is
a) Equal to zero
b) Less than g
c) Equal to g
d) Equal to g in the beginning and then more than g

3. The coils of a step down transformer have 500 and 5000 turns. In the primary coil an ac of $4\,ampere$ at $2200\,volts$ is sent. The value of the current and potential difference in the secondary coil will be
a) $20\,A, 220\,V$ b) $0.4\,A, 22000\,V$ c) $40\,A, 220\,V$ d) $40\,A, 22000\,V$

4. 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

5. A 100% efficient transformer has 100 turns in the primary and 25 turns in its secondary coil. If the current in the secondary coil is 4 amp, then the current in the primary coil is
a) $1\,amp$ b) $4\,amp$ c) $8\,amp$ d) $16\,amp$

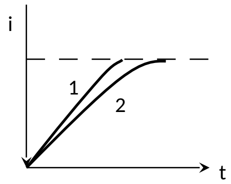
6. A conducting loop having a capacitor is moving outward from the magnetic field then which plate of the capacitor will be positive



a) Plate $-A$
b) Plate $-B$
c) Plate $-A$ and Plate $-B$ both
d) None

7. The number of turns of primary and secondary coils of a transformer are 5 and 10 respectively and the mutual inductance of the transformer is $25\,henry$. Now the number of turns in the primary and secondary of the transformer are made 10 and 5 respectively. The mutual inductance of the transformer in $henry$ will be
a) 6.25 b) 12.5 c) 25 d) 50

8. When a certain circuit consisting of a constant e.m.f. E, an inductance L and a resistance R is closed, the current in it increases with time according to curve 1. After one parameter$(E, L \vee R)$is changed, the increase in current follows curve 2 when the circuit is closed second time. Which parameter was changed and in what direction



a) L is increased b) L is decreased c) R is increased d) R is decreased

9. 2m long wire is moved with a velocity $1ms^{-1}$ in a magnetic field of intensity 0.5 Wbm^{-2} in direction perpendicular to the field. The emf induced in it will be

a) 2 V b) 1 V c) 0.1V d) 0.5 V

10. A conducting circular loop is placed in a uniform magnetic field of induction B tesla with its plane normal to the field. Now, the radius of the loop starts shrinking at the rate $\left(\frac{dr}{dt}\right)$. Then, the induced emf at the instant when the radius is r ,is

a) $\pi rB\left(\frac{dr}{dt}\right)$ b) $2\pi rB\left(\frac{dr}{dt}\right)$ c) $\pi r^2\left(\frac{dB}{dt}\right)$ d) $\left(\frac{\pi r^2}{2}\right)B\left(\frac{dr}{dt}\right)$

11. A coil of 1000 turns is wound on a book and this book is lying on the table. The vertical component of earth's magnetic field is 0.6×10^{-4} T and the area of the coil is 0.05 m^{-2}. The book is turned over once about a horizontal axis is 0.1 s. This average emf induced in the coil is

a) 0.03 V b) 0.06 V c) Zero d) 0.6 V

12. Mutual inductance of two coils can be increased by

a) Decreasing the number of turns in the coils b) Increasing the number of turns in the coils

c) Winding the coils on wooden core d) None of the above

13. If a coil made of conducting wires is rotated between poles pieces of the permanent magnet. The motion will generate a current and this device is called

a) An electric motor b) An electric generator c) An electromagnet d) All of the above

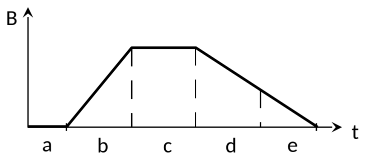
14. A circular coil has 500 turns of wire and its radius is 5 cm. The self inductance of the coil is

a) $25\times10^{-3}mH$ b) $25\,mH$ c) $50\times10^{-3}H$ d) $50\times10^{-3}mH$

15. A conducting rod of length l is moving in a transverse magnetic field of strength B with velocity v. The resistance of the rod is R. the current in the rod is

a) $\frac{Blv}{R}$ b) Blv c) Zero d) $\frac{B^2v^2l^2}{R}$

16. The graph gives the magnitude $B(t)$ of a uniform magnetic field that exists throughout a conducting loop, perpendicular to the plane of the loop. Rank the five regions of the graph according to the magnitude of the emf induced in the loop, greatest first



a) $b>(d=e)<(a=c)$ b) $b>(d=e)>(a=c)$

c) $b<d<e<c<a$ d) $b>(a=c)>(d=e)$

17. $5\,cm$ long solenoid having $10\,ohm$ resistance and $5\,mH$ inductance is joined to a $10\,volt$ battery. At steady state the current through the solenoid in $ampere$ will be

a) 5 b) 1 c) 2 d) Zero

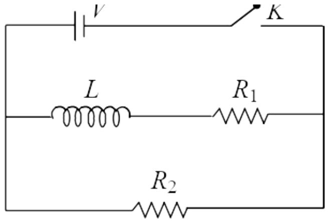
18. A horizontal straight wire 20 m long extending from east to west is falling with a speed of $5.0ms^{-1}$,at right angles to the horizontal component of the earth's magnetic field $0.030\times10^{-4}\,Wbm^{-2}$. *the instantaneous* value of the emf induced in the wire will be

a) 6.0 mV b) 3 mV c) 4.5 mV d) 1.5 mV

19. If the coefficient of mutual induction of the primary and secondary coils of an induction coils is 5 H and current of 10 A is cut-off in 5×10^{-4}s, the emf inducted (in volt) in the secondary coil is

a) 5×10^{4} b) 1×10^{5} c) 25×10^{5} d) 5×10^{6}

20. In the circuit shown below, the key K is closed at $t=0$. The current through the battery is



a) $\frac{V(R_1+R_2)}{R_1R_2}$ at $t=0$ and $\frac{V}{R_2}$ at $t=\infty$
b) $\frac{V(R_1+R_2)}{\sqrt{R_1^2R_2^2}}$ at $t=0$ and $\frac{V}{R_2}$ at $t=\infty$
c) $\frac{V}{R_2}$ at $t=0$ and $\frac{V(R_1+R_2)}{R_1R_2}$ at $t=\infty$
d) $\frac{V}{R_2}$ at $t=0$ and $\frac{V(R_1+R_2)}{\sqrt{R_1^2R_2^2}}$ at $t=\infty$

21. An transformer is employed to reduce $220\,V$ to $11\,V$. The primary draws a current of $5\,A$ and the secondary $90\,A$. The efficiency of the transformer is
a) 20% b) 40% c) 70% d) 90%

22. Which of the following phenomena is utilised in the construction of mouth piece of a telephone now a days?
a) Thermo electric effect
b) Photo electric effect
c) Change of resistance with pressure
d) Electromagnetic induction

23. Two circuits have coefficient of mutual induction of $0.09\,henry$. Average e.m.f. induced in the secondary by a change of current from 0 to $20\,ampere$ in $0.006\,second$ in the primary will be
a) $120\,V$ b) $80\,V$ c) $200\,V$ d) $300\,V$

24. The particle accelerator that uses the phenomenon of electromagnetic induction is the
a) Cyclotron
b) Betatron
c) Van de Graff generator
d) Cockroft- Walton generator

25. At a place the value of horizontal component of the earth's magnetic field H is $3\times10^{-5}\,weber/m^2$. A metallic rod AB of length $2\,m$ placed in east-west direction, having the end A towards east, falls vertically downward with a constant velocity of $50\,m/s$. Which end of the rod becomes positively charged and what is the value of induced potential difference between the two ends
a) End $A, 3\times10^{-3}\,mV$ b) End $A, 3\,mV$ c) End $B, 3\times10^{-3}\,mV$ d) End $B, 3\,mV$

26. The number of turns in the coil of an ac generator is 5000 and the area of the coil is $0.25\,m^2$. The coil is rotated at the rate of $100\,cycles/sec$ in a magnetic field of $0.2\,W/m^2$. The peak value of the emf generated is nearly
a) $786\,kV$ b) $440\,kV$ c) $220\,kV$ d) $157.1\,kV$

27. A rectangular loop of sides 10 cm and 5 cm with a cut is stationary between the pole pieces of an electromagnet. The magnetic field of the magnet is normal to the loop. The current feeding the electromagnet is reduced so that the field decreased from its initial value of 0.3 T at the rate of 0.02Ω. If the cut is joined and the loop has a resistance of 2.0Ω, the power dissipated by the loop as heat is
a) 5 nW b) 4 nW c) 3 nW d) 2 nW

28. An axle of truck is 2.5 m long. If the truck is moving due north at 30 $m\,s^{-1}$ at a place where the vertical component of the earth's magnetic field is 90μT, the potential difference between the two ends of the axle is
a) 6.75 mV with west end positive
b) 6.75 mV with east end positive
c) 6.75 mV with north end positive
d) 6.75 mV with south end positive

29. A square loop of side $22\,cm$ is converted into circular loop in $0.4\,s$. A uniform magnetic field of $0.2\,T$ directed

normal to the loop then the emf induced in the loop is

a) $6.6\times10^{-3}V$ b) $6.6\times10^{-5}V$ c) $4.6\times10^{-4}V$ d) $4.60\times10^{-8}V$

30. A conducting rod of length l is falling with a velocity v perpendicular to a uniform horizontal magnetic field B. The potential difference between its two ends will be

a) $2Blv$ b) Blv c) $\frac{1}{2}Blv$ d) $B^2l^2v^2$

31. Two pure inductors each of self inductance L are connected in parallel but are well separated from each other. The total inductance is

a) $2L$ b) L c) $\frac{L}{2}$ d) $\frac{L}{4}$

32. A physicist works in a laboratory where the magnetic field is $2T$. She wears a necklace enclosing area $0.01\,m^2$ in such a way that the plane of the necklace is normal to the field and is having a resistance $R=0.01\,\Omega$. Because of power failure, the field decays to $1T$ in time 10^{-3} $seconds$. Then what is the total heat produced in her necklace? $(T=tesla)$

a) $10\,J$ b) $20\,J$ c) $30\,J$ d) $40\,J$

33. A coil has 1,000 turns and 500 cm^2 as its area. The plane of the coil is placed at right angles to a magnetic induction field of $2\times10^{-5}\,Wbm^{-2}$. The coil is rotated through 180° in 0.2 s. the average emf induced in the coil, in mV, is

a) 5 b) 10 c) 15 d) 20

34. A coil having 500 turns of square shape each of side 10 cm is placed normal to magnetic field which is increasing at 1 Ts^{-1}. The induced emf is

a) 0.1 V b) 0.5 V c) 1 V d) -5 V

35. The current in a LR circuit builds up to 3/4th of its steady state value in $4s$. The time constant of this circuit is

a) $\frac{1}{\ln 2}s$ b) $\frac{2}{\ln 2}s$ c) $\frac{3}{\ln 2}s$ d) $\frac{4}{\ln 2}s$

36. A 50 Hz ac current of peak value 2 A flows through one of the pair of coils. If the mutual inductance between the pair of coils is 150 mH, then the peak value of voltage induced in the second coil is

a) $30\pi V$ b) $60\pi V$ c) $15\pi V$ d) $300\pi V$

37. An air core solenoid has 1000 turns and is one $metre$ long. Its cross-sectional area is $10\,cm^2$. Its self inductance is

a) $0.1256\,mH$ b) $12.56\,mH$ c) $1.256\,mH$ d) $125.6\,mH$

38. The magnetic induction in the region between the pole faces of an electromagnet is 0.7 $weber/m^2$. The induced e.m.f. in a straight conductor $10\,cm$ long, perpendicular to B and moving perpendicular both to magnetic induction and its own length with a velocity $2\,m/sec$ is

a) $0.08\,V$ b) $0.14\,V$ c) $0.35\,V$ d) $0.07\,V$

39. Quantity that remains unchanged in a transformer is

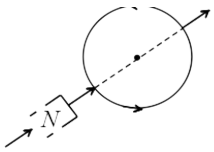
a) Voltage b) Current c) Frequency d) None of these

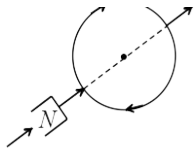
40. Which of the following is not an application of eddy currents

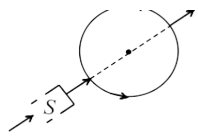
a) Induction furnace b) Galvanometer damping

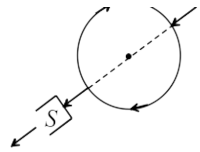
c) Speedometer of automobiles d) X-ray crystallography

41. Which of the following figure correctly depicts the Lenz's law. The arrows show the movement of the labelled pole of a bar magnet into a closed circular loop and the arrows on the circle show the direction of the induced current

a) 

b) 

c) 

d) 

42. A coil having an area A_0 is placed in a magnetic field which changes from B_0 to $4B_0$ in a time interval t. The e.m.f. induced in the coil will be
a) $\frac{3A_0B_0}{t}$ b) $\frac{4A_0B_0}{t}$ c) $\frac{3B_0}{A_0t}$ d) $\frac{4B_0}{A_0t}$

43. A power transformer is used to step up an alternating e.m.f. of $220\,V$ to $11\,kV$ to transmit $4.4\,kW$ of power. If the primary coil has 1000 turns, what is the current rating of the secondary? Assume 100% efficiency for the transformer
a) $4\,A$ b) $0.4\,A$ c) $0.04\,A$ d) $0.2\,A$

44. The ratio of secondary to primary turns is 9 : 4. If power input is P, what will be the ratio of power output (neglect all losses) to power input
a) 4 : 9 b) 9 : 4 c) 5 : 4 d) 1 : 1

45. A transformer has an efficiency of 80%. It is connected to a power input of 5kW at 200 V. If the secondary voltage is 250 V, the primary and secondary currents are respectively
a) 25 A, 20 A b) 20 A, 16 A c) 25 A, 16 A d) 40 A, 25 A

46. The self induced emf in a coils of 0.4 henry self inductance when current in it is changing at the rate of $50As^{-1}$, is
a) 8×10^{-4}V b) $8\times10^{-3}\,V$ c) 200 V d) 500 V

47. In a step-up transformer the voltage in the primary is $220\,V$ and the current is $5\,A$. The secondary voltage is found to be $22000\,V$. The current in the secondary (neglect losses) is
a) $5\,A$ b) $50\,A$ c) $500\,A$ d) $0.05\,A$

48. There is a uniform magnetic field directed perpendicular and into the plane of the paper. An irregular shaped conducting loop is slowly changing into a circular loop in the plane of the paper. Then
a) Current is induced in the loop in the anticlockwise direction

b) Current is induced in the loop in the clockwise direction

c) AC is induced in the loop

d) No current is induced in the loop

49. If a current of $10\,A$ flows in one second through a coil, and the induced e.m.f. is $10\,V$, then the self-inductance of the coil is
a) $\frac{2}{5}H$ b) $\frac{4}{5}H$ c) $\frac{5}{4}H$ d) $1\,H$

50. If a charge in current of $0.01\,A$ in one coil produces a change in magnetic flux of $1.2\times10^{-2}\,Wb$ in the other coil, then the mutual inductance of the two coils in henry is
a) 0 b) 0.5 c) 1.2 d) 3

51. When the current changes from +2 A to -2 A in 0.05 s, an emf of 8 V is induced in a coil. The coefficient of self-induction of the coil is
a) 0.2 H b) 0.4 H c) 0.8 H d) 0.1 H

52. The primary and secondary coils of a transformer have 50 and 1500 turns respectively. If the magnetic flux ϕ linked with the primary coil is given by $\phi=\phi_0+4t$, where ϕ is in weber, t is time in second and ϕ_0 is a constant, the output voltage across the secondary coil is
a) 90 V b) 120 V c) 220 V d) 30V

53. The coefficient of mutual inductance of two coils is $6\,mH$. If the current flowing in one is $2\,ampere$, then the

induced e.m.f. in the second coil will be

a) $3\,mV$ b) $2\,mV$ c) $3\,V$ d) Zero

54. The armature of dc motor has $20\,\Omega$ resistance. It draws current of 1.5 ampere when run by $220\,volts$ dc supply. The value of back e.m.f. induced in it will be

a) $150\,V$ b) $170\,V$ c) $180\,V$ d) $190\,V$

55. In an induction coil, the secondary e.m.f. is

a) Zero during break of the circuit

b) Very high during make of the circuit

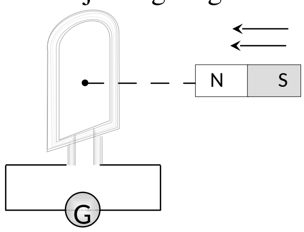
c) Zero during make of the circuit

d) Very high during break of the circuit

56. A short solenoid of length 4 cm, radius 2 cm and 100 turns is placed inside and on the axis of a long solenoid of length 80 cm and 1500 turns. A current of 3 A flows through the short solenoid. The mutual inductance of two solenoids is

a) $2.96 \times 10^{-4}\,H$ b) $5.3 \times 10^{-5}\,H$ c) $3.52 \times 10^{-3}\,H$ d) $8.3 \times 10^{-5}\,H$

57. When a magnet is pushed in and out of a circular coil C connected to a very senstitive galvanometer G as shown in the adjoining diagram with a frequency ν, then



a) Constant deflection is observed in the galvanometer

b) Visible small oscillations will be observed in the galvanometer if ν is about $50\,Hz$

c) Oscillations in the deflection will be observed clearly if $\nu = 1$ or $2\,Hz$

d) No variation in the deflection will be seen if $\nu = 1$ or $2\,Hz$

58. The north pole of a long horizontal bar magnet is being brought closer to a vertical conducting plane along the perpendicular direction. The direction of the induced current in the conducting plane will be

a) Horizontal b) Vertical c) Clockwise d) Anticlockwise

59. Two different loops are concentric and lie in the same plane. The current in the outer loop is clockwise and increasing with time. The induced current in the inner loop then, is

a) Clockwise

b) Zero

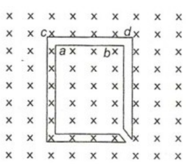
c) Counter clockwise

d) In a direction that depends on the ratio of the loop radii

60. The wing span of an aeroplane is $20\,metre$. It is flying in a field, where the vertical component of magnetic field of earth is $5 \times 10^{-5}\,tesla$, with velocity $360\,km/h$. The potential difference produced between the blades will be

a) $0.10\,V$ b) $0.15\,V$ c) $0.20\,V$ d) $0.30\,V$

61. The figure shows certain wire segments joined together to form a coplanar loop. The loop is placed in a perpendicular magnetic field in the direction going into the plane of the figure. The magnitude of the field increases with time. I_1 and I_2 are the currents in the segments ab and cd. Then,



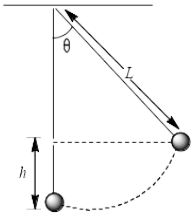
a) $I_1 > I_2$

b) $I_1 < I_2$

c) I_1 is in the direction ba and I_2 is in the direction cd

d) I_1 is in the direction ab and I_2 is in the direction dc

62. A simple pendulum with bob of mass m and conducting wire of length L swings under gravity through an angle 2θ. The earth's magnetic field component in the direction perpendicular to swing is *B.* Maximum potential difference induced across the pendulum is



a) $2BL\sin\left(\frac{\theta}{2}\right)(gL)^{1/2}$ b) $BL\sin\left(\frac{\theta}{2}\right)(gL)$ c) $BL\sin\left(\frac{\theta}{2}\right)(gL)^{3/2}$ d) $BL\sin\left(\frac{\theta}{2}\right)(gL)^2$

63. Two circular coils have their centres at the same point. The mutual inductance between them will be maximum when their axes

a) Are parallel to each other
b) Are at $60°$ to each other
c) Are at $45°$ to each other
d) Are perpendicular to each other

64. A wire of length $1\,m$ is moving at a speed of $2\,m\,s^{-1}$ perpendicular to its length and in a homogenous magnetic field of $0.5\,T$. The ends of the wire are joined to a circuit of resistance $6\,\Omega$. The rate at which work is being done to keep the wire moving at constant speed is

a) $\frac{1}{12}W$ b) $\frac{1}{6}W$ c) $\frac{1}{3}W$ d) $1\,W$

65. A metal conductor of length 1 m rotates vertically about one of its ends at angular velocity 5 rad/s. If the horizontal component of earth's magnetic field is
0.2×10^{-4}T, then the emf developed between the ends of the conductor is

a) $5\,\mu V$ b) 5 mV c) $50\,\mu V$ d) 50 mV

66. If in a coil rate of change of area is $\frac{5\,metre^2}{milli\,second}$, current becomes $1\,amp$ form $2\,amp$ in $2 \times 10^{-3}\,sec$ magnetic field is $1\,tesla$, then self inductance of the coil is

a) $2\,H$ b) $5\,H$ c) $20\,H$ d) $10\,H$

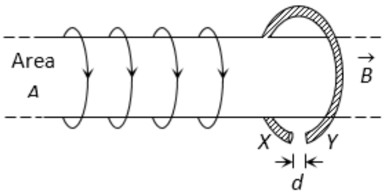
67. The north pole of a long bar magnet was pushed slowly into a short solenoid connected to a galvanometer. The magnet was held stationary for a few seconds with the north pole in the middle of the solenoid and then withdrawn rapidly. The maximum deflection of the galvanometer was observed when the magnet was

a) Moving towards the solenoid
b) Moving into the solenoid
c) At rest inside the solenoid
d) Moving out of the solenoid

68. Which of the following is constructed on the principle of electromagnetic induction

a) Galvanometer b) Electric motor c) Generator d) Voltmeter

69. A highly conducting ring of radius R is perpendicular to and concentric with the axis of a long solenoid as shown in fig. The ring has a narrow gap of width d in its circumference. The solenoid has cross sectional area A and a uniform internal field of magnitude B_0. Now beginning at $t=0$, the solenoid current is steadily increased so that the field magnitude at any time t is given by $B(t)=B_0+\alpha t$ where $a>0$. Assuming that no charge can flow across the gap, the end of ring which has excess of positive charge and the magnitude of induced e.m.f. in the ring are respectively



a) $X, A\alpha$ b) $X, \pi R^2 \alpha$ c) $Y, \pi A^2 \alpha$ d) $Y, \pi R^2 \alpha$

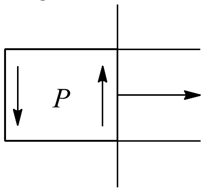
70. A copper disc of radius 0.1 m is rotated about its centre with 20 $rev-s^{-1}$ in a uniform magnetic field of 0.1 T with its plane perpendicular to the field. The emf induced across the radius of the disc is

a) $\frac{\pi}{20} V$ b) $\frac{\pi}{10} V$ c) $20\pi\, mV$ d) $10\pi\, mV$

71. Two conducting circular loops of radii R_1 and R_2 are placed in the same plane with their centres coinciding. If $R_1 \gg R_2$, the mutual inductance M between them will be directly proportional to

a) R_1/R_2 b) R_2/R_1 c) R_1^2/R_2 d) R_2^2/R_1

72. A movable wire is moved to the right crossing an anti-clock-wise induced current, figure. The direction of magnetic induction in the region P points



a) To the right b) To the left

c) Up the paper d) Down into the paper

73. The transformation ratio 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 factors

74. Two coils A and B having turns 300 and 600 respectively are placed near each other, on passing a current of $3.0\, ampere$ in A, the flux linked with A is $1.2 \times 10^{-4}\, weber$ and with B it is $9.0 \times 10^{-5}\, weber$. The mutual inductance of the system is

a) $2 \times 10^{-5}\, henry$ b) $3 \times 10^{-5}\, henry$ c) $4 \times 10^{-5}\, henry$ d) $6 \times 10^{-5}\, henry$

75. Faraday's laws are consequence of conservation of

a) Energy b) Energy and magnetic field

c) Charge d) Magnetic field

76. The oscillating frequency of a cyclotron is 10 MHz. If the radius of its dees is 0.5 m, the kinetic energy of a proton, which is accelerated by the cyclotron is

a) 10.2 MeV b) 2.55 MeV c) 20.4 MeV d) 5.1 MeV

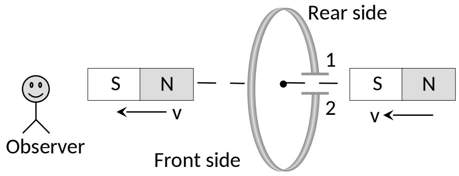
77. The magnetic flux across a loop of resistance $10\,\Omega$ is given by $\phi = 5t^2 - 4t + 1\, weber$. How much current is induced in the loop after 0.2 sec

a) $0.4\, A$ b) $0.2\, A$ c) $0.04\, A$ d) $0.02\, A$

78. The resistance and inductance of series circuit are $5\,\Omega$ and $20\, H$ respectively. At the instant of closing the switch, the current is increasing at the rate $4\, A/s$. The supply voltage is

a) $20\,V$ b) $80\,V$ c) $120\,V$ d) $100\,V$

79. The north and south poles of two identical magnets approach a coil, containing a condenser, with equal speeds from opposite sides. Then



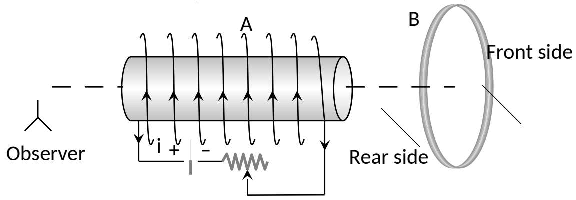
a) Plate 1 will be negative and plate 2 positive

b) Plate 1 will be positive and plate 2 negative

c) Both the plates will be positive

d) Both the plates will be negative

80. An aluminium ring B faces an electromagnet A. The current I through A can be altered



a) Whether I increases or decreases, B will not experience any force

b) If I decreases A will attract B

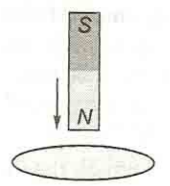
c) If I increases, A will attract B

d) If I increases, A will repel B

81. A coil of wire of a certain radius has 600 turns and a self inductance of $108\,mH$. The self inductance of a 2nd similar coil of 500 turns will be

a) $74\,mH$ b) $75\,mH$ c) $76\,mH$ d) $77\,mH$

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



a) G b) Less than g c) More than g d) Zero

83. A short-circulated coil is placed in a time-varying magnetic field. Electrical power is dissipated due to the current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be

a) Halved b) The same c) Doubled d) Quadrupled

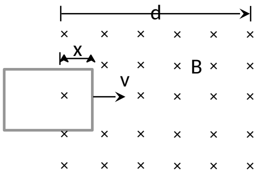
84. An ideal transformer has 100 turns in the primary and 250 turns in the secondary. The peak value of the ac is $28\,V$. The $r.m.s.$ secondary voltage is nearest to

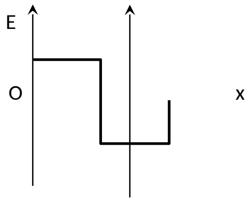
a) $50\,V$ b) $70\,V$ c) $100\,V$ d) $40\,V$

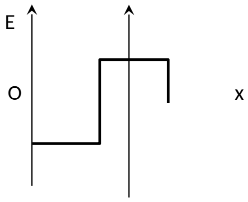
85. A wheel with ten metallic spokes each $0.50\,m$ long is rotated with a speed of $120\,rev/min$ in a plane normal to the earth's magnetic field at the place. If the magnitude of the field is 0.4 gauss, the induced e.m.f. between the axle and the rim of the wheel is equal to

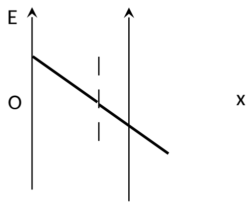
a) $1.256\times10^{-3}\,V$ b) $6.28\times10^{-4}\,V$ c) $1.256\times10^{-4}\,V$ d) $6.28\times10^{-5}\,V$

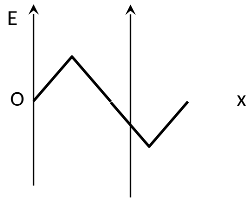
86. A rectangular loop is being pulled at a constant speed v, through a region of certain thickness d, in which a uniform magnetic field B is set up. The graph between position x of the right hand edge of the loop and the induced emf E will be



a) 

b) 

c) 

d) 

87. If the current is halved in a coil, then the energy stored is how much times the previous value

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

88. The self-inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of

a) $4\ \mu F$ b) $8 \mu F$ c) $1 \mu F$ d) $2 \mu F$

89. An electric motor operates on a $50\, volt$ supply and a current of $12\, A$. If the efficiency of the motor is 30%, what is the resistance of the winding of the motor

a) $6\,\Omega$ b) $4\,\Omega$ c) $2.9\,\Omega$ d) $3.1\,\Omega$

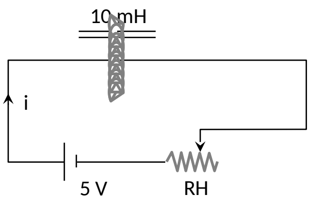
90. The total charge, induced in a conducting loop, when it is moved in a magnetic field depends on

a) Rate of change of magnetic on
b) Initial magnetic flux only
c) Total change in magnetic flux and resistance
d) Final magnetic flux only

91. A transformer rated at 10k W is used to connect a 5 kV transmission line to a 240 V circuit. The ratio of turns in the windings of the transformer is

a) 5 b) 20.8 c) 104 d) 40

92. The resistance in the following circuit is increased at a particular instant. At this instant the value of resistance is $10\,\Omega$. The current in the circuit will be



a) $i = 0.5\,A$ b) $i > 0.5\,A$ c) $i < 0.5\,A$ d) $i = 0$

93. 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

94. A step-down transformer is connected to $2400\, volts$ line and 80 amperes of current is found to flow in output load. The ratio of the turns in primary and secondary coil is 20 : 1. If transformer efficiency is 100%, then the current flowing in primary coil will be

a) $1600\,A$ b) $20\,A$ c) $4\,A$ d) $1.5\,A$

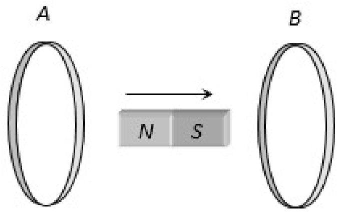
95. Flux ϕ (in weber) in a closed circuit of resistance 20Ω varies with time t (in second) according to equation $\phi = 6t^2 - 5t + 1$.

The magnitude of the induced current at $t = 0.25$ s is

a) 1.2 A b) 0.8 A c) 0.6 A d) 0.1 A

96. In an ideal transformer the number of turns of primary and secondary coil is given as 100 and 300 respectively. If the power input is $60\,W$, the power output is
a) $100\,W$ b) $300\,W$ c) $180\,W$ d) $60\,W$

97. In the diagram shown if a bar magnet is moved along the common axis of two single turn coils A and B in the direction of arrow

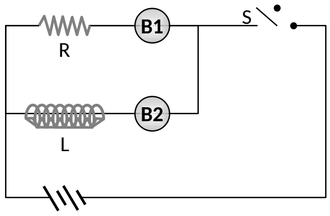


a) Current is induced only in A & not in B
b) Induced currents in A & B are in the same direction
c) Current is induced only in B and not in A
d) Induced currents in A & B are in opposite directions

98. A $10\,metre$ wire kept in east-west direction is falling with velocity $5\,m/sec$ perpendicular to the field $0.3\times10^{-4}\,Wb/m^2$. The induced e.m.f. across the terminal will be
a) $0.15\,V$ b) $1.5\,mV$ c) $1.5\,V$ d) $15.0\,V$

99. A circular coil of diameter 21 cm is placed in a magnetic field of induction 10^{-4} T. the magnitude of flux linked with coil when the plane of coil makes an angle 30° with the field is
a) $1.44\times10^{-6}\,Wb$ b) $1.732\times10^{-6}\,Wb$ c) $3.1\times10^{-6}\,Wb$ d) $4.2\times10^{-6}\,Wb$

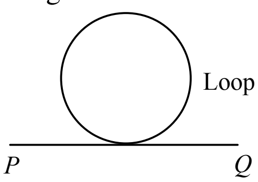
100. The adjoining figure shows two bulbs B_1 and B_2, resistor R and an inductor L. When the switch S is turned off



a) Both B_1 and B_2 die out promptly
b) Both B_1 and B_2 die out with some delay
c) B_1 dies out promptly but B_2 with some delay
d) B_2 dies out promptly but B_1 with some delay

101. The mutual inductance between two coils is $1.25\,henry$. If the current in the primary changes at the rate of $80\,ampere/second$, then the induced e.m.f. in the secondary is
a) $12.5\,V$ b) $64.0\,V$ c) $0.016\,V$ d) $100.0\,V$

102. An electron moves along the line PQ which lies in the same plane as a circular loop of conducting wire as shown in figure. What will be the direction of the induced current in the loop?



a) Anticlockwise
b) Clockwise
c) Alternating
d) No current will be induced

103. A coil of area $80\,square\,cm$ and 50 turns is rotating with $2000\,revolutions\ per\ minute$ about an axis perpendicular to a magnetic filed of $0.05\,tesla$. The maximum value of the e.m.f. developed in it is

a) $200\pi\, volt$ b) $\frac{10\pi}{3} volt$ c) $\frac{4\pi}{3} volt$ d) $\frac{2}{3} volt$

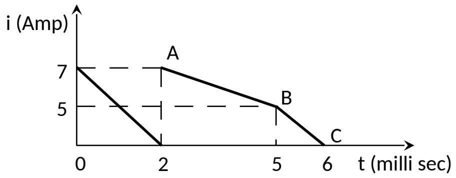
104. A motor having an armature of resistance $2\,\Omega$ is designed to operate at $220\,V$ mains. At full speed, it develops a back e.m.f. of $210\,V$. When the motor is running at full speed, the current in the armature is

a) $5\,A$ b) $105\,A$ c) $110\,A$ d) $215\,A$

105. If the number of turns in a coil becomes doubled, then it self inductance will be

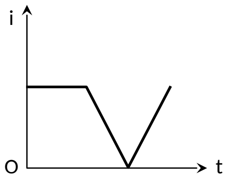
a) Double b) Halved c) Four times d) Unchanged

106. The current through a $4.6\,H$ inductor is shown in the following graph. The induced emf during the time interval $t=5\, milli-sec$ to $6\, milli-sec$ will be

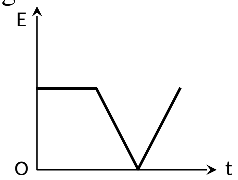


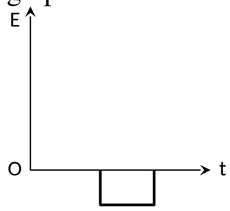
a) $10^3\,V$ b) $-23\times10^3\,V$ c) $23\times10^3\,V$ d) Zero

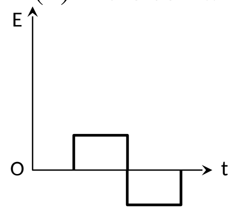
107. The current i in an induction coil varies with time t according to the graph shown

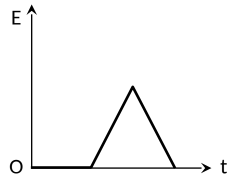


in figure. Which of the following graphs shows the induced emf (e) in the coil with time

a) 

b) 

c) 

d) 

108. A conducting ring of radius $1\, meter$ is placed in an uniform magnetic field B of $0.01\, telsa$ oscillating with frequency $100\,Hz$ with its plane at right angles to B. What will be the induced electric field

a) $\pi\, volt/m$ b) $2\, volt/m$ c) $10\, volt/m$ d) $62\, volt/m$

109. A capacitor is fully charged with a battery. Then the battery is removed and a coil is connected with the capacitor in parallel, current varies as

a) Increases monotonically b) Decreases monotonically

c) Zero d) Oscillates indefinitely

110. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon

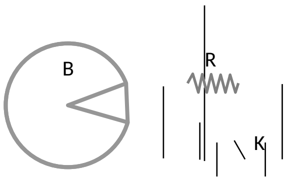
a) The rates at which currents are changing in the two coils

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

111. Shown in the figure is a circular loop of radius r and resistance R. A variable magnetic field of induction $B=B_0 e^{-t}$ is established inside the coil. If the key (K) is closed, the electrical power developed right after closing the switch is equal to



a) $\frac{B_0^2 \pi r^2}{R}$ b) $\frac{B_0 10 r^3}{R}$ c) $\frac{B_0^2 \pi^2 r^4 R}{5}$ d) $\frac{B_0^2 \pi^2 r^4}{R}$

112. An aircraft with a wing-span of $40\,m$ files with a speed of $1080\,km\,h^{-1}$ in the eastward direction at the constant altitude in the northern hemisphere, where the vertical component of earth's magnetic field is $1.75 \times 10^{-5}\,T$. Then the emf that develops between the tips of the wings is

a) $0.5\,V$ b) $0.35\,V$ c) $0.21\,V$ d) $2.1\,V$

113. A metal of radius 100 cm is rotated at a constant angular speed of 60 $rad\,s^{-1}$ in a plane at right angles to an external field of magnetic induction 0.05 Wbm^{-2}. The emf induced between between the centre and a point on the rim will be

a) 3 V b) 1.5 V c) 6 V d) 9 V

114. The current is flowing in two coaxial coils in the same direction. On increasing the distance between the two, the electric current will

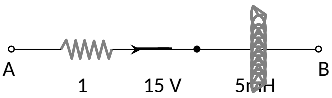
a) Increase b) Decrease

c) Remain unchanged d) The information is incomplete

115. The number of turns in primary coil of a transformer is 20 and the number of turns in the secondary is 10. If the voltage across the primary is 220 V, what is the voltage across the secondary?

a) 110 V b) 130 V c) 190 V d) 310 V

116. The network shown in the figure is a part of a complete circuit. If at a certain instant the current i is $5\,A$ and is decreasing at the rate of $10^3\,A/s$ then $V_A - V_B$ is



a) $5\,V$ b) $10\,V$ c) $15\,V$ d) $20\,V$

117. According to Lenz's law of electromagnetic induction

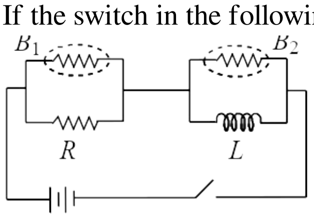
a) The induced emf is not in the direction opposing the change in magnetic flux.

b) The relative motion between the coil and magnet produces change in magnetic flux

c) Only the magnet should be moved towards coil

d) Only the coil should be moved towards magnet

118. If the switch in the following circuit is turned off, then



a) The bulb B_1 will go out immediately whereas B_2 after sometimes

b) The bulb B_2 will go out immediately whereas B_1 after sometime

c) Both B_1 and B_2 will go out immediately

d) Both B_1 and B_2 will go out after sometime

119. A transformer is employed to

a) Obtain a suitable dc voltage
b) Convert dc into ac
c) Obtain a suitable ac voltage
d) Convert ac into ac

120. In step-up transformer, relation between number of turns in primary (N_p) and number of turns is secondary (N_s) coils is

a) N_s is greater than N_p
b) N_p is greater than N_s
c) N_s is equal to N_p
d) $N_p = 2N_s$

121. A coil of $N=100$ turns carries a current $I=5$ A and creates a magnetic flux $\phi = 10^{-5} Tm^2$ per turn. The value of its inductance L will be

a) 0.05 mH
b) 0.10 mH
c) 0.15 mH
d) 0.20 mH

122. Core of transformer is made up of

a) Soft iron
b) Steel
c) Iron
d) Alnico

123. Eddy currents are produced when

a) A metal is kept in varying magnetic field
b) A metal is kept in the steady magnetic field
c) A circular coil is placed in a magnetic field
d) Through a circular coil, current is passed

124. In a transformer the primary has $500\,turns$ and secondary has $50\,turns$. $100\,volts$ is applied to the primary coil, the voltage developed in the secondary will be

a) $1\,V$
b) $10\,V$
c) $1000\,V$
d) $10000\,V$

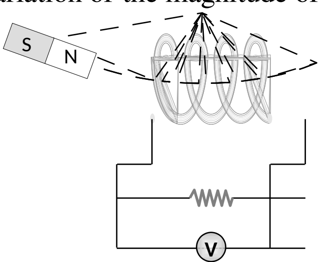
125. For a large industrial city with much load variations the DC generator should be

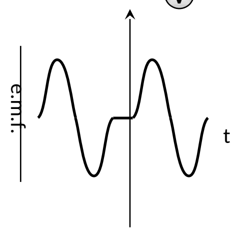
a) Series
b) Shunt wound
c) Mixed wound
d) Any

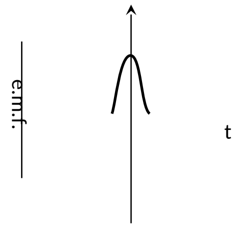
126. Find out the e.m.f. produced when the current changes from 0 to $1\,A$ in $10\,second$, given $L = 10\,\mu H$

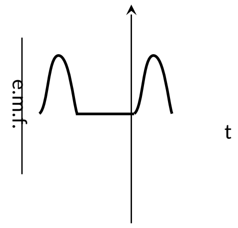
a) $1\,V$
b) $1\,\mu V$
c) $1\,mV$
d) $0.1\,V$

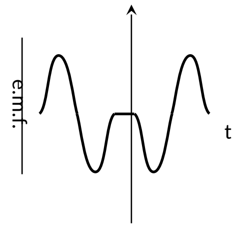
127. A magnet is made to oscillate with a particular frequency, passing through a coil as shown in figure. The time variation of the magnitude of e.m.f. generated across the coil during one cycle is



a)


b)


c)


d)


128. A coil has an inductance of $2.5\,H$ and a resistance of $0.5\,r$. If the coil is suddenly connected across a $6.0\,volt$ battery, then the time required for the current to rise 0.63 of its final value is

a) 3.5 sec
b) 4.0 sec
c) 4.5 sec
d) 5.0 sec

129. 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 $\vec{V} = v\hat{i}$. 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) The rectangular, circular and elliptical loops
b) The circular and the elliptical lops
c) Only the elliptical loop
d) Any of the four loops

130. In what form is the energy stored in an inductor **or**
A coil of inductance L is carrying a steady current i. What is the nature of its stored energy

a) Magnetic
b) Electrical
c) Both magnetic and electrical
d) Heat

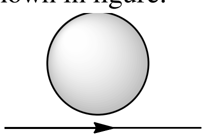
131. A circular metal plate of radius $R$is rotating with a uniform angular velocity$\omega$with its plane perpendicular to a uniform magnetic field B. Then the emf developed between the centre and the rim of the plate is

a) $\pi\omega B R^2$
b) $\omega B R^2$
c) $\pi\omega B R^2/2$
d) $\omega B R^2/2$

132. There is an arial 1 m long in a car. It is moving from east to west with a velocity of 100 kmh^{-1}. If the horizontal component of earth's magnetic field is 0.18 gauss, this induced emf is nearly

a) 0.5 mV
b) 0.25 mV
c) 0.75 mV
d) 1 mV

133. The current from $A \text{¿} B$ is increasing in magnitude. What is the direction of induced current, if any, in the loop shown in figure.



a) No current is induced
b) Clock-wise current
c) Anti-clock-wise current
d) Alternating current

134. In L-R circuit, for the case of increasing current, the magnitude of current can be calculated by using the formula

a) $I = I_0 e^{-Rt/L}$
b) $I = I_0(1 - e^{-Rt/L})$
c) $I = I_0(1 - e^{Rt/L})$
d) $I = I_0 e^{Rt/L}$

135. The current in a coil changes from $4\,ampere$ to zero in $0.1\,s$. If the average e.m.f. induced is $100\,volt$, what is the self inductance of the coil

a) $2.5\,H$
b) $25\,H$
c) $400\,H$
d) $40\,H$

136. The coil of dynamo is rotating in a magnetic field. The developed induced e.m.f. changes and the number of magnetic lines of force also changes. Which of the following conditions is correct

a) Lines of force minimum but induced e.m.f. is zero
b) Lines of force maximum but induced e.m.f. is zero
c) Lines of force maximum but induced e.m.f. is not zero
d) Lines of force maximum but induced e.m.f. is also maximum

137. A coil of inductance $300\,mH$ and resistance $2\,\Omega$ is connected to a source of voltage $2\,V$. The current reaches half of its steady state value in

a) $0.15\,s$
b) $0.3\,s$
c) $0.05\,s$
d) $0.1\,s$

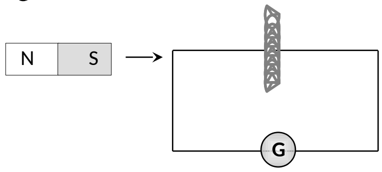
138. Two concentric coils each of radius equal to $2\pi\,cm$ are placed at right angles to each other. $3\,A$ and $4\,A$ are the currents flowing in each coil respectively. The magnetic induction in Wb/m^2 at the centre of the coils will be $(\mu_0 = 4\pi \times 10^{-7} Wb/Am)$

a) 12×10^{-5}
b) 10^{-5}
c) 5×10^{-5}
d) 7×10^{-5}

139. A $16\,\mu F$ capacitor is charged to a 20 volt potential. The battery is then disconnected and pure $40\,mH$ coil is connected across the capacitor so that LC oscillations are setup. The maximum current in the coil is

a) $0.2\,A$ b) $40\,mA$ c) $2\,A$ d) $0.4\,A$

140. As shown in the figure, a magnet is moved with a fast speed towards a coil at rest. Due to this induced electromotive force, induced current and induced charge in the coil is E, I and Q respectively. If the speed of the magnet is doubled, the incorrect statement is



a) E increases b) I increases c) Q remains same d) Q increases

141. A square coil of $10^{-2}\,m^2$ area is placed perpendicular to a uniform magnetic field of intensity $10^3\,Wb/m^2$. The magnetic flux through the coil is

a) $10\,weber$ b) $10^{-5}\,weber$ c) $10^5\,weber$ d) $100\,weber$

142. A 50 mH coil carries a current of 2 A, the energy stored in joule is

a) 1 b) 0.05 c) 10 d) 0.1

143. A 220-volt input is supplied to a 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

144. In a coil of self inductance $0.5\,henry$, the current varies at a constant rate from zero to $10\,amperes$ in $2\,seconds$. The e.m.f. generated in the coil is

a) $10\,volts$ b) $5\,volts$ c) $2.5\,volts$ d) $1.25\,volts$

145. In an A.C. generator, when the plane of the armature is perpendicular to the magnetic field

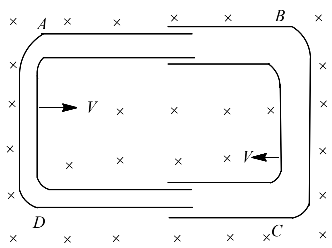
a) Both magnetic flux and emf are maximum

b) Both magnetic flux and emf are zero

c) Both magnetic flux and emf are half of their respective maximum values

d) Magnetic flux is maximum and emf is zero

146. One conducting U-tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube moves towards the other at a constant speed v, then the emf induced in the circuit in terms of $B, l \wedge v, where\, l$ is the width of each tube, will be



a) Blv b) $-Blv$ c) Zero d) $2\,Blv$

147. Lenz's law is expressed by the following formula (here $e=¿$ induced e.m.f., $\phi=¿$ magnetic flux in one turn and $N=¿$ number of turns)

a) $e=-\phi\frac{dN}{dt}$ b) $e=-N\frac{d\phi}{dt}$ c) $e=\frac{-d}{dt}\left(\frac{\phi}{N}\right)$ d) $e=N\frac{d\phi}{dt}$

148. In a uniform magnetic field of induction B, a wire in the form of semicircle of radius r rotates about the diameter of the circle with angular frequency ω. If the total resistance of the circuit is R, the mean power generated per period of rotation is

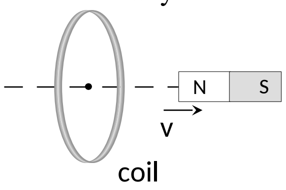
a) $\frac{B\pi r^2 \omega}{2R}$ b) $\frac{(B\pi r^2 \omega)^2}{5Rt}$ c) $\frac{(B\pi r\omega)^2}{2R}$ d) $\frac{(B\pi r\omega^2)^2}{8R}$

149. Lenz's law applies to

a) Electrostatics b) Lenses

c) Electro-magnetic induction d) Cinema slides

150. In the following figure, the magnet is moved towards the coil with a speed v and induced emf e. If magnet and coil recede away from one another each moving with speed v, the induced emf in the coil will be



a) e b) $2e$ c) $e/2$ d) $4e$

151. When a rod of length l is rotated with angular velocity of ω in a perpendicular field of induction B, about one end, the emf across its ends is

a) $Bl^2\omega$ b) $\frac{Bl^2\omega}{2}$ c) $Bl\omega$ d) $\frac{Bl\omega}{2}$

152. A LC circuit is in the state of resonance. If $C=0.1\,\mu F$ and $L=0.25\,henry$, neglecting ohmic resistance of circuit what is the frequency of oscillations

a) $1007\,Hz$ b) $100\,Hz$ c) $109\,Hz$ d) $500\,Hz$

153. When a metallic plate swings between the poles of magnet

a) No effect on the plate

b) Eddy currents are set up inside the plate and the direction of the current is along the motion of the plate

c) Eddy currents are set up inside the plate and the direction of the current oppose the motion of the plate

d) Eddy currents are set up inside the plate

154. A rectangular coil of 20 turns and area of cross-section $25\,sqcm$ has resistance of $100\,ohm$. If a magnetic field which is perpendicular to the plane of the coil changes at the rate of $1000\,tesla$ per second, the current in the coil is

a) $1.0\,ampere$ b) $50\,ampere$ c) $0.5\,ampere$ d) $5.0\,ampere$

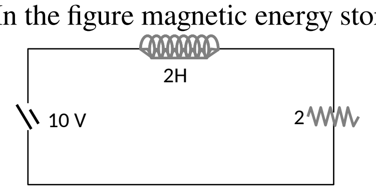
155. The wing span of an aeroplane is 36 m. If the plane is flaying at 400 kmh^{-1}, the emf induced between the wings tips is (assume $V=4\times10^{-5}\,T$ ¿

a) 16 V b) 1.6 V c) 0.16 V d) 0.016 V

156. The current passing through a choke coil of 5 henry is decreasing at the rate of $2\,ampere/sec$. The e.m.f. developing across the coil is

a) $10\,V$ b) $-10\,V$ c) $2.5\,V$ d) $-2.5\,V$

157. In the figure magnetic energy stored in the coil is



a) Zero b) Infinite c) $25\,joules$ d) None of the above

158. If coil is open then L and R become

a) $\infty, 0$ b) $0, \infty$ c) ∞, ∞ d) $0, 0$

159. A magnet is brought towards a coil (i) speedly (ii) slowly, then the induced e.m.f/induced charge will be respectively

a) More in first case/More in first case
b) More in first case/Equal in both cases
c) Less in first case/More in second case
d) Less in first case/Equal in both cases

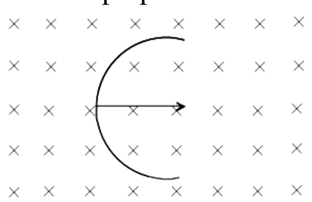
160. Armature current in dc motor will be maximum when

a) Motor has acquired maximum speed
b) Motor has acquired intermediate speed
c) Motor has just started moving
d) Motor is switched off

161. When a low flying aircraft passes over head, we sometimes notice a slight shaking of the picture on our TV screen. This is due to

a) Diffraction of the signal received from the antenna.
b) Interference of the direct signal received by the antenna with the weak signal reflected by the passing aircraft.
c) Change of magnetic flux occuring due to the passage of aircraft
d) Vibration created by the passage of aircraft

162. A straight wire of length L is bent into a semicircle. It is moved in a uniform magnetic field with speed v with diameter perpendicular to the field. The induced emf between the ends of the wire is



a) BLv b) $2BLv$ c) $2\pi BLv$ d) $\frac{2BvL}{\pi}$

163. 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 emf in the wire of aerial is

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

164. 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 emf in the loop when the radius is $2\,cm$ is

a) $3.2\,\pi\mu V$ b) $4.8\,\pi\mu V$ c) $0.8\,\pi\mu V$ d) $1.6\,\pi\mu V$

165. A square loop of wire, side length 10 cm is placed at angle of 45° with a magnetic field that changes uniformly from 0.1 T to zero in 0.7 s. The induced current in the loop (its resistance is 1 Ω ¿is

a) 1.0 mA b) 2.5 mA c) 3.5 mA d) 4.0 mA

166. An infinitely cylinder is kept parallel to an uniform magnetic field B directed along positive z axis. This direction of induced current as seen from the z axis will be

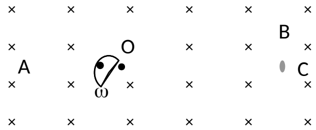
a) Clockwise of the +ve z axis
b) Anticlockwise +ve z axis
c) Zero
d) Along the magnetic field

167. The self inductance of a solenoid of length L, area of cross-section A and having N turns is

a) $\frac{\mu_0 N^2 A}{L}$ b) $\frac{\mu_0 NA}{L}$ c) $\mu_0 N^2 LA$ d) $\mu_0 NAL$

168. A conducting rod AC of length $4l$ is rotated about a point O in a uniform magnetic field $\vec{B}$ directed into the

paper. $AO=l$ and $OC=3l$. Then



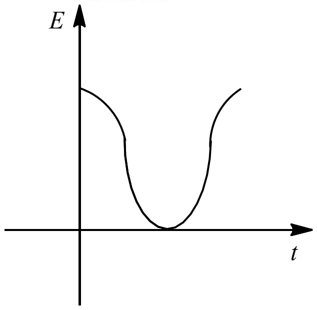
a) $V_A-V_O=\frac{B\omega l^2}{2}$ b) $V_O-V_C=\frac{7}{2}B\omega l^2$ c) $V_A-V_C=4B\omega l^2$ d) $V_C-V_O=\frac{9}{2}B\omega l^2$

169. A transformer of efficiency 90% draws an input power of 4 kW. An electrical appliance connected across the secondary draws a current of 6 A. The impedance of the device is

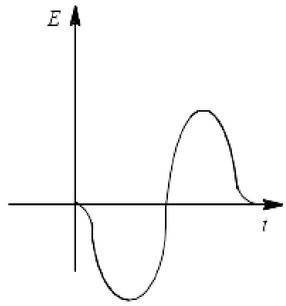
a) 60Ω b) 50Ω c) 80Ω d) 100Ω

170. The variation of induced emf(ε) with time (t) in a coil if a short bar magnet is moved along its axis with a constant velocity is best represented as

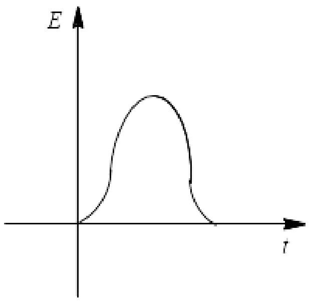
a)



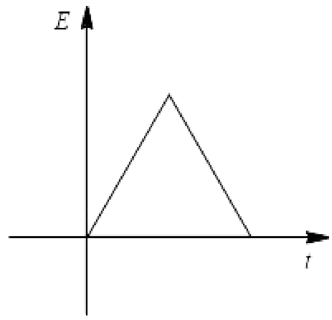
b)



c)



d)



171. Three solenoid coils of same dimension, same number of turns and same number of layers of winding are taken. Coil 1 with inductance L_1 was wound using a Mn wire of resistance $11\Omega m^{-1}$;Coil 2 with inductance L_2 was wound using the similar wire but the direction of winding was reversed in each layer; Coil 3 with inductance L_3 was wound using a superconducting wire. The self-inductance of the Coils L_1, L_2, L_3 are

a) $L_1=L_2=L_3$ b) $L_1,=L_2;L_3=0$ c) $L_1,=L_3;L_2=0$ d) $L_1>L_2>L_3$

172. A transformer is often filled with oil. The oil used should have

a) Low viscosity b) High dielectric strength

c) Low boiling point d) High thermal conducting

173. Which of the following is a wrong statement

a) An emf can be induced between the ends of a straight conductor by moving it through a uniform magnetic field

b) The self induced emf produced by changing current in a coil always tends to decrease the current

c) Inserting an iron core in a coil increases its coefficient of self induction

d) According to Lenz's law, the direction of the induced current is such that it opposes the flux change that causes it

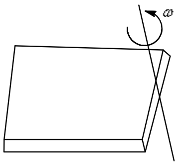
174. Voltage in the secondary coil of a transformer does not depend upon

a) Voltage in the primary coil
b) Ratio of number of turns in the two coils
c) Frequency of the source
d) Both (a) and (b)

175. Fleming's left and right hand rule are used in

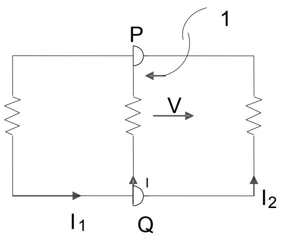
a) DC motor and AC generator
b) DC generator and AC motor
c) DC motor and DC generator
d) Both rules are same, any one can be used

176. A horizontal rod of length L rotates about a vertical axis with a uniform angular velocity ω. $A uniform$magnetic field B exists parallel to the axis of rotation. Then potential difference between the to ends of the rod is



a) $\omega L^2 B$
b) $\omega^2 LB$
c) $\frac{1}{2}\omega L^2 B$
d) $\frac{1}{2}\omega^2 LB$

177. A rectangular loop has a sliding connector PQ of length l and resistance $R\,\Omega$ and it is moving with a speed v as shown. The set-up is placed in a uniform magnetic field going into the plane of the paper. The three currents $I_1, I_2 \wedge I$ are



a) $I_1 = -I_2 = \frac{Blv}{R}, I = \frac{2Blv}{R}$
b) $I_1 = I_2 = \frac{Blv}{3R}, I = \frac{2Blv}{3R}$
c) $I_1 = I_2 = I = \frac{Blv}{R}$
d) $I_1 = I_2 = \frac{Blv}{6R}, I = \frac{Blv}{3R}$

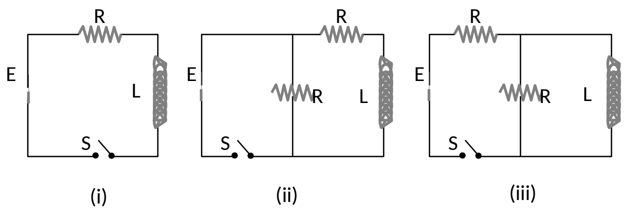
178. In transformer, core is made of soft iron to reduce

a) Hysteresis losses
b) Eddy current losses
c) Force opposing electric current
d) None of the above

179. A coil of self inductance $50\,henry$ is joined to the terminals of a battery of e.m.f. $2\,volts$ through a resistance of $10\,ohm$and a steady current is flowing through the circuit. If the battery is now disconnected, the time in which the current will decay to $1/e$ of its steady value is

a) $500\,seconds$
b) $50\,seconds$
c) $5\,seconds$
d) $0.5\,seconds$

180. In which of the following circuit is the current maximum just after the switch S is closed



a) (i)
b) (ii)
c) (iii)
d) Both (ii) and (iii)

181. A circular loop of radius R, carrying current I lies in $xy-¿$plane with its centre at origin. The total magnetic flux through xy-plane is

a) Directly proportional or R
b) Directly proportional or I
c) Inversely proportional to I
d) Zero

182. The number of turns of the primary and the secondary coils of a transformer are 10 and 100 respectively. The primary voltage and the current are given as $2\,V$ and $1\,A$. Assuming the efficiency of the transformer as 90%, the secondary voltage and the current respectively are

a) $20\,V$ and $0.1\,A$
b) $0.2\,V$ and $1\,A$
c) $20\,V$ and $0.09\,A$
d) $0.2\,V$ and $0.9\,A$

183. 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

184. A six pole generator with fixed field excitation developes an emf of 100 V, when operating at 1500 rpm. At what speed must it rotate to develop 120 V?

a) 1200 rpm
b) 1800 rpm
c) 1500 rpm
d) 400 rpm

185. If a coil of metal wire is kept stationary in a non-uniform magnetic field, then

a) An e.m.f. is induced in the coil
b) A current is induced in the coil
c) Neither e.m.f. nor current is induced
d) Both e.m.f. and current is induced

186. 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%

187. The number of turns in the primary coil of a transformer is 200 and the number of turns in the secondary coil is 10. If $240\,volt\ AC$ is applied to the primary, the output from the secondary will be

a) $48\,V$
b) $24\,V$
c) $12\,V$
d) $6\,V$

188. Whenever a magnet is moved either towards or away from a conducting coil, an emf is induced, the magnitude of which is independent of

a) The strength of the magnetic field
b) The speed with which the magnet is moved
c) The number of turns is the coil
d) The resistance of the coil

189. A helicopter rises vertically with a speed of 100 ms^{-1}. If helicopter has length 10 m and horizontal component of earth's magnetic field is $5\times10^{-3}\,Wbm^{-2}$,then the induced emf between the tip of nose and tail of helicopter is

a) 50 V
b) 0.5 V
c) 5 V
d) 25 V

190. A coil of Cu wire (radius-r, self inductance-L) is bent in two concentric turns each having radius $\frac{r}{2}$. The self inductance now

a) $2\,L$
b) L
c) $4\,L$
d) $L/2$

191. The net magnetic flux through any closed surface, kept in a magnetic field is

a) Zero
b) $\frac{\mu_0}{4\pi}$
c) $4\pi\mu_0$
d) $\frac{4\mu_0}{\pi}$

192. A coil of resistance $400\,\Omega$ is placed in a magnetic filed. If the magnetic flux $\phi\,(wb)$linked with the coil varies with time t (sec) as $\phi=50t^2+4$. The current in the coil at $t=2$ sec is

a) $0.5\,A$ b) $0.1\,A$ c) $2\,A$ d) $1\,A$

193. A varying current at the rate of $3\,A/s$ in a coil generates an e.m.f. of $8\,mV$ in a nearby coil. The mutual inductance of the two coils is

a) $2.66\,mH$ b) $2.66\times10^{-3}mH$ c) $2.66\,H$ d) $0.266\,H$

194. The number of turns in primary and secondary coils of a transformer is 50 and 200 respectively. If the current in the secondary coil is 4A, then the current in the secondary coil is

a) 1A b) 2 A c) 4 A d) 5 A

195. A circular coil of mean radius of $7\,cm$ and having 400 turns is rotated at the rate of 1800 revolutions per minute in the earth's magnetic field ($B=0.5$ gauss), the maximum e.m.f. induced in coil will be

a) $1.158\,V$ b) $0.58\,V$ c) $0.29\,V$ d) $5.8\,V$

196. Electric fields induced by changing magnetic fields are

a) Conservative

b) Non-conservative

c) May be conservative or non-conservative depending on the condition

d) Nothing can be said

197. In an induction coil with resistance, the induced emf will be maximum when

a) The switch is put on due to high resistance b) The switch is put off due to high resistance

c) The switch is put on due to low resistance d) The switch is put off due to low resistance

198. The inductance of a solenoid $0.5\,m$ long of cross-sectional area $20\,cm^2$ and with 500 turns is

a) $12.5\,mH$ b) $1.25\,mH$ c) $15.0\,mH$ d) $0.12\,mH$

199. A coil of resistance $10\,\Omega$ and an inductance $5\,H$ is connected to a $100\,volt$ battery. Then energy stored in the coil is

a) $125\,erg$ b) $125\,J$ c) $250\,erg$ d) $250\,J$

200. A small piece of metal wire is dragged across the gap between the poles of a magnet in 0.4 s. If change in magnetic flux in the wire is 8×10^{-4} Wb, then emf induced in the wire is

a) $8\times10^{-3}V$ b) $6\times10^{-3}V$ c) $4\times10^{-3}V$ d) $2\times10^{-3}V$

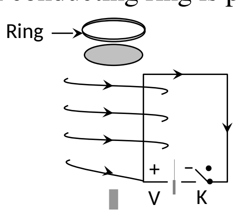
201. A current $I=10\sin(100\,\pi t)\,A$ is passed in first coil, which induces a maximum emf of $5\,\pi V$ in second coil. The mutual inductance between the coils is

a) $5\,mH$ b) $10\,mH$ c) $15\,mH$ d) $20\,mH$

202. The current through choke coil increases from zero to 6 A in $0.3\,seconds$ and an induced e.m.f. of 30 V is produced. The inductance of the coil of choke is

a) $5\,H$ b) $2.5\,H$ c) $1.5\,H$ d) $2\,H$

203. A conducting ring is placed around the core of an electromagnet as shown in fig. when key K is pressed, the ring



a) Remain stationary b) Is attracted towards the electromagnet

c) Jumps out of the core d) None of the above

204. The magnetic flux linked with the coil varies with time as $\phi = 3t^2 + 4t + 9$. the magnitude of the induced emf at 2 s is

a) 9 V b) 16 V c) 3 V d) 4 V

205. A conducting wire is dropped along east-west direction, then

a) No emf is induced b) No induced current flows

c) Induced current flows from west to east d) Induced current flows from east to west

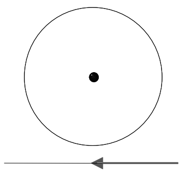
206. Induced potential in a coil is developed by change of magnetic flux from $1\,wb$ to $0.1\,wb$ in 0.1 second is

a) $1/9\,volt$ b) $0.09\,volt$ c) $1\,volt$ d) $9\,volt$

207. Two solenoids of equal number of turns have their lengths and the radii in the same ratio 1 : 2. The ratio of their self inductances will be

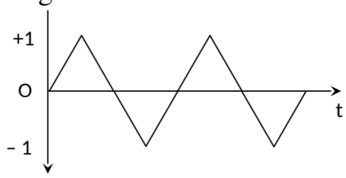
a) 1 : 2 b) 2 : 1 c) 1 : 1 d) 1 : 4

208. Near a circular loop of conducting wire as shown in the figure an electron moves along a straight line. The direction of the induced current if any in the loop is



a) Variable b) Clockwise c) Anticlockwise d) Zero

209. An alternating current of frequency $200\,rad/sec$ peak value $1\,A$ as shown in the figure, is applied to the primary of a transformer. If the coefficient of mutual induction between the primary and the secondary is $1.5\,H$, the voltage induced in the secondary will be



a) $300\,V$ b) $191\,V$ c) $220\,V$ d) $471\,V$

210. The energy stored in an inductor of self inductance L henry carrying a current of 1 A is

a) $L^2 I$ b) $-LI^2$ c) $\frac{1}{2}LI^2$ d) $\frac{1}{2}L^2 I$

211. A 50 turns circular coil has a radius of 3 cm, it is kept in a magnetic field acting normal to the area of the coil. The magnetic field B increased from 0.10 to 0.35 T in 2 millisecond. The average induced emf in the coil is

a) 1.77 V b) 17.7 V c) 177 V d) 0.177 V

212. The primary winding of transformer has 500 turns whereas its secondary has 5000 turns. The primary is connected to an ac supply of $20\,V, 50\,Hz$. The secondary will have an output of

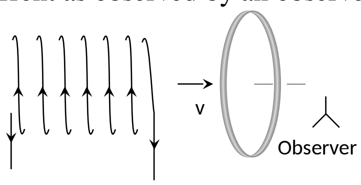
a) $200\,V, 50\,Hz$ b) $2\,V, 50\,Hz$ c) $200\,V, 500\,Hz$ d) $2\,V, 5\,Hz$

213. A coil of $40\,\Omega$ resistance has 100 turns and radius $6\,mm$ is connected to ammeter of resistance of $160\,ohms$. Coil is placed perpendicular to the magnetic field. When coil is taken out of the field, $32\,\mu$ C charge flows through it. The intensity of magnetic field will be

a) $6.55\,T$ b) $5.66\,T$ c) $0.655\,T$ d) $0.566\,T$

214. A current carrying solenoid is approaching a conducting loop as shown in the figure. The direction of induced

current as observed by an observer on the other side of the loop will be



a) Anticlockwise b) Clockwise c) East d) West

215. In a circuit with a coil resistance $2\,ohms$, the magnetic flux changes from $2.0\,Wb$ to $10.0\,Wb$ in 0.2 second. The charge that flows in the coil during this time is

a) $5.0\,coulomb$ b) $4.0\,coulomb$ c) $1.0\,coulomb$ d) $0.8\,coulomb$

216. In a choke coil, the resistance X_L and resistance R are such that

a) $X_L = R$ b) $X_L \gg R$ c) $X_L \ll R$ d) $X_L = \infty$

217. The magnitude of the earth's magnetic field at a place is B_0 and the angle of dip is δ. A horizontal conductor of length l lying magnetic north-south moves eastwards with a velocity v. The emf induced across the conductor is

a) Zero b) $B_0 lv\,sin\delta$ c) $B_0 lv$ d) $B_0 lv\,cos\delta$

218. Two coils of self inductances $2\,mH$ and $8\,mH$ are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coil is

a) $4\,mH$ b) $16\,mH$ c) $10\,mH$ d) $6\,mH$

219. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating; it is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to

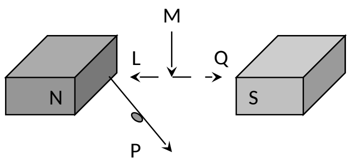
a) Development of air current when the plate is placed

b) Induction of electrical charge on the plate

c) Shielding of magnetic lines of force as aluminium is a paramagnetic material

d) Electromagnetic induction in the aluminium plate giving rise to electromagnetic damping

220. An electric potential difference will be induced between the ends of the conductor shown in the diagram, when the conductor moves in the direction



a) P b) Q c) L d) M

221. A step-up transformer has transformation ratio of 3 : 2. What is the voltage in secondary if voltage in primary is $30\,V$

a) $45\,V$ b) $15\,V$ c) $90\,V$ d) $300\,V$

222. If a current of $3.0\,amperes$ flowing in the primary coil is reduced to zero in $0.001\,second$, then the induced e.m.f. in the secondary coil is $15000\,volts$. The mutual inductance between the two coils is

a) $0.5\,henry$ b) $5\,henry$ c) $1.5\,henry$ d) $10\,henry$

223. The formula for induced e.m.f. in a coil due to change in magnetic flux through the coil is (here A = area of the coil, $B=¿$ magnetic field)

a) $e=-A.\frac{dB}{dt}$ b) $e=-B.\frac{dA}{dt}$ c) $e=\frac{-d}{dt}(A.B)$ d) $e=\frac{-d}{dt}(A\times B)$

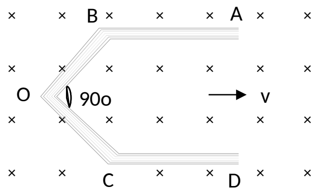
224. A transformer has 100 turns in the primary coil and carries $8\,A$ current. If input power is one kilowatt, the number of turns required in the secondary coil to have $500\,V$ output will be

a) 100 b) 200 c) 400 d) 300

225. When a wire loop is rotated in a magnetic field, the direction of induced e.m.f. changes one in each

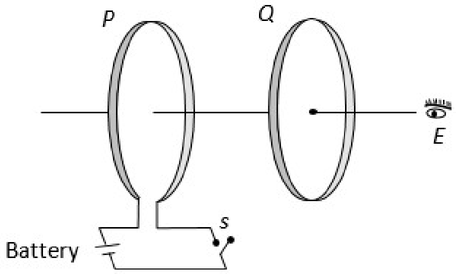
a) 1/4 revolution b) 1/2 revolution c) 1 revolution d) 2 revolution

226. A conductor $ABOCD$ moves along its bisector with a velocity of $1\,m/s$ through a perpendicular magnetic field of $1\,wb/m^2$, as shown in fig. If all the four sides are of $1\,m$ length each, then the induced emf between points A and D is



a) 0 b) $1.41\,volt$ c) $0.71\,volt$ d) None of the above

227. As shown in the figure, P and Q are two coaxial conducting loops separated by some distance. When the switch S is closed, a clockwise current I_P flows in P (as seen by E) and an induced current I_{Q_1} flows in Q. The switch remains closed for a long time. When S is opened, a current I_{Q_2} flows in Q. Then the directions of I_{Q_1} and I_{Q_2} (as seen by E) are



a) Respectively clockwise and anticlockwise

b) Both clockwise

c) Both anticlockwise

d) Respectively anticlockwise and clockwise

228. A transformer is used to

a) Change the alternating potential

b) Change the alternating current

c) To prevent the power loss in alternating current flow

d) To increase the power of current source

229. Large transformers, when used for some time, become hot and are cooled by circulating oil. The heating of transformer is due to

a) Heating effect of current alone b) Hysteresis loss alone

c) Both the hysteresis loss and heating effect of current d) None of the above

230. The north pole of a bar magnet is moved swiftly downward towards a closed coil and then second time it is raised upwards slowly. The magnitude and direction of the induced current in the two cases will be of

First case	Second case
a) Low value clockwise	Higher value anticlockwise
b) Low value clockwise	Higher value anticlockwise

c) Higher value anticlockwise Low value clockwise

d) Higher value anticlockwise Low value clockwise

231. In an AC generator, a coil with N turns, all of the same area A and total resistance R, rotates with frequency ω in a magnetic field B. The maximum value of emf generated in the coil is

a) $NABR\omega$ b) NAB c) $NABR$ d) $NAB\omega$

232. A transformer connected to $220\,volt$ line shows an output of $2\,A$ at $11000\,volt$. The efficiency is 100%. The current drawn from the line is

a) $100\,A$ b) $200\,A$ c) $22\,A$ d) $11\,A$

233. 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 emf is

a) $\frac{1}{2}Br\omega^2$ b) $Br\omega^2$ c) $2Br\omega^2$ d) Zero

234. The self inductance of a straight conductor is

a) Zero b) Very large c) Infinity d) Very small

235. The flux associated with coil changes from 1.35 Wb to 0.79 Wb within $\frac{1}{10}$ s. Then the charge produced by the earth coil, if resistance of coil is 7Ω is

a) 0.08 C b) 0.8 C c) 0.008 C d) 8 C

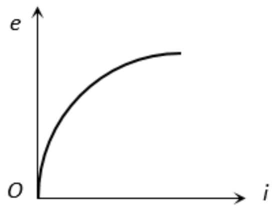
236. An e.m.f. of $12\,volt$ is produced in a coil when the current in it changes at the rate of $45\,amp/minute$. The inductance of the coil is

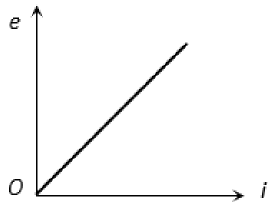
a) $0.25\,henry$ b) $1.5\,henry$ c) $9.6\,henry$ d) $16.0\,henry$

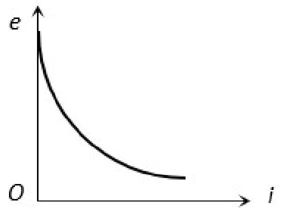
237. Two identical induction coils each of inductance L joined in series are placed very close to each other such that the winding direction of one is exactly opposite to that of the other, what is the net inductance?

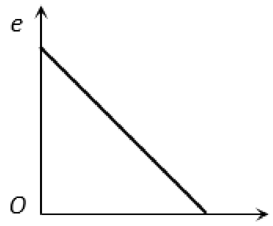
a) L^2 b) $2L$ c) $L/2$ d) Zero

238. For previous objective, which of the following graphs is correct

a) 

b) 

c) 

d) 

239. A solenoid has 2000 turns wound over a length of 0.30 m. The area of its cross-section is $1.2 \times 10^{-3} m^2$. Around its central section a coil of 300 turns is wound. If an initial current of 2 A in the solenoid is reversed in 0.25s, the emf induced in the coil is

a) 48 V b) 4.8 V c) $4.8 \times 10^{-1} V$ d) $4.8 \times 10^{-2} V$

240. An aeroplane in which the distance between the tips of the wings in 50 m is flying horizontally with a speed of 360 $km\,h^{-1}$ over a place where the vertical component of earth's magnetic field is $2 \times 10^{-4}\ Wb\,m^{-2}$. The potential difference between the tips of the wings would be

a) 0.1 V b) 1.0 V c) 0.2 V d) 0.01 V

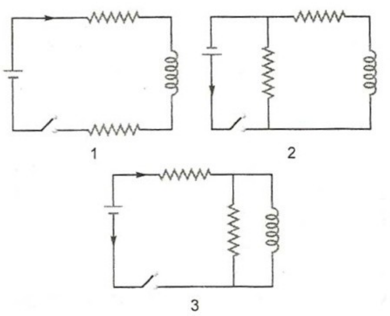
241. A metal conductor of length 1 m rotates vertically about one of its ends at angular velocity 5 rads^{-1}. If the horizontal component of earth's magnetic field is $0.2 \times 10^{-4} T$, then the emf developed between the two ends of the conductor is

a) $5\ \mu V$ b) $50 \mu V$ c) 5 mV d) 50 mV

242. In a coil when current changes from 10A to 2A in time 0.1s, induced emf is 3.28 V. what is self –inductance of coil?

a) 4 H b) 0.4 H c) 0.04 H d) 5 H

243. The figure shows three circuits with identical batteries, inductors and resistances. Rank the circuits according to the currents through the battery just after the switch is closed, greatest first



a) $i_2 > i_3 > i_1$ b) $i_2 > i_1 > i_3$ c) $i_1 > i_2 > i_3$ d) $i_1 > i_3 > i_2$

244. A wire of length 50 cm moves with a velocity of 300 m-min^{-1}, perpendicular to a magnetic field. If the emf induced in the wire is 2 V, the magnitude of the field in telsa is

a) 2 b) 5 c) 0.4 d) 0.8

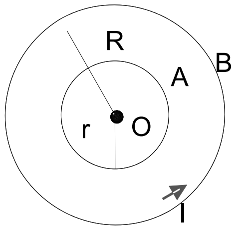
245. The turn ratio of a transformer is 1:2. An electrolytic DC cell of emf 2 V is connected to its primary. The output voltage across transformer is

a) Zero b) 4 V c) 2.4 V d) 12 V

246. The current through a coil of self inductance $L = 2\,mH$ is given by $I = t^2 e^{-t}$ at time. t. How long it will take to make the e.m.f. zero

a) 1 s b) 2 s c) 3 s d) 4 s

247. O is the centre of two coplanar concentric circular conductors, A and B, of radii r and R respectively as shown in the figure. Here, $r <<< R$. the mutual inductance of the system of the conductors can be given by



a) $\frac{\mu_0 \pi r^2}{2R}$ b) $\frac{\mu_0 \pi R^2}{2r}$ c) $\frac{\pi R^2}{\mu_0 r}$ d) $\frac{\mu_0 \pi r}{2R}$

248. Self induction of a solenoid is

a) Directly proportional to current flowing through the coil

b) Directly proportional to its length

c) Directly proportional to area of cross-section

d) Inversely proportional to area of cross-section

249. A solenoid has an inductance of $60\,henry$ and a resistance of $30\,ohms$. If it is connected to a 100 volt battery, how long will it take for the current to reach $\frac{e-1}{e} \approx 63.2\%$ of its final value

a) $1\,second$ b) $2\,seconds$ c) $e\,seconds$ d) $2e\,seconds$

250. In a step-up transformer the turn ratio is 1 : 10. A resistance of $200\,ohm$ connected across the secondary is drawing a current of $0.5\,A$. What is the primary voltage and current

a) $50\,V, 1\,amp$ b) $10\,V, 5\,amp$ c) $25\,V, 4\,amp$ d) $20\,V, 2\,amp$

251. The equivalent inductance of two inductance is $2.4\,henry$ when connected in parallel and $10\,henry$ when connected in series. The difference between the two inductances is

a) $2\,henry$ b) $3\,henry$ c) $4\,henry$ d) $5\,henry$

252. In an LR-circuit time constant is that time in which current grows from zero to the value (where I_0 is the steady state current)

a) $0.63\,I_0$ b) $0.50\,I_0$ c) $0.37\,I_0$ d) I_0

253. Induced emf in the coil depends upon

a) Conductivity of coil b) Amount of flux

c) Rate of change of linked flux d) Resistance of coil

254. A coil of inductance $40\,henry$ is connected in series with a resistance of $8\,ohm$ and the combination is joined to the terminals of a $2\,volt$ battery. The time constant of the circuit is

a) $40\,seconds$ b) $20\,seconds$ c) $8\,seconds$ d) $5\,seconds$

255. 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 losses must be equal to

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

256. A generator at a utility company produces 100 A of current at 4000 V. The voltage is stepped up to 240000 V by a transformer before it is sent on a high voltage transmission line. The current in transmission line is

a) 3.67 A b) 2.67 A c) 1.67 A d) 2.40 A

257. A solenoid 60 mm long has 50 turns on it and is wound on an iron rod of 7.5 mm radius. Find the flux through the solenoid when the current in it is 3A. The relative permeability of iron is 600

a) 1.66 Wb b) 1.66 nWb c) 1.66 mWb d) $1.66\mu Wb$

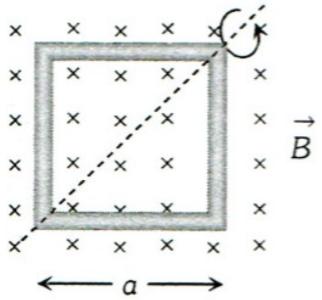
258. Self-inductance of a coil is $50\,mH$. A current of $1\,A$ passing through the coil reduces to zero at steady rate in $0.1\,sec.$, the self-induced emf is

a) 5 volts
b) 0.05 volts
c) 50 volts
d) 0.5 volts

259. A step-up transformer operates on a $230\,V$ line and supplies a load of $2\,ampere$. The ratio of the primary and secondary windings is 1 : 25. The current in the primary is

a) $15\,A$
b) $50\,A$
c) $25\,A$
d) $12.5\,A$

260. A square loop of side a is rotating about its diagonal with angular velocity ω in a perpendicular magnetic field $\vec{B}$. It has 10 turns. The $e.m.f.$ induced is



a) $B_a^2 \sin \omega t$
b) $B_a^2 \cos \omega t$
c) $5\sqrt{2} B a^2$
d) $10 B a^2 \omega \sin \omega t$

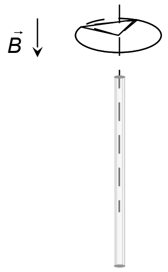
261. The device that does not work on the principle of mutual induction is

a) Induction coil
b) Motor
c) Tesla coil
d) Transformer

262. In a step-up transformer, the turn ratio is 1 : 2. A Leclanche cell (e.m.f. 1.5V) is connected across the primary. The voltage developed in the secondary would be

a) $3.0\,V$
b) $0.75\,V$
c) $1.5\,V$
d) Zero

263. A conducting rod of length $2l$ is rotating with constant angular speed ω about its perpendicular bisector. A uniform magnetic field $\vec{B}$ exists parallel to the axis of rotation. The e.m.f. induced between two ends of the rod is



a) $B\omega l^2$
b) $\frac{1}{2} B\omega l^2$
c) $\frac{1}{8} B\omega l^2$
d) Zero

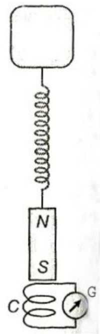
264. Two coils have a mutual inductance $0.005\,H$. The current changes in the first coil according to equation $I = I_0 \sin \omega t$, where $I_0 = 10\,A$ and $\omega = 100\,\pi\, radian/sec$. The maximum value of e.m.f. in the second coil is

a) 2π
b) 5π
c) π
d) 4π

265. The charge which will flow through a 200 Ω galvanometer connected to a 400 Ω 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) $6.3\,\mu C$
b) $63\,\mu C$
c) $0.63\,\mu C$
d) $630\,\mu C$

266. A magnet *N-S* is suspended from a spring and when it oscillates, the magnet moves in and out of the coil *C*. The coil is connected to a galvanometer *G*. Then, as the magnet oscillates



a) G shows no deflection

b) G shows deflection to the left and right but the amplitude steadily decreases

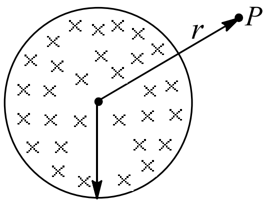
c) G shows deflection to the left and right with constant amplitude

d) G shows deflection on one side

267. When power is drawn from the secondary coil of the transformer, the dynamic resistance

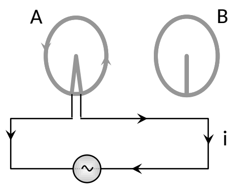
a) Increases b) Decreases c) Remains unchanged d) Changes erratically

268. A uniform but time varying magnetic field $B(t)$ exists in a circular region of radius a and is directed into the plane of the paper as shown in figure. The magnitude of induced electric filed at point P at a distance r from the centre of the circular region



a) Is zero b) Decrease as $1/r$ c) Increases as r d) Decreases $1/¿r^2$

269. Two circular coils A and B are facing each other as shown in figure. When the current i through A is altered



a) There will be repulsion between A and B if i is increased

b) There will be attraction between A and B if i is increased

c) There will be neither attraction nor repulsion when i is changed

d) Attraction or repulsion between A and B depends on the direction of current. It does not depend whether the current is increased or decreased

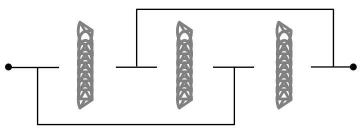
270. The inductance of a closed-packed coil of 400 turns is $8\,mH$. A current of $5\,mA$ is passed through it. The magnetic flux through each turn of the coil is

a) $\frac{1}{4\pi}\mu_0 Wb$ b) $\frac{1}{2\pi}\mu_0 Wb$ c) $\frac{1}{3\pi}\mu_0 Wb$ d) $0.4\,\mu_0 Wb$

271. In a transformer 220 ac 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

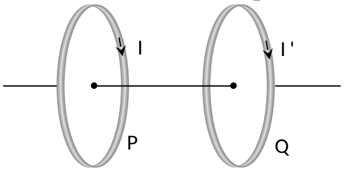
a) 200 b) 100 c) 50 d) 20

272. Pure inductance of $3.0\,H$ is connected as shown below. The equivalent inductance of the circuit is



a) $1H$ b) $2H$ c) $3H$ d) $9H$

273. Two coils P and Q are placed co-axially and carry current I and I' respectively



a) If $I'=0$ and P moves towards Q, a current in the same direction as I is induced in Q

b) If $I=0$ and Q moves towards P, a current opposite in direction to that of I' is induced in P

c) When $I\neq 0$ and $I'\neq 0$ are in the same direction, then two coil tend to move apart

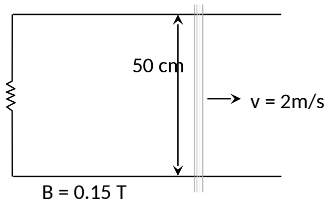
d) None of the above

274. A cylindrical bar magnet is kept along the axis of a circular coil. If the magnet is rotated about its axis, then

a) A current will be induced in a coil b) No current will be induced in a coil

c) Only an e.m.f. will be induced in the coil d) An e.m.f and a current both will be induced in the coil

275. As shown in the figure a metal rod makes contact and completes the circuit. The circuit is perpendicular to the magnetic field with $B=0.15\,tesla$. If the resistance is $3\,\Omega$, force needed to move the rod as indicated with a constant speed of $2\,m/sec$ is



a) $3.75\times10^{-3}N$ b) $3.75\times10^{-2}N$ c) $3.75\times10^{2}N$ d) $3.75\times10^{-4}N$

276. Fan is based on

a) Electric Motor b) Electric dynamo c) Both d) None of these

277. In a primary coil $5A$ current is flowing on 220 volts. In the secondary coil $2200\,V$ voltage produces. Then ratio of number of turns in secondary coil and primary coil will be

a) 1 : 10 b) 10 : 1 c) 1 : 1 d) 11 : 1

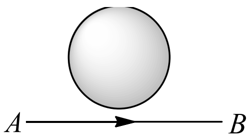
278. An AC generator of $220\,V$ having internal resistance $r=10\,\Omega$ and external resistance $R=100\,\Omega$. What is the power developed in the external circuit

a) $484\,W$ b) $400\,W$ c) $441\,W$ d) $369\,W$

279. When a circular coil of radius 1 m and 100 turns is rotated in a horizontal uniform magnetic field, the peak value of emf induced is 100 V. the coil is unwound and then rewound into a circular coil of radius 2 m. If it is rotated now, with the same speed, under similar conditions, the new peak value of emf developed is

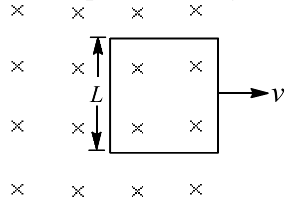
a) 50 V b) 25 V c) 100 V d) 200 V

280. Current from $A\wedge B$ in the straight wire is decreasing. The direction of induced current in the loop, is



a) Clock-wise b) Anti-clock-wise c) Changing d) Nothing can be said

281. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere with part of the loop outside the field, as shown in figure. The induced emf is



a) BvR b) vBL/R c) vBL d) $BLv/2$

282. The momentum in mechanics is expressed as $m\times V$. The analogous expression in electricity is

a) $i\times Q$ b) $i\times V$ c) $L\times i$ d) $L\times Q$

283. A $50\,volt$ potential difference is suddenly applied to a coil with $L=5\times10^{-3}\,henry$ and $R=180\,ohm$. The rate of increase of current after $0.001\,second$ is

a) $27.3\,amp/sec$ b) $27.8\,amp/sec$ c) $2.73\,amp/sec$ d) None of the above

284. An ideal transformer has 500 and 5000 turn in primary and secondary windings respectively. If the primary voltage is connected to a $6\,V$ battery then the secondary voltage is

a) 0 b) $60\,V$ c) $0.6\,V$ d) $6.0\,V$

285. The horizontal component of the earth's magnetic field at a place is $3\times10^{-4}\,T$ and the dip is $\tan^{-1}\left(\frac{4}{3}\right)$. A metal rod of length $0.25\,m$ placed in the north-south position and is moved at a constant speed of $10\,cm/s$ towards the east. The emf induced in the rod will be

a) Zero b) $1\,\mu V$ c) $5\,\mu V$ d) $10\,\mu V$

286. An L-R circuit has a cell of e.m.f. E, which is switched on at time $t=0$. The current in the circuit after a long time will be

a) Zero b) $\frac{E}{R}$ c) $\frac{E}{L}$ d) $\frac{E}{\sqrt{L^2+R^2}}$

287. A transformer works on the principle of

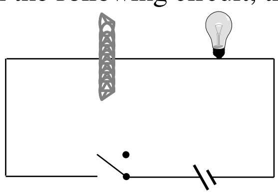
a) Magnetic effect of the electrical current b) Mutual induction

c) Electrical inertia d) Self induction

288. A conducting circular loop is placed in a uniform magnetic field, $B=0.25\,T$ with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of $1\,mm\,s^{-1}$. The induced e.m.f. when radius is $2\,cm$, is

a) $2\,\mu V$ b) $2\pi\mu V$ c) $\pi\mu V$ d) $\frac{\pi}{2}\mu V$

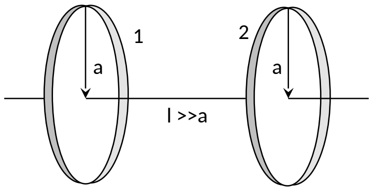
289. In the following circuit, the bulb will become suddenly bright if



a) Contact is made or broken b) Contact is made

c) Contact is broken d) Won't become bright at all

290. What is the mutual inductance of a two-loop system as shown with centre separation l



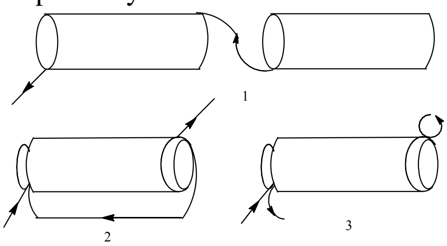
a) $\frac{\mu_0 \pi a^4}{8 l^3}$ b) $\frac{\mu_0 \pi a^4}{4 l^3}$ c) $\frac{\mu_0 \pi a^4}{6 l^3}$ d) $\frac{\mu_0 \pi a^4}{2 l^3}$

291. Lenz's law is statement of

a) Law of conservation of charge b) Law of conservation of current

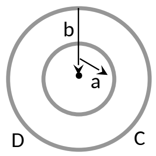
c) Law of conservation of energy d) None of the above

292. There are two solenoids of same length and inductance L but their diameters differ to the extent that one can just fit into the other. They are connected in three different ways in series. (1) They are connected in series but separated by large distance, (2) they are connected in series with one inside the other and senses of the turns coinciding, (3) both are connected in series with one inside the other with senses of the turns opposite as depicted in figures 1, 2 and 3 respectively. The total inductance of the solenoids in each of the case 1, 2 and 3 are respectively



a) $0, 4L_0, 2L_0$ b) $4L_0, 2L_0, 0$ c) $2L_0, 0, 4L_0$ d) $2L_0, 4L_0, 0$

293. Plane figures made of thin wires of resistance $R+50\, milli\, ohm/metre$ are located in a uniform magnetic field perpendicular into the plane of the figures and which decrease at the rate $dB/dt=0.1\, mT/s$. The current in the inner and outer boundary are inner radius $a=10\, cm$ and outer radius $b=20\, cm$)



a) $10^{-4} A$ (Clockwise), $2\times10^{-4} A$ (Clockwise)

b) $10^{-4} A$ (Anticlockwise), $2\times10^{-4} A$ (Clockwise)

c) $2\times10^{-4} A$ (Clockwise), $10^{-4} A$ (Anticlockwise)

d) $2\times10^{-4} A$ (Anticlockwise), $10^{-4} A$ (Anticlockwise)

294. The number of turns in primary and secondary coils of a transformer are 100 and 20 respectively. If an alternating potential of $200\, volt$ is applied to the primary, the induced potential in secondary will be

a) $10\, V$ b) $40\, V$ c) $1000\, V$ d) $20{,}000\, V$

295. A rectangular loop of length l and breadth b is placed at distance of x from infinitely long wire carrying current i such that the direction of current is parallel to breadth. If the loop moves away from the current wire in a direction perpendicular to it with a velocity v, the magnitude of the emf in the loop is ¿permeability of free space)

a) $\frac{\mu_0 i v}{2\pi x}\left(\frac{1+b}{b}\right)$ b) $\frac{\mu_0 i^2 v}{4\pi^2 x}\log\left(\frac{b}{l}\right)$ c) $\frac{\mu_0 i l b v}{2\pi x(l+x)}$ d)

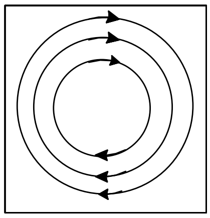
296. A coil of N turns and mean cross-sectional area A is rotating with uniform angular velocity ω about an axis at right angle to uniform magnetic field B. The induced e.m.f. E in the coil will be

a) $NBA \sin \omega t$ b) $NB \omega \sin \omega t$ c) $NB/A \sin \omega t$ d) $NBA \omega \sin \omega t$

297. A uniformly wound solenoid coil of self-inductance $1.8 \times 10^{-4} H$ and resistance 6Ω is broken up into two identical coils. These identical coils are then connected in parallel across a 12 V battery of negligible resistance. The time constant for the current in the circuit is

a) 0.1×10^{-4}s b) $0.2 \times 10^{-4} s$ c) $0.3 \times 10^{-4} s$ d) $0.4 \times 10^{-4} s$

298. When a sheet of metal is placed in a magnetic field, which changes from zero to a maximum value, the induced currents are set up in the direction shown in figure. What is the direction of magnetic field.



a) Into the plane of the paper
b) Out of the plane f the paper
c) West to East
d) South to North

299. What is the self inductance of a solenoid of length 31.4 cm, area of cross-section $10^{-3} m^2$ and total number of turns 10^3 ?

a) 4 mH b) 4 H c) 40 H d) 0.4 H

300. Work of electric motor is

a) To convert ac into dc
b) To convert dc into ac
c) Both (a) and (b)
d) To convert ac into mechanical work

301. Which type of losses donot occur in the transformer?

a) Iron losses b) Copper losses c) Mechanical losses d) Flux leakage

302. In a transformer, the number of turns in primary coil and secondary coil are 5 and 4 respectively. If $240 V$ is applied on the primary coil, then the ratio of current in primary and secondary coil is

a) 4 : 5 b) 5 : 4 c) 5 : 9 d) 9 : 5

303. A loop of area 0.1 m^2 rotates with a speed of 60 rps perpendicular to a magnetic field of 0.4 T. If there are 100 turns in the loop, maximum voltage induced in the loop is

a) 15.07 V b) 1507 V c) 250 V d) 150 V

304. A current passing through a coil of self inductance of 2mH changes at the rate of $20 mAs^{-1}$. The emf induced in the coil is

a) $10 \mu V$ b) $40 \mu V$ c) $10 mV$ d) $40 mV$

305. When the speed of a dc motor increases the armature current

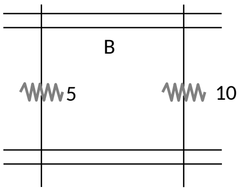
a) Increases
b) Decreases
c) Does not change
d) Increases and decreases continuously

306. A magnet is dropped down an infinitely long vertical copper tube

a) The magnet moves with continuously increasing velocity and ultimately acquires a constant terminal velocity
b) The magnet moves with continuously decreasing velocity and ultimately comes to rest
c) The magnet moves with continuously increasing velocity but constant acceleration

d) The magnet moves with continuously increasing velocity and acceleration

307. A pair of parallel conducting rails lie at right angles to a uniform magnetic field of $2.0\,T$ as shown in the fig. Two resistors $10\,\Omega$ and $5\,\Omega$ are to slide without friction along the rail. The distance between the conducting rails is $0.1\,m$. Then



a) Induced current ¿ $\frac{1}{150}A$ directed clockwise if $10\,\Omega$ resistor is pulled to the right with speed $0.5\,m\,s^{-1}$ and $5\,\Omega$ resistor is held fixed

b) Induced current ¿ $\frac{1}{300}A$ directed anti-clockwise if $10\,\Omega$ resistor is pulled to the right with speed $0.5\,m\,s^{-1}$ and $5\,\Omega$ resistor is held fixed

c) Induced current ¿ $\frac{1}{300}A$ directed clockwise if $5\,\Omega$ resistor is pulled to the left at $0.5\,m\,s^{-1}$ and $10\,\Omega$ resistor is held at rest

d) Induced current ¿ $\frac{1}{150}A$ directed anti-clockwise if $5\,\Omega$ resistor is pulled to the left at $0.5\,m\,s^{-1}$ and $10\,\Omega$ resistor is held at rest

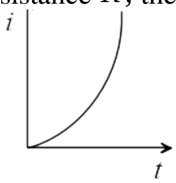
308. Magnetic flux of $10\,\mu Wb$ is linked with a coil, when a current of 2 mA flows through through it. What is the self inductance of the coil?

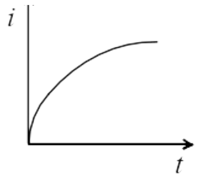
a) 10 mH b) 5 mH c) 15 mH d) 20 mH

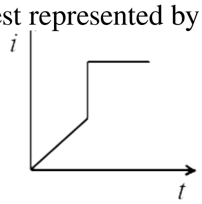
309. An electric motor runs a DC source of emf 200V and draws a current of 10A. If the efficiency is 40%, then the resistance of the armature is

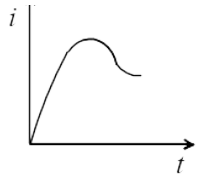
a) 5Ω b) 12Ω c) 120Ω d) 160Ω

310. When a battery is connected across a series combination of self inductance L and Resistance R, the variation in the current i with time t is best represented by

a)


b)


c)


d)


311. The north pole of a magnet is brought near a metallic ring. The direction of the induced current in the ring will be

a) Clockwise b) Anticlockwise c) Towards north d) Towards south

312. A cylindrical bar magnet is kept along the axis of a circular coil. The magnet is rotated about its axis such that north pole faces the coil. The induced current in the coil

a) Is zero

b) Is clock-wise from magnet side

c) May be clock-wise or anti clock wise

d) Is anti-clock-wise from magnet side

313. Two parallel rails of a railways track insulated from each other and with the ground are connected to a millivoltmeter. The distance between the rails is one metre. A train is travelling with a velocity of 72 km-h^{-1} along the track. The reading of the millivotmeter (in mV) is : (Vertical component of the earth's magnetic induction is$2\times10^{-5}\,T$ ¿

a) 1.44 b) 0.72 c) 0.4 d) 0.2

314. What should be the value of self inductance of an inductor that should be connected to 220 V, 50 Hz supply so that a maximum current of 0.9 A flows through it?

a) 11 H b) 2 H c) 1.1 H d) 5 H

315. The magnetic flux linked with a vector area $\vec{A}$ in a uniform magnetic field $\vec{B}$ is

a) $\vec{B}\times\vec{A}$ b) AB c) $\vec{B}\cdot\vec{A}$ d) $\frac{B}{A}$

316. What is increased in step-down transformer

a) Voltage b) Current c) Power d) Current density

317. A small square loop wire of side l is placed inside a large squre loop of side L $(L>¿l)$. If the loops are coplanar and their centres coincide, the mutual induction of the system is directly proportional to

a) $\frac{L}{l}$ b) $\frac{l}{L}$ c) $\frac{L^2}{l}$ d) $\frac{l^2}{L}$

318. Two identical circular loops of metal wire are lying on a table. Loop A carries a current which increases with time. In response, the loop B

a) Is attracted by the loop B b) Is repelled by the loop A

c) Remains stationary d) None of the above

319. A coil having an inductance of $0.5\,H$ carries a current which is uniformly varying from zero to 10 ampere in 2 second. The e.m.f. (in volts) generated in the coil is

a) 10 b) 5 c) 2.5 d) 1.25

320. An average induced e.m.f. of $1\,V$ appears in a coil when the current in it is changed from $10\,A$ in opposite direction in $0.5\,sec$. Self-inductance of the coil is

a) $25\,mH$ b) $50\,mH$ c) $75\,mH$ d) $100\,mH$

321. A small coil is introduced between the poles of an electromagnet so that its axis coincides with the magnetic field direction. The number of turns is n and the cross sectional area of the coil is A. When the coil turns through $180°$ about its diameter, the charge flowing through the coil is Q. The total resistance of the circuit is R. What is the magnitude of the magnetic induction

a) $\frac{QR}{nA}$ b) $\frac{2QR}{nA}$ c) $\frac{Qn}{2RA}$ d) $\frac{QR}{2nA}$

322. To induce an e.m.f. in a coil, the linking magnetic flux

a) Must decrease b) Can either increase or decrease

c) Must remain constant d) Must increase

323. The magnetic field in a coil of 100 turns and $40\,square\,cm$ area is increased from $1\,tesla$ to $6\,tesla$ in $2\,second$. The magnetic field is perpendicular to the coil. The e.m.f. generated in it is

a) $10^4\,V$ b) $1.2\,V$ c) $1.0\,V$ d) $10^{-2}\,V$

324. An e.m.f. of $100\,millivolts$ is induced in a coil when the current in another nearby coil becomes $10\,ampere$ from zero in $0.1\,second$. The coefficient of mutual induction between the two coils will be

a) $1\,milli\,henry$ b) $10\,milli\,henry$ c) $100\,milli\,henry$ d) $1000\,milli\,henry$

325. Energy associated with a moving charge is due to

a) Electric field b) Magnetic field c) Both (a) and (b) d) None of these

326. A copper disc of radius $0.1\,m$ is rotated about its centre with 10 revolutions per second in a uniform magnetic field of $0.1\,tesla$ with its plane perpendicular to the field. The e.m.f. induced across the radius of disc is

a) $\frac{\pi}{10}V$ b) $\frac{2\pi}{10}V$ c) $\pi\times10^{-2}\,V$ d) $2\pi\times10^{-2}\,V$

327. The turn ratio of a transformers is given as 2 : 3. If the current through the primary coil is $3\,A$, thus calculate the current through load resistance

a) $1\,A$ b) $4.5\,A$ c) $2\,A$ d) $1.5\,A$

328. The flux linked with circuit is given by $\phi = t^3 + 3t - 7$. The graph between time $(x-axis)$ and induced emf $(y-axis)$ will be a

a) Straight line through the origin
b) Straight line with positive intercept
c) Straight line with negative intercept
d) Parabola not through the origin

329. The inductance of a coil is L = 10 H and resistance $R = 5\,\Omega$. If applied voltage of battery is 10 V and it switches off in 1 millisecond, find induced emf of inductor

a) $2 \times 10^4\,V$ b) $1.2 \times 10^4\,V$ c) $2 \times 10^{-4}\,V$ d) None of these

330. A circular coil and a bar magnet placed near by are made to move in the same direction. The coil covers a distance of $1\,m$ in $0.5\,sec$ and the magnet a distance of $2\,m$ in $1\,sec$. The induced emf produced in the coil

a) Zero
b) $1\,V$
c) $0.5\,V$
d) Cannot be determined from the given information

331. When the current through a solenoid increases at a constant rate, the induced current

a) Is constant and is in the direction of the inducing current
b) Is constant and is opposite to the direction of the inducing current
c) Increases with time and is in the direction of the inducing current
d) Increases with time and opposite to the direction of the inducing current

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

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

333. A coil of $100\,turns$ and area $5\,square\ centimeter$ is placed in a magnetic field $B = 0.2\,T$. The normal to the plane of the coil makes an angle of $60°$ with the direction of the magnetic field. The magnetic flux linked with the coil is

a) $5 \times 10^3\,Wb$ b) $5 \times 10^{-5}\,Wb$ c) $10^{-2}\,Wb$ d) $10^{-4}\,Wb$

334. A closely wound coil of 100 turns and area of cross-section $1\,cm^2$ has a coefficient of self-induction $1\,mH$. The magnetic induction in the centre of the core of the coil when a current of $2\,A$ flows in it, will be

a) $0.022\,Wb\,m^{-2}$ b) $0.4\,Wb\,m^{-2}$ c) $0.8\,Wb\,m^{-2}$ d) $1\,Wb\,m^{-2}$

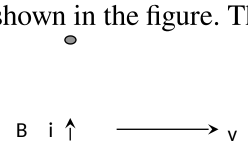
335. A coil of area $100\,cm^2$ has 500 turns. Magnetic field of $0.1\,weber/metre^2$ is perpendicular to the coil. The field is reduced to zero in $0.1\,second$. The induced e.m.f in the coil is

a) $1\,V$ b) $5\,V$ c) $50\,V$ d) Zero

336. An inductor having coefficient of self induction 40mH. What is the energy stored in it when a current of 2 A is passed through it?

a) 40mJ b) 80mJ c) 20mJ d) 100mJ

337. A conducting wire is moving towards right in a magnetic field B. The direction of induced current in the wire is shown in the figure. The direction of magnetic field will be



a) In the plane of paper pointing towards right

b) In the plane of paper pointing towards left

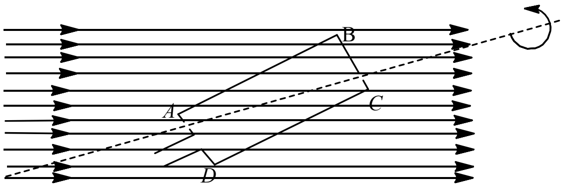
c) Perpendicular to the plane of paper and down-wards

d) Perpendicular to the plane of paper and upwards

338. If a coil of 40 turns and area 4.0 cm^2 is suddenly removed from a magnetic field, it is observed that a charge of $2.0 \times 10^{-4} C$ flows into the coil. If the resistance of the coil is 80Ω, the magnetic flux density in Wbm^{-2} is…….

a) 0.5 b) 1.0 c) 1.5 d) 2.0

339. A rectangular $ABCD$which is rotated at a constant angular velocity about an horizontal as shown in the figure. The axis of rotation of the coil as well as the magnetic field B are horizontal. Maximum current will flow in the circuit when the plane of the coil is



a) Inclined at 30° to the magnetic field

b) Perpendicular to the magnetic field

c) Inclined at 45° to the magnetic field

d) Parallel to the magnetic field

340. Average energy stored in a pure inductance L when a current i flows through it, is

a) Li^2 b) $2Li^2$ c) $\frac{Li^2}{4}$ d) $\frac{2i^2}{2}$

341. A step down transformer, transforms a supply line voltage of 2200 V into 220 V. The primary coil has 5000turns. 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

342. The mutual inductance between a primary and secondary circuits is $0.5\,H$. The resistances of the primary and the secondary circuits are $20\,ohms$ and $5\,ohms$ respectively. To generate a current of $0.4\,A$ in the secondary, current in the primary must be changed at the rate of

a) $4.0\,A/s$ b) $16.0\,A/s$ c) $1.6\,A/s$ d) $8.0\,A/s$

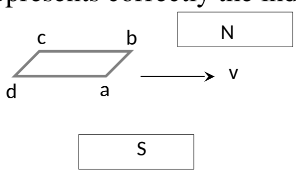
343. A circular ring of diameter 20 cm has a resistance of 0.01Ω. The charge that will flow through the ring if it is turned from a position perpendicular to a uniform magnetic field of 2.0 T to a position to the field is about

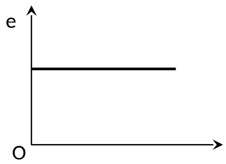
a) 63 C b) 0.63 C c) 6.3 C d) 0.063 C

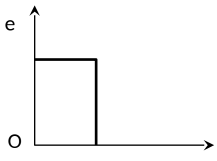
344. A step up transformer connected to a $220\,V\,AC$ line is to supply $22\,kV$ a neon sign in secondary circuit. In primary circuit a fuse wire is connected which is to blow when the current in the secondary circuit exceeds $10\,mA$. The turn ratio of the transformer is

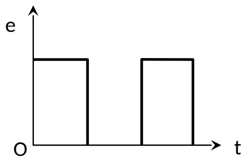
a) 50 b) 100 c) 150 d) 200

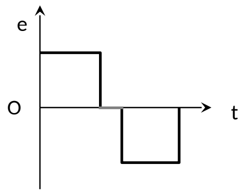
345. A horizontal loop $abcd$ is moved across the pole pieces of a magnet as shown in fig. with a constant speed v. When the edge ab of the loop enters the pole pieces at time $t=0\,sec$, which one of the following graphs represents correctly the induced emf in the coil



a) 

b) 

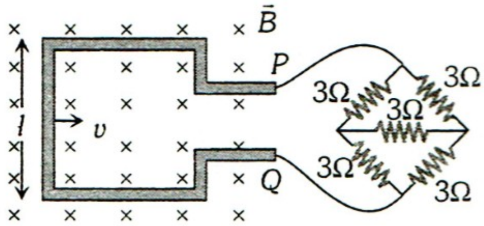
c) 

d) 

346. The direction of induced e.m.f. during electromagnetic induction is given by

a) Faraday's law
b) Lenz's law
c) Maxwell's law
d) Ampere's law

347. A square metallic wire loop of side $0.1\,m$ and resistance of $1\,\Omega$ is moved with a constant velocity in a magnetic field of $2\,wb/m^2$ as shown in figure. The magnetic field is perpendicular to the plane of the loop, loop is connected to a network of resistances. What should be the velocity of loop so as to have steady current of $1\,mA$ in loop



a) $1\,cm/sec$
b) $2\,cm/sec$
c) $3\,cm/sec$
d) $4\,cm/sec$

348. A coil having n turns and resistance $R\,\Omega$ is connected with a galvanometer of resistance $4\,R\,\Omega$. This combination is moved in time t sec from a magnetic field $W_1\,wb$ ¿ $W_2\,wb$. The induced current in the circuit is

a) $\frac{W_2-W_1}{5\,Rnt}$
b) $\frac{n(W_2-W_1)}{5\,Rt}$
c) $\frac{-(W_2-W_1)}{Rnt}$
d) $\frac{-n(W_2-W_1)}{Rt}$

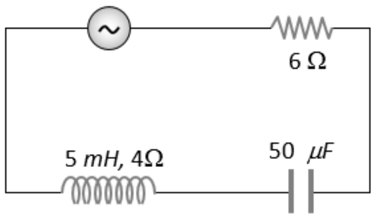
349. The alternating voltage induced in the secondary coil of a transformer is mainly due to

a) A varying electric field
b) A varying magnetic field
c) The vibrations of the primary coil
d) The iron core of the transformer

350. Lenz's law of electromagnetic induction corresponds to the

a) Law of conservation of charge
b) Law of conservation of energy
c) Law of conservation of momentum
d) Law of conservation of angular momentum

351. In the circuit shown below, the ac source has voltage $V=20\cos(\omega t)$ volts with $\omega=2000\,rad/sec$. The amplitude of the current will be nearest to



a) First clockwise then anticlockwise
b) In clockwise direction
c) In anticlockwise direction
d) First anticlockwise then clockwise

352. An ideal coil of $10\,henry$ is joined in series with a resistance of $5\,ohm$ and a battery of $5\,volt$. 2 second after joining, the current flowing in $ampere$ in the circuit will be

a) e^{-1}
b) $(1-e^{-1})$
c) $(1-e)$
d) e

353. A coil has an area of $0.05\,m^2$ and it has 800 turns. It is placed perpendicularly in a magnetic field of strength $4\times10^{-5}\,Wb/m^2$, it is rotated through $90°$ in $0.1\,sec$. The average e.m.f. induced in the coil is

a) $0.056\,V$ b) $0.046\,V$ c) $0.026\,V$ d) $0.016\,V$

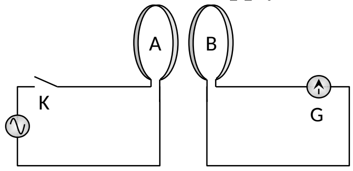
354. Consider the statements:
(I)If magnetic field, **B** =0, then magnetic flux is also zero.
(II)If magnetic flux, $\phi = 0$,then magnetic field is also zero.
a) (I)is true , (II) may be true
b) Both (I) and (II) are true
c) (I) may be true, (II) is true
d) (I) and (II) both are false

355. An inductance L and a resistance R are first connected to a battery. After some time the battery is disconnected but L and R remain connected in a closed circuit. Then the current reduces to 37% of its initial value in
a) $RL\,sec$ b) $R/L\,sec$ c) $L/R\,sec$ d) $1/LR\,sec$

356. Two similar circular loops carry equal currents in the same direction. On moving coils further apart, the electric current will
a) Increase in both
b) Decrease in both
c) Remain unaltered
d) Increases in one and decreases in the second

357. A coil having 500 square loops each of side 10 cm is placed normal to a magnetic field which increases at the rate of 1 $W\,m^{-2}$. The induced emf is
a) 0.1 V b) 5.0 V c) 0.5 V d) 1.0 V

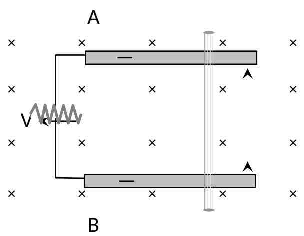
358. The diagram below shows two coils A and B placed parallel to each other at a very small distance. Coil A is connected to an ac supply. G is a very sensitive galvanometer. When the key is closed



a) Constant deflection will be observed in the galvanometer for 50 Hz supply
b) Visible small variations will be observed in the galvanometer for 50 Hz input
c) Oscillations in the galvanometer may be observed when the input ac voltage has a frequency of 1 to 2 Hz
d) No variation will be observed in the galvanometer even when the input ac voltage is 1 to or 2 Hz

359. A varying magnetic flux linking a coil is given by $\phi - X t^2$. If at time t=3 s, the emf induced is 9V, then the value of X is
a) $0.66\,Wbs^{-2}$ b) $1.5\,Wbs^{-2}$ c) $-0.66\,Wbs^{-2}$ d) $-1.5\,Wbs^{-2}$

360. Consider the situation shown in the figure. The wire AB is sliding on the fixed rails with a constant velocity. If the wire AB is replaced by semicircular wire, the magnitude of the induced current will



a) Increase
b) Remain the same
c) Decrease
d) Increase or decrease depending on whether the semicircle bulge is towards the resistance or away from it

361. In 0.1 s, the current in a coil increases from 1A to 1.5 A. If inductance of coil is 60mH, then induced current in

external resistance of $3\,\Omega$ will be

a) 1 A b) 0.5 A c) 0.2 A d) 0.1 A

362. The two rails of a railway track insulated from each other and the ground are connected to a milli-voltmeter. What is the reading of the mV, when a train travels at a speed of 180 $km\,h^{-1}$ along the track, given that the horizontal components of earth's magnetic field is $0.2 \times 10^{-4}\,Wb\,m^{-2}$ and the rails are separated by 1 m

a) 10^{-2}mV b) 10 mV c) 100 mV d) 1 m V

363. A solenoid is $1.5\,m$ long and its inner diameter is $4.0\,cm$. It has three layers of windings of 1000 turns each and carries a current of $2.0\,amperes$. The magnetic flux for a cross-section of the solenoid is nearly

a) $2.5 \times 10^{-7}\,weber$ b) $6.31 \times 10^{-6}\,weber$ c) $5.2 \times 10^{-5}\,weber$ d) $4.1 \times 10^{-5}\,weber$

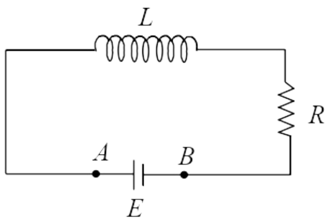
364. The magnitude of the earth's magnetic field at a place is B_0 and the angle of dip is δ. A horizontal conductor of length l, lying north-south, moves eastwards with a velocity v. The emf induced across the rod is

a) Zero b) $B_0 lv$ c) $B_0 lv \sin\delta$ d) $B_0 lv \cos\delta$

365. In a magnetic field of $0.05\,T$, area of a coil changes from $101\,cm^2$ to $100\,cm^2$ without changing the resistance which is $2\,\Omega$. The amount of charge that flow during this period is

a) $2.5 \times 10^{-6}\,coulomb$ b) $2 \times 10^{-6}\,coulomb$ c) $10^{-6}\,coulomb$ d) $8 \times 10^{-6}\,coulomb$

366. An inductor $(L=100\,mH)$, a resistor $(R=100\,\Omega)$ and a battery $(E=100\,V)$ are initially connected in series as shown in the figure. After a long time the battery is disconnected after short circuiting the points A and B. The current in the circuit $1\,ms$ after the short circuit is



a) $e\,A$ b) $0.1\,A$ c) $1\,A$ d) $1/e\,A$

367. A rectangular coil of 300 turns has an average area of 25 cm $\times$ 10cm. The coil rotates with a speed of 50 cps in uniform magnetic field of strength $4 \times 10^{-2}\,T$ about an axis perpendicular to the field. The peak value of the induced emf is (in volt)

a) 300π b) 3000π c) $3\,\pi$ d) 30π

368. Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross-sectional area $A=10\,cm^2$ and length=20 cm. If one of the solenoids has 300 turns and the other 400 turns , their mutual inductance is $(\mu_0=4\pi \times 10^{-7}\,TmA^{-1})$

a) $2.4\pi \times 10^{-5}\,H$ b) $4.8\pi \times 10^{-4}\,H$ c) $4.8\pi \times 10^{-5}\,H$ d) $2.4\pi \times 10^{-4}\,H$

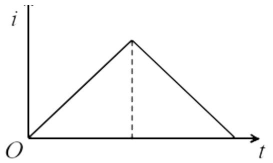
369. In a transformer, number of turns in the primary are 140 and that in the secondary are 280. If current in primary is $4\,A$, then that in the secondary is

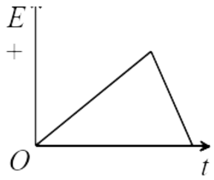
a) $4\,A$ b) $2\,A$ c) $6\,A$ d) $10\,A$

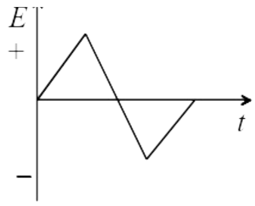
370. A current of 5 A is flowing at 220 V in the primary coil of a transformer. If the voltage produced in the secondary coil is 2200 V and 50% of power is lost, then the current in secondary will be

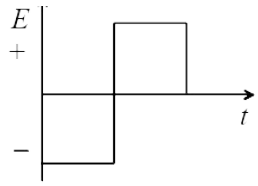
a) 2.5 A b) 5 A c) 0.25 A d) 0.5 A

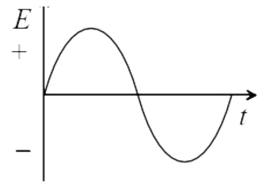
371. The current i in an inductance coil varies with time t according to the graph shown in fig. Which one of the following plots shows the variation of voltage in the coil with time



a) 

b) 

c) 

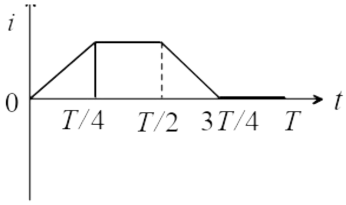
d) 

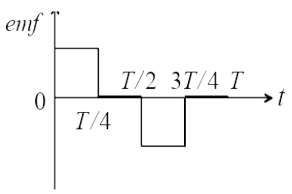
372. A coil self inductance $L = 0.04$ H and resistance $R = 12\Omega$, connected to 220 V, 50Hz supply, what will be the current flow in the coil?
a) 11.7 A b) 12.7 A c) 10.7 A d) 14.7 A

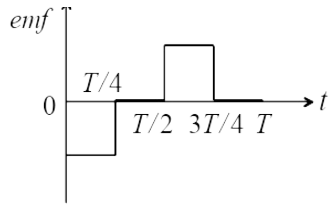
373. When the number of turns and the length of the solenoid are doubled keeping the area of cross-section same, the inductance
a) Remains the same b) Is halved c) Is doubled d) Becomes four times

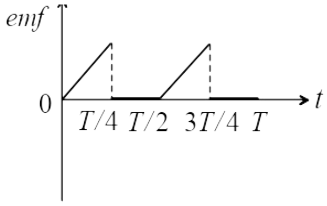
374. A hundred turns of insulated copper wire are wrapped around an iron cylinder of area $1 \times 10^{-3} m^2$ and are connected to a resistor. The total resistance in the circuit is $10\, ohms$. If the longitudinal magnetic induction in the iron changes from $1\, weber\, m^{-2}$, in one direction to $1\, weber\, m^{-2}$ in the opposite direction, how much charge flows through the circuit
a) $2 \times 10^{-2} C$ b) $2 \times 10^{-3} C$ c) $2 \times 10^{-4} C$ d) $2 \times 10^{-5} C$

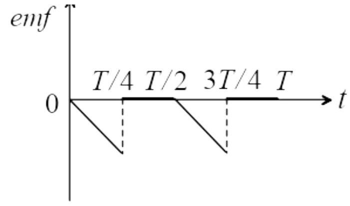
375. The current i in a coil varies with time as shown in the figure. The variation of induced emf with time would be



a) 

b) 

c) 

d) 

376. A player with $3\, m$ long iron rod runs towards east with a speed of $30\, km/hr$. Horizontal component of earth's magnetic field is $4 \times 10^{-5}\, Wb/m^2$. If he is running with rod in horizontal and vertical positions, then the potential difference induced between the two ends of the rod in two cases will be
a) Zero in vertical and $1 \times 10^{-3} V$ in horizontal position
b) $1 \times 10^{-3} V$ in vertical position and zero is horizontal position
c) Zero in both cases
d) $1 \times 10^{-3} V$ in both cases

377. A coil having an area $2\, m^2$ is placed in a magnetic field which changes from $1\, Wb/m^2$ to $4\, Wb/m^2$ in an interval of $2\, second$. The e.m.f. induced in the coil will be
a) $4\, V$ b) $3\, V$ c) $1.5\, V$ d) $2\, V$

378. In a region of uniform magnetic induction $B = 10^{-2} tesla$, a circular coil of radius $30\, cm$ and resistance $\pi^2\, ohm$

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 $200\, rpm$ the amplitude of the alternating current induced in the coil is

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

379. According to phenomenon of mutual inductance

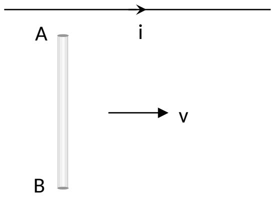
a) The mutual inductance does not dependent on geometry of the two coils involved

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

380. The current carrying wire and the rod AB are in the same plane. The rod moves parallel to the wire with a velocity v. Which one of the following statements is true about induced emf in the rod



a) End A will be at lower potential with respect to B

b) A and B will be at the same potential

c) There will be no induced e.m.f. in the rod

d) Potential at A will be higher than that at B

381. What is the coefficient of mutual inductance when the magnetic flux changes by $2 \times 10^{-2}\, Wb$ and change in current in $0.01\, A$

a) $2\, henry$ b) $3\, henry$ c) $\frac{1}{2} henry$ d) Zero

382. A circular coil of radius $5\, cm$ has 500 turns of a wire. The approximate value of the coefficient of self induction of the coil will be

a) $25\, milli\, henry$ b) $25 \times 10^{-3} milli\, henry$ c) $50 \times 10^{-3} milli\, henry$ d) $50 \times 10^{-3} milli\, henry$

383. The direction of induced current is such that it opposes the very cause that has produced it. This is the law of

a) Lenz b) Faraday c) Kirchhoff d) Fleming

384. Two identical coaxial circular loops carry current i each circulating in the clockwise direction. If the loops are approaching each other, then

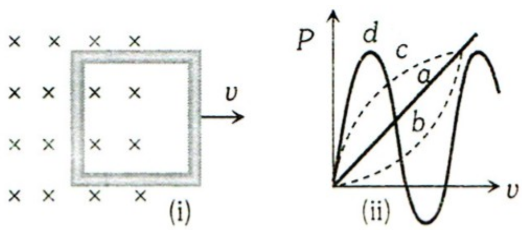
a) Current in each loop increases

b) Current in each loop remains the same

c) Current in each loop decreases

d) Current in one-loop increases and in the other it decreases

385. Figure (i) shows a conducting loop being pulled out of a magnetic field with a speed v. Which of the four plots shown in figure (ii) may represent the power delivered by the pulling agent as a function of the speed v



a) a
b) b
c) c
d) c'

386. Current in a coil changes from 5 A to 10 A in 0.2 s. If the coefficient of self-induction is 10 H, then the induced emf is

a) 112 V
b) 250 V
c) 125 V
d) 230 V

387. 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

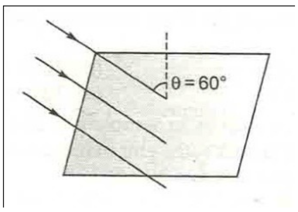
c) Its pointer is very light

d) Its frame is made of abonite

388. A loss free transformer has 500 turns on its primary winding and 2500 in secondary. The meters of the secondary indicate 200 *volts* at 8 *amperes* under these conditions. The voltage and current in the primary is

a) $100\,V, 16\,A$
b) $40\,V, 40\,A$
c) $160\,V, 10\,A$
d) $80\,V, 20\,A$

389. A square loop of wire of side 5 cm is lying on a horizontal table. An electromagnet above and to one side of the loop is turned on, causing a uniform magnetic field down-wards at an angle of 60° to the vertical as shown in figure. The magnetic induction is 0.50 T. The average induced emf in the loop, if the field increases from zero to its final value in 0.2 s is



a) $5.4 \times 10^{-3} V$
b) $3.12 \times 10^{-3} V$
c) 0
d) $25.0 \times 10^{-3} V$

390. A small piece of metal wire is dragged across the gap between the pole pieces of a magnet in 0.5 second. The magnetic flux between the pole pieces is known to be $8 \times 10^{-4}\,Wb$. The *emf* induced in the wire is

a) $16\,mV$
b) $1.6\,V$
c) $1.6\,mV$
d) $16\,V$

391. A moving conductor coil in a magnetic field produces an induced e.m.f. This is in accordance with

a) Ampere's law
b) Coulomb's law
c) Lenz's law
d) Faraday's law

392. Induction furnace is based on the heating effect of

a) Electric field
b) Eddy current
c) Magnetic field
d) Gravitational field

393. Turn ratio is 1.25. The step up transformer operates at 230 V and current through secondary is 2 A. Then current in primary is

a) 25 A
b) 100 A
c) 50 A
d) 20 A

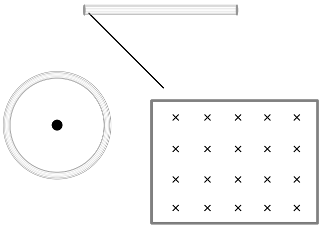
394. The core of a transformer is laminated to reduce

a) Flux leakage
b) Output power
c) Hysteresis
d) Eddy current

395. A copper rod of length l is rotated about one end perpendicular to the magnetic field B with constant angular velocity ω. The induced e.m.f. between the two ends is

a) $1/2 B\omega l^2$ b) $3/4 B\omega l^2$ c) $B\omega l^2$ d) $2 B\omega l^2$

396. A metallic ring connected to a rod oscillates freely like a pendulum. If now a magnetic field is applied in horizontal direction so that the pendulum now swings through the field, the pendulum will



a) Keep oscillating with the old time period b) Keep oscillating with a smaller time period

c) Keep oscillating with a larger time period d) Come to rest very soon

397. A circular coil of 500 turns of wire has an enclosed area of $0.1\, m^2$ per turn. It kept perpendicular to a magnetic field of induction $0.2\, T$ and rotated by $180°$ about a diameter perpendicular to the field in $0.1\, sec$. How much charge will pass when the coil is connected to a galvanometer with a combined resistance of $50\, ohms$

a) $0.2\, C$ b) $0.4\, C$ c) $2\, C$ d) $4\, C$

398. The self inductance of a coil is $5\, henry$, a current of $1\, amp$ change to $2\, amp$ within $5\, second$ through the coil. The value of induced e.m.f. will be

a) $10\, volt$ b) $0.10\, volt$ c) $1.0\, volt$ d) $100\, volt$

399. In an oscillations of L-C circuit, the maximum charge on the capacitor is Q. The charge on the capacitor, when the energy is stored equally between the electric and magnetic field is

a) $\frac{Q}{2}$ b) $\frac{Q}{\sqrt{2}}$ c) $\frac{Q}{\sqrt{3}}$ d) $\frac{Q}{3}$

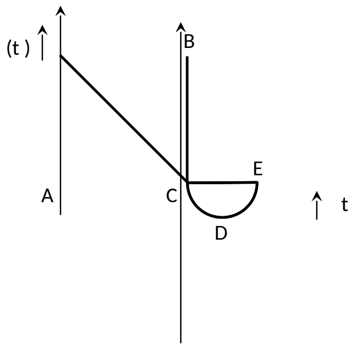
400. The mutual inductance of an induction coil is $5\, H$. In the primary coil, the current reduces from $5\, A$ to zero in $10^{-3}\, s$. What is the induced emf in the secondary coil

a) $2500\, V$ b) $25000\, V$ c) $2510\, V$ d) Zero

401. Energy required to establish a current of 4 A in a coil of self-inductance L =200mH is

a) 0.16 J b) 0.18 J c) 0.40 J d) 1.6 J

402. The graph shows the variation in magnetic flux $\phi(t)$ with time through a coil. Which of the statements given below is not correct



a) There is a change in the direction as well as magnitude of the induced emf between B and D

b) The magnitude of the induced emf is maximum between B and C

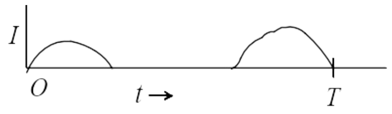
c) There is a change in the direction as well as magnitude of induced emf between A to C

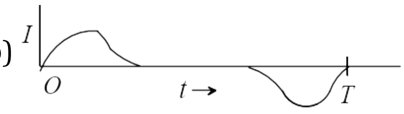
d) The induced emf is not zero at B

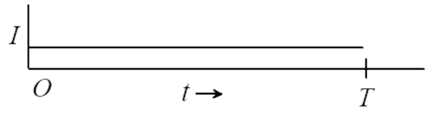
403. An e.m.f. of $5\, volt$ is produced by a self inductance, when the current changes at a steady rate from $3\, A$ to $2\, A$ in 1 millisecond. The value of self inductance is

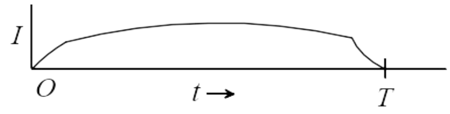
a) Zero b) $5\,H$ c) $5000\,H$ d) $5\,mH$

404. A metallic ring is dropped down, keeping its plane perpendicular to a constant and horizontal magnetic field. The ring enters the region of magnetic field at $t=0$ and completely emerges out at $t=T sec$. The current in the ring varies as

a) 

b) 

c) 

d) 

405. A solenoid is placed inside another solenoid, the length of both being equal carrying same magnitude of current. The parameters like radius and number of turns are in the ratio 1 : 2 for the two solenoids. The mutual inductance on each other would be

a) $M_{12}=M_{21}$ b) $M_{12}=2M_{21}$ c) $2M_{12}=M_{21}$ d) $M_{12}=4M_{21}$

406. A horizontal straight wire 10 m long extending from east to west is falling with a speed of 5.0 ms^{-1}, at right angles to the horizontal component of the earth's magnetic field of strength $0.30\times10^{-4}\,Wbm^{-2}$. the instantaneous value of the induced potential gradient in the wire, from west to east, is

a) $+1.5\times10^{-3}\,Vm^{-1}$ b) $-1.5\times10^{-3}\,Vm^{-1}$ c) $+1.5\times10^{-4}\,Vm^{-1}$ d) $-1.5\times10^{-4}\,Vm^{-1}$

407. If a current of $5\,A$ in a coil of self inductance $2\,mH$ is cut off in time $0.1\,s$, the induced emf in the coil is

a) $0.1\,V$ b) $0.01\,V$ c) $0.2\,V$ d) $0.02\,V$

408. According to Faraday's law of electromagnetic induction

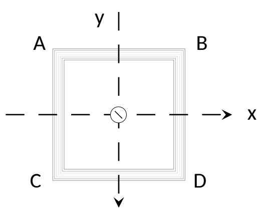
a) The direction of induced current is such that it opposes the cause producing it

b) The magnitude of induced e.m.f. produced in a coil is directly proportional to the rate of change of magnate flux

c) The direction of induced e.m.f. is such that it opposes the cause producing it

d) None of the above

409. A square coil $ABCD$ lying in $x-y$ plane with it's centre at origin. A long straight wire passing through origin carries a current $i=2t$ in negative z-direction. The induced current in the coil is



a) Clockwise b) Anticlockwise c) Alternating d) Zero

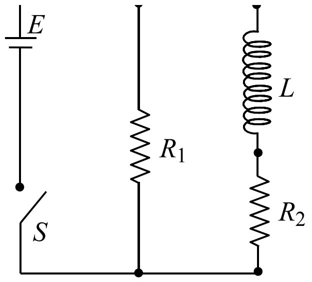
410. A long horizontal metallic rod with length along the east-west direction is falling under gravity. The potential difference between its two ends will

a) Be zero b) Be constant c) Increase with time d) Decrease with time

411. An e.m.f. of $12\,volts$ is induced in a given coil when the current in it changes at the rate of $48\,amperes\ per\ minute$. The self inductance of the coil is

a) $0.25\,henry$ b) $15\,henry$ c) $1.5\,henry$ d) $9.6\,henry$

412. An inductor of inductance $L=400\,mH$ and resistors of resistances $R_1=2\,\Omega$ and $R_2=2\,\Omega$ are connected to a battery of emf $12\,V$ as shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at $t=0$. The potential drop across L as a function of time is

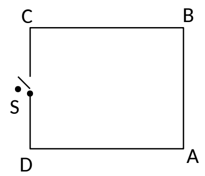


a) $6e^{-5t}V$ b) $\frac{12}{t}e^{-3t}V$ c) $6\left(1-e^{\frac{-t}{0.2}}\right)V$ d) $12e^{-5t}V$

413. An inductor of $2\,henry$ and a resistance of $10\,ohms$ are connected in series with a battery of $5\,volts$. The initial rate of change of current is

a) $0.5\,amp/sec$ b) $2.0\,amp/sec$ c) $2.5\,amp/sec$ d) $0.25\,amp/sec$

414. The magnetic field in the cylindrical region shown in figure increases at a constant rate of $20\,mT/sec$. Each side of the square lop $ABCD$ has a length of $1\,cm$ and resistance of $4\,\Omega$. Find the current in the wire AB if the switch S is closed



a) $1.25\times10^{-7}\,A$, (anti-clockwise) b) $1.25\times10^{-7}\,A$, (clockwise)

c) $2.5\times10^{-7}\,A$, (anti-clockwise) d) $2.5\times10^{-7}\,A$, (clockwise)

415. The output voltage of a transformer connected to $220\,volt$ line is $1100\,volt$ at $2\,amp$ current. Its efficiency is 100%. The current coming from the line is

a) $20\,A$ b) $10\,A$ c) $11\,A$ d) $22\,A$

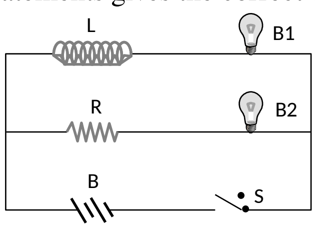
416. A straight conductor of length $4\,m$ moves at a speed of $10\,m/s$. When the conductor makes an angle of $30\,°$ with the direction of magnetic field of induction of $0.1\,wb.m^2$ then induced emf is

a) $8\,V$ b) $4\,V$ c) $1\,V$ d) $2\,V$

417. A magnetic field of $2\times10^{-2}\,T$ acts at right angles to a coil of area $100\,cm^2$ with 50 turns. The average emf induced in the coil is $0.1\,V$, when it is removed from the field in time T. The value of t is

a) $0.1\,sec$ b) $0.01\,sec$ c) $1\,sec$ d) $20\,sec$

418. An inductor L, a resistance R and two identical bulbs, B_1 and B_2 are connected to a battery through a switch S as shown in the figure. The resistance R is the same as that of the coil that makes L. Which of the following statements gives the correct description of the happenings when the switch S is closed



a) The bulb B_2 lights up earlier than B_1 and finally both the bulbs shine equally bright

b) B_1 light up earlier and finally both the bulbs acquire equal brightness

c) B_2 lights up earlier and finally B_1 shines brighter than B_2

d) B_1 and B_2 light up together with equal brightness all the time

419. Why the current does not rise immediately in a circuit containing inductance

a) Because of induced emf
b) Because of high voltage drop
c) Because of low power consumption
d) Because of Joule heating

420. The self inductance of a coil is L. Keeping the length and area same, the number of turns in the coil is increased to four times. The self inductance of the coil will now be

a) $\frac{1}{4}L$
b) L
c) $4\,L$
d) $16\,L$

421. Choke coil works on the principle of

a) Transient current
b) Self induction
c) Mutual induction
d) Wattless current

422. The primary winding of a transformer has 100 turns and its secondary winding has 200 turns. The primary is connected to an ac supply of $120\,V$ and the current flowing in it is $10\,A$. The voltage and the current in the secondary are

a) $240\,V, 5\,A$
b) $240\,V, 10\,A$
c) $60\,V, 20\,A$
d) $120\,V, 20\,A$

423. In a coil rate of change of area is $5\,m^2/milli\,second$ and current between becomes 1 amp from $2\,amp$ in $2\times10^{-3}\,sec$. If magnitude of field is $1\,tesla$ inductance of the coil is

a) $2\,H$
b) $5\,H$
c) $20\,H$
d) $10\,H$

424. 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 emf induced in the coil is $e=200\sin 100\pi t$. The magnetic induction is

a) 0.50 T
b) 0.02 T
c) $10^{-3}\,T$
d) 0.01 T

425. The efficiency of transformer is very high because

a) There is no moving part in a transformer
b) It produces very high voltage
c) It produces very low voltage
d) None of the above

426. The induction coil works on the principle of

a) Self-induction
b) Mutual induction
c) Ampere's rule
d) Fleming's right hand rule

427. Lenz's law gives

a) The magnitude of the induced e.m.f.
b) The direction of the induced current
c) Both the magnitude and direction of the induced current
d) The magnitude of the induced current

428. Two coils of self inductance L_1 and L_2 are placed closer to each other so that total flux in one coil is completely linked with other. If M is mutual inductance between them, then

a) $M=L_1 L_2$
b) $M=L_1/L_2$
c) $M=\sqrt{L_1 L_2}$
d) $M=(L_1 L_2)^2$

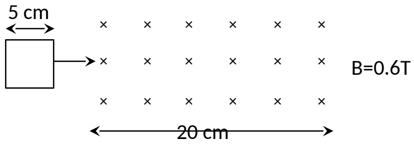
429. In a dc motor, induced e.m.f. will be maximum

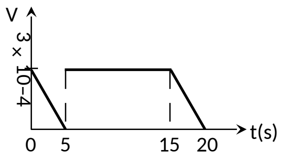
a) When motor takes maximum speed
b) When motor starts rotating
c) When speed of motor increases
d) When motor is switched off

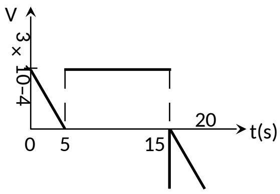
430. The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in time Δt. The total independent of quantity of electric charge Q which passes during this time through any point of the circuit is given by

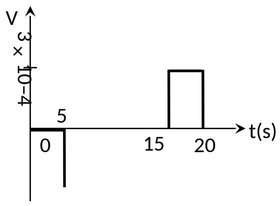
a) $Q=\frac{\Delta\phi}{\Delta t}$
b) $Q=\frac{\Delta\phi}{\Delta t}\times R$
c) $Q=\frac{-\Delta\phi}{\Delta t}+R$
d) $Q=\frac{\Delta\phi}{R}$

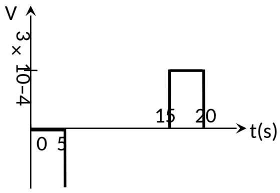
431. A square loop of side $5\,cm$ enters a magnetic field with $1\,cm\,s^{-1}$. The front edge enters the magnetic field at $t=0$ then which graph best depicts emf



a)


b)


c)


d)


432. Magnetic flux linked with a coil is $\phi=5t^2+2t+3$, where t is second and ϕ is in weber. At time $t=1$ s, the value of induced emf in volt

a) 14 b) 1.2 c) 12 d) 6

433. In circular coil, when no. of turns is doubled and resistance becomes $\frac{1}{4}th$ of initial, then inductance becomes

a) $4\times$¿ b) $2\times$¿ c) $8\times$¿ d) No change

434. The time constant of an LR circuit represents the time in which the current in the circuit

a) Reaches a value equal to about 37% of its final value
b) Reaches a value equal to about 63% of its final value
c) Attains a constant value
d) Attains 50% of the constant value

435. A coil and a bulb are connected in series with a dc source, a soft iron core is then inserted in the coil. Then

a) Intensity of the bulb remains the same
b) Intensity of the bulb decreases
c) Intensity of the bulb increases
d) The bulb ceases to glow

436. If a copper ring is moved quickly towards south pole of a powerful stationary bar magnet, then

a) Current flows through the copper ring
b) Voltage in the magnet increase
c) Current flows in the magnet
d) Copper ring will get magnetised

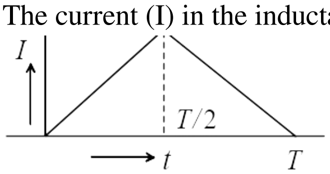
437. The average power dissipation in pure inductance is

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

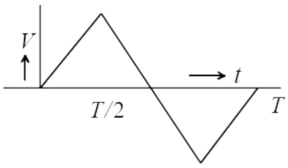
438. The magnitude of magnetic induction for a current carrying toroid of uniform cross-section is

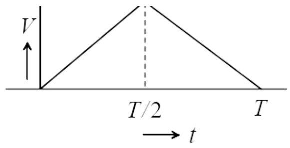
a) Uniform over the whole cross-section
b) Maximum on the outer edge
c) Maximum on the inner edge
d) Maximum at the center of cross-section

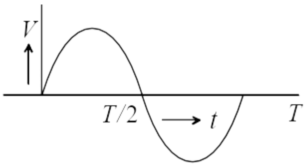
439. The current (I) in the inductance is varying with time according to the plot shown in figure

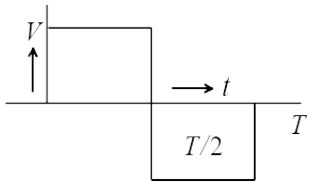


Which one of the following is the correct variation of voltage with time in the coil

a) 

b) 

c) 

d) 

440. The square root of the product of inductance and capacitance has the dimension of

a) Length b) Mass c) Time d) No dimension

441. A step-down transformer is connected to main supply $200\,V$ to operate a $67\,V$, $30\,W$ bulb. The current in primary is

a) $3\,A$ b) $1.5\,A$ c) $0.3\,A$ d) $0.15\,A$

442. Coefficient of coupling between two coils of self-inductances $L_1 \wedge L_2$ is unity. It means

a) 50% flux of L_1 islinked with L_2

b) 100% flux of $L_1$is linked with L_2

c) $\sqrt{L_1}$ time of flux of L_1 is linked with L_2

d) None of the above

: ANSWER KEY :

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

169)	c	170)	b	171)	c	172)	b
173)	b	174)	c	175)	c	176)	c
177)	b	178)	a	179)	c	180)	b
181)	d	182)	c	183)	c	184)	b
185)	c	186)	c	187)	c	188)	d
189)	c	190)	a	191)	a	192)	a
193)	a	194)	a	195)	b	196)	b
197)	b	198)	b	199)	d	200)	d
201)	a	202)	c	203)	c	204)	b
205)	c	206)	d	207)	a	208)	a
209)	b	210)	c	211)	b	212)	a
213)	d	214)	b	215)	b	216)	b
217)	b	218)	a	219)	d	220)	d
221)	a	222)	b	223)	c	224)	c
225)	b	226)	b	227)	d	228)	a
229)	c	230)	d	231)	d	232)	a
233)	d	234)	a	235)	a	236)	d
237)	d	238)	d	239)	a	240)	b
241)	b	242)	c	243)	a	244)	d
245)	d	246)	b	247)	a	248)	c
249)	b	250)	b	251)	a	252)	a
253)	c	254)	d	255)	c	256)	c
257)	c	258)	d	259)	b	260)	d
261)	c	262)	d	263)	d	264)	b
265)	a	266)	b	267)	a	268)	b
269)	a	270)	a	271)	a	272)	a
273)	b	274)	b	275)	a	276)	a
277)	b	278)	b	279)	d	280)	b
281)	c	282)	c	283)	d	284)	a
285)	d	286)	b	287)	b	288)	c
289)	c	290)	d	291)	c	292)	d
293)	a	294)	b	295)	d	296)	d
297)	c	298)	b	299)	a	300)	d
301)	c	302)	a	303)	b	304)	d
305)	b	306)	a	307)	d	308)	b
309)	b	310)	b	311)	b	312)	a
313)	c	314)	c	315)	c	316)	b
317)	d	318)	c	319)	c	320)	a
321)	d	322)	b	323)	c	324)	a
325)	c	326)	c	327)	c	328)	d
329)	a	330)	a	331)	b	332)	a
333)	a	334)	a	335)	b	336)	b

337)	**c**	**338)**	**b**	**339)**	**d**	**340)**	**d**
341)	**b**	**342)**	**a**	**343)**	**c**	**344)**	**b**
345)	**d**	**346)**	**b**	**347)**	**b**	**348)**	**b**
349)	**b**	**350)**	**b**	**351)**	**c**	**352)**	**b**
353)	**d**	**354)**	**a**	**355)**	**c**	**356)**	**a**
357)	**b**	**358)**	**c**	**359)**	**b**	**360)**	**b**
361)	**d**	**362)**	**d**	**363)**	**b**	**364)**	**c**
365)	**a**	**366)**	**d**	**367)**	**d**	**368)**	**d**
369)	**b**	**370)**	**c**	**371)**	**c**	**372)**	**b**
373)	**c**	**374)**	**a**	**375)**	**b**	**376)**	**b**
377)	**b**	**378)**	**c**	**379)**	**b**	**380)**	**d**
381)	**a**	**382)**	**a**	**383)**	**a**	**384)**	**c**
385)	**b**	**386)**	**b**	**387)**	**a**	**388)**	**b**
389)	**b**	**390)**	**c**	**391)**	**d**	**392)**	**b**
393)	**c**	**394)**	**d**	**395)**	**a**	**396)**	**d**
397)	**b**	**398)**	**c**	**399)**	**b**	**400)**	**b**
401)	**d**	**402)**	**d**	**403)**	**d**	**404)**	**b**
405)	**a**	**406)**	**a**	**407)**	**a**	**408)**	**b**
409)	**d**	**410)**	**c**	**411)**	**b**	**412)**	**d**
413)	**c**	**414)**	**a**	**415)**	**b**	**416)**	**d**
417)	**a**	**418)**	**c**	**419)**	**a**	**420)**	**d**
421)	**b**	**422)**	**a**	**423)**	**d**	**424)**	**d**
425)	**a**	**426)**	**b**	**427)**	**b**	**428)**	**c**
429)	**a**	**430)**	**d**	**431)**	**c**	**432)**	**c**
433)	**a**	**434)**	**b**	**435)**	**b**	**436)**	**a**
437)	**d**	**438)**	**a**	**439)**	**d**	**440)**	**c**
441)	**d**	**442)**	**b**				

: HINTS AND SOLUTIONS :

1 **(a)**

$\frac{80}{100}=\frac{120\times 20}{1000\times I_p}$

$I_p=\frac{120\times 20}{1000\times 0.8}=3\,A$

2 **(a)**

If bar magnet is falling vertically through the hollow region of long vertical copper tube then the magnetic flux linked with the copper tube (due to 'non-uniform' magnetic field of magnet) changes and eddy currents are generated in the body of the tube by Lenz's law. The eddy currents oppose the falling of the magnet which therefore experience a retarding force. The retarding force increases with increasing velocity of the magnet and finally equals the weight of the magnet. The magnet then attains a constant final terminal velocity $i.e.$, magnet ultimately falls with zero acceleration in the tube

3 **(c)**

$\frac{N_p}{N_s}=\frac{V_p}{V_s}=\frac{i_s}{i_p}$. The transformer is step-down type, so primary coil will have more turns. Hence

$\frac{5000}{500}=\frac{2200}{V_s}=\frac{i_s}{4}\Rightarrow V_s=220\,V.\,i_s=40\,amp$

4 **(c)**

Efficiency of transformer,

$$\eta=\frac{Output\ power}{Input\ power}$$

$\Rightarrow\frac{88}{100}=\frac{880}{P_i}$

$\Rightarrow P_i=1000\,W$

Input current , $I_p=\frac{P_i}{V_i}$

¿ $\frac{1000}{2200}=0.45\,A$

5 **(a)**

For 100% efficient transformer

$V_s i_s=V_p i_p\Rightarrow\frac{V_s}{V_p}=\frac{i_p}{i_s}=\frac{N_s}{N_p}\Rightarrow\frac{i_p}{4}=\frac{25}{100}\Rightarrow i_p=1\,A$

6 **(a)**

Crosses (×) linked with the loop are decreasing, so induced current in it is clockwise, $i.e.$, from $B\to A$. Hence electrons flow from plate A and B so plate A becomes positively charged

7 **(c)**

$M=\frac{\mu_0 N_1 N_2 A}{l}$

8 **(a)**

$\frac{di}{dt}=$ ¿ slope of $i-t$ graph; slope of graph (2) < slope of graph (1) so $\left(\frac{di}{dt}\right)_2<\left(\frac{di}{dt}\right)_1$; Also

$L\propto\frac{1}{(di/dt)}\Rightarrow L_2>L_1$

9 **(b)**

The emf induced will be

$e=vBl=1\times 0.5\times 2=1V$

10 **(b)**

Induced emf is given by

$e=\frac{-d\phi}{dt}$

If the radius of loop is r at a time t, then the instantaneous magnetic flux is given by

$\phi=\pi r^2 B$

$\therefore e=\frac{-d}{dt}(\pi r^2 B)$

$e=-\pi B\left(\frac{2r\,dr}{dt}\right)$

$e=-2\pi Br\frac{dr}{dt}$

Numerically, $e=2\pi Br\left(\frac{dr}{dt}\right)$

11 **(b)**

$e=\frac{-d\phi}{dt}=-NBA$ ¿¿

$=\frac{2NBA}{dt}=\frac{2\times 1000\times 0.6\times 10^{-4}\times 0.05}{0.1}$

= 0.06 V

14 **(b)**

Self inductance of coil is

$L=\frac{\mu_0 n^2 \pi r}{2}$

¿ $\frac{4\pi\times10^{-7}}{2}\times(500)^2\times\pi\times(5\times10^{-2})$

¿ $25\times10^{-3}H=25\,mH$

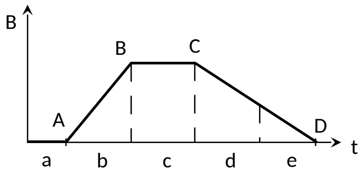
15 **(c)**

Since the rod is moving in transverse magnetic field, so it will cut no flux passing through the field and hence no induced emf is produced. So, no current will flow through the rod.

16 **(b)**

Induced emf $e=A\frac{dB}{dt}$

$i.e.,e\propto\frac{dB}{dt}$ (= slope of $B-t$ graph)



In the given graph slope of $AB>$ ¿ slope of CD, slope in the $'a'$ region ¿ slope in the $'c'$ region = 0, slope in the $'d'$ region = slope in the $'e'$ region $\neq 0$. That's why $b>(d=e)>(a=c)$

17 **(b)**

In steady state current passing through solenoid

$i=\frac{E}{R}=\frac{10}{10}=1\,A$

18 **(b)**

Induced emf

$e=B_H lv$

¿ $0.30\times10^{-4}\times20\times5.0=3\,mV$

19 **(b)**

The induced emf e in the secondary is given by

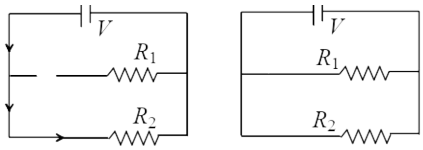
$e=\frac{-d\phi}{dt}=-M\frac{dl}{dt}$

or $|e|=M\frac{dI}{dt}$

$\therefore|e|=5\times\frac{10}{5\times10^{-4}}=1\times10^5 V$

20 **(c)**

At $t=0$ inductor behaves as broken wire then $i=\frac{V}{R_2}$



At $t=\infty$ Inductor behaves as conducting wire

$i=\frac{V}{R_2R_2/(R_1+R_2)}=\frac{V(R_1+R_2)}{R_1R_2}$

21 **(d)**

$\eta=\frac{V_s i_s}{V_p i_p}\times100=\frac{11\times90}{220\times5}\times100=90\%$

22 **(c)**

In the construction of mouth piece of a telephone, we use the phenomenon of change of resistance with pressure (of sound waves).

23 **(d)**

$e=M\frac{di}{dt}=0.09\times\frac{20}{0.006}=300\,V$

24 **(b)**

Betatron uses the phenomenon of electromagnetic induction.

25 **(b)**

Induced potential difference between two ends

¿ $Blv=B_H lv$

¿ $3\times10^{-5}\times2\times50=30\times10^{-3}\,volt=3\,millivolt$

By Fleming's right hand rule, end A becomes positively charged

26 **(d)**

$e_0=\omega NBA=(2\pi v)NBA$

¿ $2\times3.14\times1000\times5000\times0.2\times0.25=157\,kV$

27 **(a)**

Here, $A=10\times5=50\,cm^2=50\times10^{-4}m^2$

$\frac{dB}{dt}=0.2\,Ts^{-1}$

$R=2\,\Omega$

$E=\frac{d\phi}{dt}=A.\frac{dB}{dt}=50\times10^{-4}\times0.02=10^{-4}V$

Power dissipated in the form of heat

¿ $\frac{E^2}{R}=\frac{10^{-4}\times10-4}{2}=0.5\times10^{-8}W$

¿ $5\times10^{-9}W=5\,nW$

28 **(a)**

While moving due north, the truck intercepts vertical component of earth's field.

$\therefore e=Blv=(90\times10^{-6})2.5\times30$

= 6.75×10^{-23}V = 6.75 mV

According to Lenz's law, west end of the axle will be positive.

29 **(a)**

$$e=\frac{d\phi}{dt}=\frac{BdA}{dt}=\frac{2\left(\pi r^2-L^2\right)}{dt}=6.6\times10^{-3}V$$

31 **(c)**

Inductors obey the laws of parallel and series combination of resistors

32 **(a)**

$$H=\frac{V^2 t}{R} \text{ and } V=\frac{N\left(B_2-B_1\right)A\cos\theta}{t}$$

$$V=\frac{1\times(1-2)\times0.01\times\cos0°}{10^{-3}}=10V$$

So, $H=\frac{(10)^2\times10^{-3}}{0.01}=10\,J$

33 **(b)**

$N=1000,\ A=500\,cm^2=500\times10^{-4}$

¿ $5\times10^{-2}m^2$

$B=2\times10^{-5}Wb-m^{-2},\theta_1=0°,$

$\theta_2=180°,\Delta t=0.2\,s$

Initial flux linked with coil

$\phi_1=NBA\cos\theta_1$

¿ $NBA\cos0°$

¿ NBA

Final flux $\phi_2=NBA\cos180^0$

$=NBA(-1)=-NBA$

Change in flux $\phi=\phi_2-\phi_1$

¿ $-NBA-(NBA)=-2NBA$

∴ Induced emf

$$e=\frac{-\Delta\phi}{\Delta t}=\frac{-(-2NBA)}{\Delta t}=\frac{2NBA}{\Delta t}$$

¿ $\frac{2\times1000\times2\times10^{-5}\times5\times10^{-2}}{0.2}$

¿ $10\times10^{-3}V=10\,mV$

34 **(d)**

The magnetic flux through area A placed in magnetic field B is

$\phi=BA\cos\theta$

given, $\theta=0°, B=1\,Ts^{-1},$

$A=(10)^2cm^2=10^{-2}m^2$

$\therefore\phi=1\times10^{-2}$

By Faraday's law, induced emf is

$$e=-N\frac{\Delta\phi}{\Delta t}$$

¿ $-500\times10^{-2}=-5V$

35 **(b)**

We know that $i=i_0\left[1-e^{\frac{-Rt}{L}}\right]$ or $\frac{3}{4}i_o=i_o\left[1-e^{-t/\tau}\right]$

[where $\tau=\frac{L}{R}=$ ¿ time constant]

$\frac{3}{4}=1-e^{-t}$ or $e^{-t/\tau}=1-\frac{3}{4}=\frac{1}{4}$

$e^{t/\tau}=4$ or $\frac{t}{\tau}=\ln4$

$$\Rightarrow\tau=\frac{t}{\ln4}=\frac{4}{2\ln2}\Rightarrow\tau=\frac{2}{\ln2}sec$$

36 **(a)**

The current flows through the coil 1 is $I_1=I_0\sin\omega t$

Where I_0 is the peak value of current

Magnetic flux linked with the coil 2 is

$\phi_2=M\,I_1=M\,I_0\sin\omega t$

Where M is the mutual inductance between the two coils

The magnitude of induced emf in coil 2 is

$$\left|\varepsilon_2\right|=\frac{d\phi_2}{dt}=\frac{d}{dt}\left(M\,I_0\sin\omega t\right)=M\,I_0\,\omega\cos\omega t$$

∴ Peak value of voltage induced in the coil 2 is

¿ $M\,I_0\,\omega=150\times10^{-3}\times2\times2\pi\times50=30\pi V$

37 **(c)**

$$L=\frac{\mu_0N^2A}{l}=\frac{4\pi\times10^{-7}\times(1000)^2\times10\times10^{-4}}{1}$$

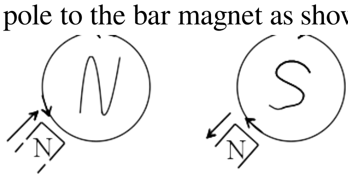
¿ $1.256\,mH$

38 **(b)**

$e=Bvl\Rightarrow e=0.7\times2\times\left(10\times10^{-2}\right)=0.14\,V$

41 **(a)**

When a north pole of a bar magnet moves towards the coil, the induced current in the coil flows in a direction such that the coil presents its north pole to the bar magnet as shown in figure (a). Therefore, the induced current flows in the coil in the anticlockwise direction. When a north pole of a bar magnet moves away from the coil, the induced current in the coil flows in a direction such that the coil presents its such pole to the bar magnet as shown in figure (b)



Therefore induced current flows in the coil in the clockwise direction

42 **(a)**

$$e=\frac{-d\phi}{dt}=\frac{-3B_0A_0}{t}$$

43 **(b)**

$$i_s=\frac{P_s}{V_s}=\frac{4.4\times10^3}{11\times10^3}=0.4\,A$$

44 **(d)**

Since all the losses are neglected

So $P_{out}=P_{¿}$

45 **(c)**

Efficiency $¿\frac{Output\ power}{Input\ power}$

Input power=5000 W

Input voltage=200 V

$\therefore$ primary current, $I_p=\frac{5000}{200}=25\,A$

Output power $¿5000\times\frac{80}{100}=4000\,W$

Output voltage =250 V

Secondary current, $I_s=\frac{4000}{250}=16\,A$

46 **(c)**

The induced emf is given by

$|e|=\left(L\frac{di}{dt}\right)$

$¿0.4\times500=200\,V$

47 **(d)**

$\frac{V_p}{V_s}=\frac{i_s}{i_p}\Rightarrow\frac{220}{22000}=\frac{i_s}{5}\Rightarrow i_s=0.05\,amp$

48 **(a)**

As the shape of the loop is changing and hence, the flux linked with the loop changes. There will an induced emf hence, induced current in the coil. Applying right hand screw rule we get induced current in anticlockwise direction.

49 **(d)**

$|e|=L\frac{di}{dt}\Rightarrow10=L\times\frac{10}{1}\Rightarrow L=1\,H$

50 **(c)**

$\phi=Mi\Rightarrow M=\frac{1.2\times10^{-2}}{0.01}=1.2\,H$

51 **(d)**

Induced emf, $e=-L\frac{di}{dt}=-L\frac{(-2-2)}{0.05}$

$8=L\frac{(4)}{0.05}$

$\therefore L=\frac{8\times0.05}{4}=0.1\,H$

52 **(b)**

The magnetic flux linked with the primary coil is given by

$\phi=\phi_0+4t$

So, voltage across primary

$V_P=\frac{d\phi}{dt}=\frac{d}{dt}(\phi+4t)$

$¿4\,V\,(as\ \phi_0=constant)$

Also, we have

$N_P=50\wedge N_S=1500$

From relation,

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

Or $V_S=V_P\frac{N_S}{N_P}=4\left(\frac{1500}{50}\right)=120\,V$

53 **(d)**

In secondary e.m.f. induces only when current through primary changes

54 **(d)**

$i=\frac{E-e}{R}\Rightarrow1.5=\frac{220-e}{20}\Rightarrow e=190\,V$

56 **(a)**

$M_{21}=\frac{\mu_0N_1N_2A_2}{l_2}$

$\therefore M_{21}=\frac{(4\times3.14\times10^{-7})\times1500\times100\times\{3.14(2\times10^{-2})^2\}}{80\times10^{-2}}$

$M_{21}=2.96\times10^{-4}\,H$

$\Rightarrow M_{12}=M_{21}=2.96\times10^{-4}H$

57 **(c)**

When frequency is high, the galvanometer will not show deflection

58 **(d)**

According to Lenz's law

59 **(c)**

The induced current will be in such a direction so that it opposes the change due to which it is produced

60 **(a)**

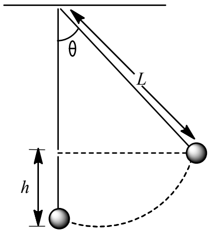
$e=Bvl=5\times10^{-5}\times\frac{360\times1000}{3600}\times20=0.1\,V$

61 **(d)**

Cross$\otimes$ magnetic field passing from the closed loop is increasing. Therefore, from Lenz's law induced current will produce dot $\odot$ magnetic field. Hence, induced current is anticlockwise.

62 **(a)**

$h=L-L\cos\theta$



$\Rightarrow h=L(1-\cos\theta)$ ….(i)

$\therefore v^2=2gh-2gL(1-\cos\theta)$

¿ $2gL\left(2\sin^2\frac{\theta}{2}\right)$

$\Rightarrow v=2\sqrt{gL}\sin\frac{\theta}{2}$

Thus, maximum potential difference

$V_{max}=BvL$

¿ $B\times 2\sqrt{gL}\sin\frac{\theta}{2}L$

$=2BL\sin\frac{\theta}{2}(gL)^{1/2}$

64 **(b)**

Rate of work ¿ $\frac{W}{t}=P=Fv;$ also

$F=Bil=B\left(\frac{Bvl}{R}\right)l$

$\Rightarrow P=\frac{B^2v^2l^2}{R}=\frac{(0.5)^2\times(2)^2\times(1)^2}{6}=\frac{1}{6}W$

65 **(c)**

The emf developed between the ends of the conductor

$e=\frac{1}{2}B\lambda^2\omega$

¿ $\frac{1}{2}\times 0.2\times 10^{-4}\times(1)^2\times 5=50\,\mu V$

66 **(d)**

$e=B.\frac{dA}{dt}=L\frac{di}{dt}\Rightarrow 1\times\frac{5}{10^{-3}}=L\times\frac{(2-1)}{2\times 10^{-3}}\Rightarrow L=1$

67 **(d)**

More rapid is the movement of bar magnet, more is the deflection observed in the galvanometer

68 **(c)**

In a generator e.m.f. is induced according as Lenz's rule

69 **(a)**

Since the current is increasing, so inward magnetic flux linked with the ring also increases (as viewed from left side). Hence induced current in the ring is anticlockwise, so end x will be positive

Induced emf $|e|=A\frac{dB}{dt}=A\frac{d}{dt}(B_o+\alpha t)\Rightarrow|e|=A\alpha$

70 **(c)**

From Faraday's law of electromagnetic induction

$e=\frac{-d\phi}{dt}=-BAN$

Given, $B=0.1\,T, N=20, A=\pi r^2=\pi(0.1)^2$

$\therefore e=-0.1\times 20\times\pi(0.1)^2=20\pi\,mV$

71 **(d)**

Mutual inductance between two coil in the same plane with their centers coinciding is given by

$M=\frac{\mu_0}{4\pi}\left(\frac{2\pi^2R_2^2N_1N_2}{R_1}\right)henry$

72 **(d)**

Using Fleming's right hand rule, the direction of magnetic induction $\vec{B}$ in the region P is downward into the paper.

73 **(b)**

Transformation ratio, $k=\frac{N_s}{N_p}=\frac{V_s}{V_p}$

For step-up transformer,

$N_s>N_p, ie, V_s>V_p, hence, k>1.$

74 **(b)**

$N_2\phi_2=Mi_1\Rightarrow 9\times 10^{-5}=M\times 3\Rightarrow M=3\times 10^{-5}H$

75 **(a)**

Faraday's laws involve conversion of mechanical energy into electrical energy. This is in accordance with the law of conservation of energy

76 **(d)**

KE of charged possible in a cyclotron,

$E_k=\frac{q^2B^2r^2}{2m}$

But frequency $f=\frac{qB}{2\pi m}$

$\therefore E_k=\frac{(2\pi mf)^2r^2}{2m}=2\pi^2mf^2r^2$

Or

$E_k=2\times(3.14)^2\times 1.67\times 10^{-27}\times(10\times 10^6)^2\times(0.5)^2$

¿ $8.23\times 10^{-13}J$

$\therefore E_k=\frac{8.23\times 10^{-13}}{1.6\times 10^{-19}}=5.1\times 10^6eV=5.1\,MeV$

77 **(b)**

Magnetic flux, $\phi=5t^2-4t+1\,Wb$

$\therefore\frac{d\phi}{dt}=10t-4\,Wb\,s^{-1}$

The induced $e$mf is $\varepsilon=\frac{-d\phi}{dt}=-(10t-4)$

At, $t=0.2S, \varepsilon=-(10\times0.2-4)=2V$

The induced current is $I=\frac{\varepsilon}{R}=\frac{2V}{10\Omega}=0.2A$

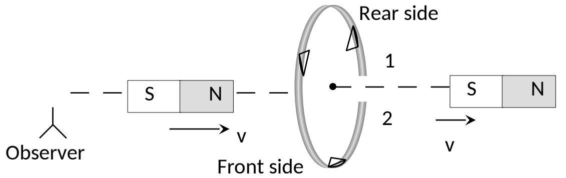
78 **(b)**

$i=i_0\left(1-e^{\frac{Rt}{L}}\right)\Rightarrow\frac{di}{dt}=-i_0\left(\frac{-R}{L}\right)e^{\frac{Rt}{L}}=\frac{i_0R}{L}.e^{\frac{Rt}{L}}$

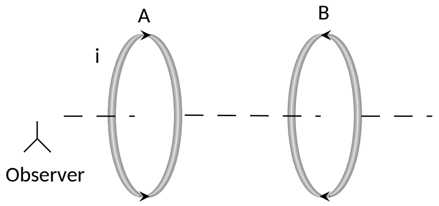
At $t=0; \frac{di}{dt}=\frac{i_0R}{L}=\frac{E}{L}\Rightarrow4=\frac{E}{20}\Rightarrow E=80V$

79 **(b)**

By the movement of both the magnets, current will be anticlockwise, as seen from left side, $i.e.$, plate 1 will be positive and 2 will be negative



80 **(d)**



If current through A increases, magnetic field $(\times)$ linked with coil B increases. Hence anticlockwise current induces in coil B. As shown in figure both the currents produce repulsive effect

81 **(b)**

$\frac{L_B}{L_A}=\left(\frac{n_B}{n_A}\right)^2\Rightarrow L_B=\left(\frac{500}{600}\right)^2\Rightarrow108=75mH$

82 **(a)**

Though emf is induced in the copper ring, but there is no induced current because current because of cut in the ring. Hence nothing opposes the free fall of the magnet. Therefore, $a=¿$g.

83 **(b)**

Power $P=\frac{e^2}{R}$; hence $e=-\left(\frac{d\phi}{dt}\right)$ where $\phi=NBA$

$\therefore e=-NA\left(\frac{dB}{dt}\right)$. Also $R\propto\frac{1}{r^2}$

Where $R=¿$ resistance, $r=¿$ radius, $l=¿$ length

$\therefore P\propto\frac{N^2r^2}{l}\Rightarrow\frac{P_1}{P_2}=1$

84 **(a)**

$\frac{N_s}{N_p}=\frac{V_s}{V_p}\Rightarrow\frac{250}{100}=\frac{V_s}{28/\sqrt{2}}\Rightarrow V_s=50V$

85 **(d)**

$e=Bl^2\pi v=0.4\times10^{-4}\times(0.5)^2\times(3.14)\times\frac{120}{60}$

$¿6.28\times10^{-5}V$

86 **(b)**

As x increases so $\frac{dB}{dt}$ increases, $i.e.$, induced emf (e) is negative. When loop completely enters in the magnetic field, emf = 0

When it exists, x increases but $\frac{dB}{dt}$ decreases, $i.e.,e$ is positive

87 **(b)**

$U=\frac{1}{2}Li^2, i.e.,\frac{U_2}{U_1}=\left(\frac{i_2}{i_1}\right)^2=\left(\frac{1}{2}\right)^2=\frac{1}{4}\Rightarrow U_2=\frac{1}{4}U_1$

88 **(c)**

Given, $L=10H, f=50Hz$

For maximum power

$X_C=X_L$

$\frac{1}{\omega C}=\omega L$

$C=\frac{1}{\omega^2L}$

$\therefore C=\frac{1}{4\pi^2\times50\times50\times10}$

$C=0.1\times10^{-5}F=1\mu F$

89 **(c)**

$\eta=\frac{e}{E}\times100\Rightarrow e=0.3E$

Now, $i=\frac{E-e}{R}\Rightarrow12=\frac{50-(0.3\times50)}{R}\Rightarrow R=2.9\Omega$

90 **(c)**

Total charge induced in a loop depends on resistance and change in magnetic flux linked with the loop.

91 **(b)**

In transformer

$\frac{n_p}{n_s}=\frac{V_P}{V_S}$

$¿\frac{5000}{240}=20.8$

92 **(b)**

If resistance is constant (10Ω) then steady current in the circuit $i=\frac{5}{10}=0.5A$. But resistance is increasing it means current through the circuit starts decreasing. Hence inductance comes in picture which induces a current in the circuit in the same direction of main current. So $i>0.5A$

93 **(b)**

$e\propto\omega$

94 **(c)**

$$\frac{N_s}{N_p}=\frac{V_s}{V_p}\Rightarrow\frac{1}{20}=\frac{V}{2400}\Rightarrow V_s=120\,V$$

For 100% efficiency $V_s i_s=V_p i_p$

$\Rightarrow 120\times 80=2400\,i_p\Rightarrow i_p=4\,A$

95 **(d)**

From, Faraday's second law, $e=\frac{-d\phi}{db}$

$=-[12t-5]$

$=-[12\times(0.25)-5]=+2$

Now, $i=\frac{e}{R}=\frac{2}{20}=0.1\,A$

96 **(d)**

Efficiency of a transformer,

$$\eta=\frac{Power\ output}{Power\ input}$$

For an ideal transformer, $\eta=1$

$\therefore$ Power output = Power input ¿ $60\,W$

98 **(b)**

Induced e.m.f. ¿ $Blv=0.3\times10^{-4}\times10\times5$

¿ $1.5\times10^{-3}\,V=1.5\,mV$

99 **(b)**

Magnetic flux , $\phi=\int B.dA=BA\cos\theta$, *where* θ is angle between normal to the area dA with magnetic field B.

Here, $\theta=(90°-30°)=60°$

and $\theta=10^{-4}\times\pi\left[\frac{21}{2}\times10^{-2}\right]^2\times\cos 60°$

¿ $1.732\times10^{-6}\,Wb$

100 **(c)**

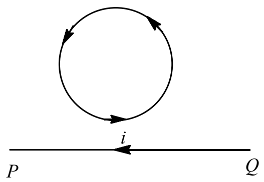
Current in B_1 will promptly become zero while current in B_2 will slowly tend to zero

101 **(d)**

$$e=M\frac{di}{dt}=1.25\times80=100\,V$$

102 **(a)**

From right hand thumb rule, the magnetic field passing through the loop due to the current i will be perpendicular to the plane of the page pointing downwards. The direction of current in the loop will be such as to oppose the increase of this field (Lenz's law), hence direction of induced current in the loop is anticlockwise.



103 **(c)**

$e=NBA\omega\,;\ \omega=2\pi f=2\pi\times\frac{2000}{60}$

$\therefore e=50\times0.05\times80\times10^{-4}\times2\pi\times\frac{2000}{60}=\frac{4\pi}{3}$

104 **(a)**

$$i=\frac{E-e}{R}=\frac{220-210}{2}=\frac{10}{2}=5\,A$$

105 **(c)**

From formula

$$L=\frac{\phi}{i}=\frac{\mu_0 N^2 A}{2r}=\frac{\mu_0 N^2\pi r^2}{2}r$$

$\Rightarrow L\propto N^2$

So, if N is doubled, self inductance will be four times.

106 **(c)**

Rate of decay of current between $t=5\,ms$ to

$6\,ms=\frac{di}{dt}=-¿$ (Slope of the line BC)

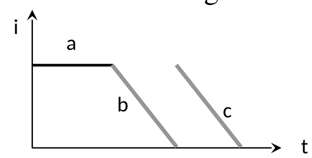
¿ $-\left(\frac{5}{1\times10^{-3}}\right)=-5\times10^3\,A/s$. Hence induced emf

$e=-L\frac{di}{dt}=-4.6\times(-5\times10^3)=23\times10^3\,V$

107 **(c)**

Emf induces during 'a' = 0

emf induces during 'b' is constant throughout emf induces during 'c' is constant throughout magnitude of emf induced during 'b' is equal to the magnitude of emf induced during 'c'. But the direction opposite



108 **(b)**

In a constant magnetic field conducting ring oscillates with a frequency of $100\,Hz$

$i.e.,T=\frac{1}{100}\,s$, in time $\frac{T}{4}$ flux links with coil changes from BA to zero $\Rightarrow$ Induced emf

¿ $\frac{change \in flux}{time}$

¿ $\frac{BA}{T/4}=\frac{4BA}{T}=\frac{4B\times\pi r^2}{T}=\frac{4\times0.01\times\pi\times1^2}{1/100}=2\pi$

Induced electric field along the circle, using Maxwell equation $\oint E.dl = \frac{-d\phi}{dt} = A\frac{dB}{dt} = e$

$\Rightarrow E = \frac{1}{2\pi r} \times \left(\pi r^2 \times \frac{dB}{dt}\right) = \frac{e}{2\pi r} = \frac{4\pi}{2\pi r} = 2\,V/m$

110 **(b)**

Mutual inductance of the pair of coils depends on distance between two coils and geometry of two coils.

111 **(d)**

$$P=\frac{e^2}{R};e=\frac{-d}{dt}(BA)=A\frac{d}{dt}(B_o e^{-t})=A B_o e^{-t}$$

$$\Rightarrow P=\frac{1}{R}(A B_o e^{-t})^2=\frac{A^2 B_o^2 e^{-2t}}{R}$$

At the time of starting $t=0$ so $P=\frac{A^2 B_o^2}{R}$

$$\Rightarrow P=\frac{(\pi r^2)^2 B_o^2}{R}=\frac{B_o^2 \pi^2 r^4}{R}$$

112 **(c)**

$L=40\,m, v=1080\,km h^{-1}=300\,m\,sec^{-1}$ and

$B=1.75\times10^{-5}T \Rightarrow e=Blv=1.75\times10^{-5}\times 40\times 30($

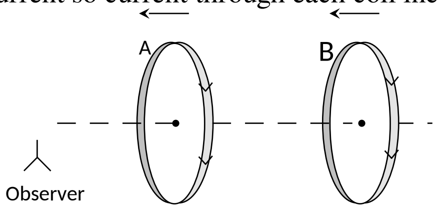
113 **(b)**

The emf developed between the centre and the rim is

$$e=\frac{1}{2}B\omega l^2=\frac{1}{2}\times0.05\times60[1]^2=1.5V$$

114 **(a)**

Induced current in both the coil assists the main current so current through each coil increases



115 **(a)**

Given, $N_P=20, N_S=10, e_p=220V$

$\therefore$ Transformation ratio, k

$$\frac{e_s}{e_p}=\frac{N_s}{N_p}$$

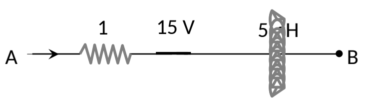
or $e_s=\frac{N_s}{N_p}\times ep$

$$¿\frac{10}{20}\times220=110V$$

116 **(c)**

By using Kirchhoff's voltage law

$$V_A-iR+E-L\frac{di}{dt}=V_B\Rightarrow V_B-V_A=15\,volt$$



117 **(b)**

According to Lenz's law of electromagnetic induction, the relative motion between the coil and magnet produces change in magnetic flux.

119 **(c)**

A transformer is a device used to convert alternating current at high voltage into low voltage and $vice-versa$

120 **(a)**

In step-up transformer, number of turns in primary coil is less than the number of turns in secondary coil.

$ie, \frac{N_s}{N_p}>1$

121 **(d)**

The inductance of a coil of wire of N turns is given by

$$L=N\frac{\phi}{i}$$

Where i is current and ϕ the magnetic flux.

Given, $N=100, i=5\,A, \phi=10^{-5}Tm^2(turn)^{-1}$

$$\therefore L=100\times\frac{10^{-5}}{5}=0.20\,mH$$

125 **(c)**

The DC generator must be mixed wound to withstand the load variation.

126 **(b)**

$$|e|=L\frac{di}{dt}\Rightarrow|e|=10\times10^{-6}\times\frac{1}{10}=1\,\mu V$$

127 **(a)**

As the north pole approaches, a north pole is developed at the face, $i.e.$, the current flows anticlockwise. Finally when it completes the oscillation, no emf is present. Now south pole approaches the other side, $i.e.$, RHS, the current flows clockwise to repel the south pole. This means the current is anticlockwise at the LHS a before. The break occurs when the pendulum is at the extreme and momentarily stationary

128 **(d)**

$$t=\tau=\frac{L}{R}=\frac{2.5}{0.5}=5\,sec$$

129 **(b)**

$$|e|=\frac{d\phi}{dt}=\frac{BdA}{dt}$$

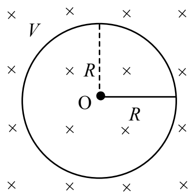
Now, as the square loop and rectangular loop move out of magnetic field, $\frac{dA}{dt}$ is constant, therefore $¿e\vee¿$ is constant. But in case of circular and elliptical loops, $\frac{dA}{dt}$ changes. Therefore, $¿e\vee¿$ does not remain constant

130 **(a)**

Energy stored $¿\frac{1}{2}Li^2$, where Li is magnetic flux

131 **(d)**

From Faraday's law of electromagnetic induction, the emf induced between center and rim is equal to rate of change of magnetic flux.



$e = \frac{-d\phi}{dt}$

Where, $d\phi = B\,dA$,where B is magnetic field and dA the area.

$\therefore e = \frac{-B\int_0^R dA}{T}$

$e = \frac{-B \times \pi R^2}{T}$

Also, $\omega = \frac{2\pi}{T}$, where T is periodic time,

$e = \frac{-B\pi R^2}{2\pi/\omega}$

¿ $-\frac{BR^2\omega}{2}$

132 **(a)**

$l = 1\,m, v = 100\,km\,h^{-1}$

¿ $\frac{100 \times 1000}{60 \times 60} = \frac{250}{9} m\,s^{-1}$

$e = Blv = 0.18 \times 10^{-4} \times 1 \times \frac{250}{9} = 5 \times 10^{-4}$V

= 0.5 mV

133 **(b)**

Magnetic flux through the loop is upward and its is increasing due to increasing current along AB. Current induced in the loop should have magnetic flux in the downward direction so at to oppose the increase in flux. Therefore, current induced in the loop is clockwise.

135 **(a)**

$e = L\frac{di}{dt} \Rightarrow 100 = L \times \frac{4}{0.01} \Rightarrow L = 2.5\,H$

136 **(b)**

$e \propto \frac{d\phi}{dt}$; if $\phi \rightarrow$ maximum then $e \rightarrow$ minimum

137 **(d)**

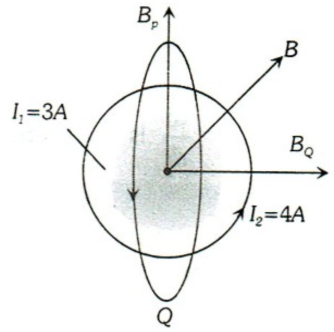
$i = i_0\left(1 - e^{\frac{-Rt}{L}}\right) \Rightarrow$ For $i = \frac{i_0}{2}, t = 0.693\frac{L}{R}$

$\Rightarrow t = 0.693 \times \frac{300 \times 10^{-3}}{2} = 0.1\,sec$

138 **(c)**

$B_p = \frac{\mu_0 I_2}{2R}$

¿ $\frac{4\pi \times 10^{-7} \times 4}{2 \times 0.02\pi} = 4 \times 10^{-5}\,Wb/m^2$



$B_Q = \frac{\mu_0 I_1}{2R}$

¿ $\frac{4\pi \times 10^{-7} \times 3}{2 \times 0.02\pi} = 3 \times 10^{-5}\,Wb/m^2$

$\therefore B = \sqrt{B_p^2 + B_Q^2}$

¿ $\sqrt{(4 \times 10^{-5})^2 + (3 \times 10^{-5})^2} = 5 \times 10^{-5}\,Wb/m^2$

139 **(d)**

$q = Q_0 \cos\omega t$

$I = \frac{dq}{dt} = -Q_0\omega.\sin\omega t$

$I_{max} = C\omega V = V\sqrt{\frac{C}{L}} = 20\sqrt{\frac{16 \times 10^{-6}}{40 \times 10^{-3}}} = 0.4\,A$

140 **(d)**

Induced charge doesn't depend upon the speed of magnet

141 **(a)**

$\phi = BA = 10\,weber$

142 **(d)**

Energy stored,

$U = \frac{1}{2}Li^2$

¿ $\frac{1}{2} \times 50 \times 10^{-3} \times 2 \times 2 = 0.1\,J$

143 **(a)**

$\eta = \frac{V_s I_s}{V_p I_p} = 0.8 \Rightarrow I_P = \frac{(440)(2)}{(0.8)(220)} = 5\,A$

144 **(c)**

$\frac{\Delta i}{\Delta t} = \frac{10}{2} = 5\,A/sec \Rightarrow e = L\frac{\Delta i}{\Delta t} = 0.5 \times 5 = 2.5\,volts$

145 **(d)**

Magnetic field, $\phi_B = BA\cos\theta$

Where θ is the angle between normal to the plane of the coil and magnetic field

Induced emf, $\varepsilon = BA\sin\theta$

Here, $\theta=0°$

$\therefore$ Magnetic flux is maximum and induced emf is zero

146 **(d)**

Relative velocity ¿ $v-(-v)=2v=\frac{dl}{dt}$

Now, $e=\frac{d\phi}{dt}$

$e=\frac{Bldl}{dt}\left(\frac{dl}{dt}=2v\right)$

Induced emf $e=2\,Blv$

148 **(b)**

The flux associated with coil of area A and magnetic induction$B$ is

$\phi=BA\cos\theta$

¿ $\frac{1}{2}B\pi r^2\cos\omega t\left[\because A=\frac{1}{2}\pi r^2\right]$

$\therefore e_{induced}=\frac{-d\phi}{dt}$

¿ $-\frac{d}{dt}\left(\frac{1}{2}B\pi r^2\cos\omega t\right)$

¿ $\frac{1}{2}B\pi r^2\omega\sin\omega t$

$\therefore power\ p=\frac{e_{induced}^2}{R}$

¿ $\frac{B^2\pi^2r^4\omega^2\sin^2\omega t}{4R}$

Hence,$P_{mean}=$¿ $p>$¿

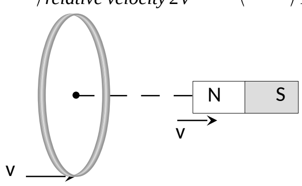
¿ $\frac{B^2\pi^2r^4\omega^2}{4R}.\frac{1}{2}\left(\because<\sin\omega t\geq\frac{1}{2}\right)$

¿ $\frac{(B\pi r^2\omega)^2}{8R}$

150 **(b)**

$\left(\frac{d\phi}{dtr}\right)_{¿first\ case}=e$

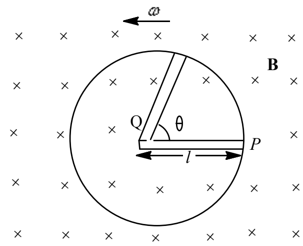
$\left(\frac{d\phi}{dt}\right)_{relative\ velocity\ 2v}=2\left(\frac{d\phi}{dt}\right)_{I\ case}=2e$



151 **(b)**

A conducting rod of length$l$ whose one end is fixed, is rotated about the axis passing through its fixed end and perpendicular to its length with constant angular velocityω. Magnetic field (B) is perpendicular to the plane of the paper.

Emf induced across the ends of the rod is $e=BAn$



¿ $B\pi l^2 n$

¿ $\frac{Bl^2\pi}{T}$

¿ $\frac{1}{2}Bl^2\omega$

152 **(a)**

$v_0=\frac{1}{2\pi\sqrt{(0.25)\times(0.1\times10^{-6})}}=\frac{10^4}{9.93}=1007\,Hz$

153 **(c)**

Eddy currents are set up when a plate swings in a magnetic field. This opposes the motion

154 **(c)**

$i=$¿$e\vee$¿$/R=\frac{N}{R}\cdot\frac{\Delta B}{\Delta t}A\cos\theta=\frac{20}{100}\times1000\times(25\times1$

$\Rightarrow i=0.5A$

155 **(c)**

$l=36\,m, v=400\,km\,h^{-1}$

$=\frac{400\times1000}{60\times60}=\frac{100}{9}m\,s^{-1}$

= V= 4 $\times10^{-5}T$

$e=Blv=4\times10^{-5}\times36\times\frac{1000}{9}=0.16$V

156 **(a)**

Given $\frac{di}{dt}=2A/sec.,$

$L=5H\therefore e=L\frac{di}{dt}=5\times2=10V$

157 **(c)**

$i=\frac{V}{R}=\frac{10}{2}=5A$

$U=\frac{1}{2}Li^2=\frac{1}{2}\times2\times25=25J$

158 **(b)**

When coil is open, there is no current in it, hence no flux associated with it, $ie,\phi=0$.

Also, we know that flux linked with the coil is directly proportional to the current in the coil,

$ie,\phi\propto i$

Or $\phi=Li$

Where L is proportionality constant known as self-inductance.

$\therefore L=\frac{\phi}{i}=0$

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

159 **(b)**

The magnitude of induced e.m.f. is directly proportional to the rate of change of magnetic flux. Induced charge doesn't depend upon time

160 **(c)**

Motor e.m.f. equation $E_b=V-I_aR_a$

At starting $E_b=0$, so I_a will be maximum

162 **(d)**

Induced emf $e=Bvl \Rightarrow e=Bv(2R)=\frac{2BvL}{\pi}$

163 **(c)**

Induced emf

$e=B_H lv$

¿$5.0\times10^{-5}\times2\times1.50$

¿$0.15\times10^{-3}V=0.15mV$

164 **(a)**

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

165 **(a)**

Initial magnetic flux linked with the loop

$\phi=B_1A_1\cos\phi$

¿$0.1\times(10\times10^{-2})^2\cos45°$

¿$\frac{0.1\times10^{-2}\times1}{\sqrt{2}}=\frac{10^{-3}}{\sqrt{2}}$

Final magnetic flux linked with the loop, $\phi_2=2$

Now, induced emf in the loop , $e=\frac{-d\phi}{dt}$

¿$\frac{-\left[\frac{10^{-3}}{\sqrt{2}}\right]}{0.7}=10^{-3}V$

$\therefore$ Induced current $=\frac{e}{R}=\frac{10^{-3}}{1}=1mA$

166 **(c)**

In uniform magnetic field, change in magnetic flux is zero. Therefore, induced current will be zero.

168 **(c)**

By using $e=\frac{1}{2}Bl^2\omega$

For part $AO; e_{OA}=e_O-e_A=\frac{1}{2}Bl^2\omega$

For part $OC; e_{OC}=e_O-e_C=\frac{1}{2}B(3l)^2\omega$

$\therefore e_A-e_C=4Bl^2\omega$

170 **(b)**

Polarity of emf will be opposite in the two cases while entering and while leaving the coil. Only in option (b) polarity is changing.

171 **(c)**

As inductance L_2 was wound using the similar wire but the direction of winding is reversed, so flux through L_2 is zero.

$\therefore L_2\propto\phi=0$

Also, $L_1=L_3$

Therefore, $L_1=L_3, L_2=0$

175 **(c)**

DC motor is a device which converts electrical energy into mechanical energy. It employs Fleming's left hand rule.

DC generator converts mechanical energy into electrical energy in from of DC. It employs Fleming's right hand rule.

176 **(c)**

The potential difference across the ends of the conductor

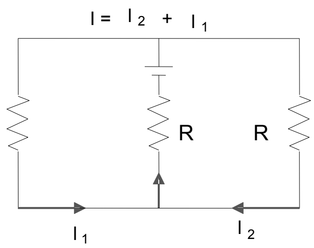
$V=\frac{1}{2}\omega L^2B$

177 **(b)**

A moving conductor is equivalent to battery of emf

¿vBl (motion emf)

Equivalent circuit



$I=I_2+I_2$

Applying Kirchhoff's law

$I_1R+IR-vBl=0\ldots(i)$

$I_2R+IR-vBl=0$ …(ii)

Adding Eqs. (i) and (ii), we get

$2IR+IR=2vBl$

$I=\frac{2vBl}{3R}$

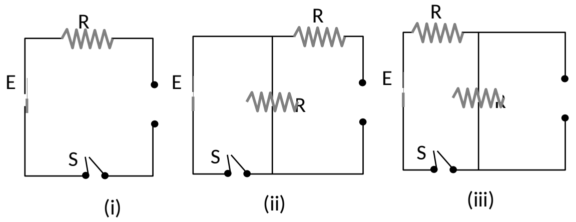
$I_1=I_2=\frac{vBl}{3R}$

179 **(c)**

Time in which the current will decay to $\frac{1}{e}$ of its steady value is $t=\tau=\frac{L}{R}=\frac{50}{10}=5\,seconds$

180 **(b)**

At $t=0$ current through L is zero so it acts as open circuit. The given figures can be redrawn as follow

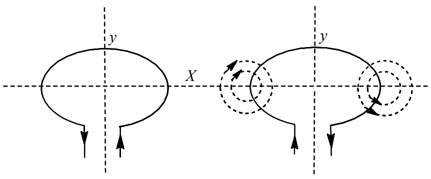


$i_1=0\, i_2=\frac{E}{R}\, i_3=\frac{E}{2R}$

Hence $i_2>i_3>i_1$

181 **(d)**

Whenever the flux of magnetic field through the area bounded by a closed conducting loop changes, an emf is produced in the loop in this case the magnetic flux $ie.$,number of magnetic lines of force entering and leaving the loop is same hence magnetic flux is zero.



183 **(c)**

Mutual inductance of the pair of coils depends on distance between two coils and geometry of two coils.

184 **(b)**

The emf induced is directly proportional to rate at which flux is intercepted which varies directly as the speed of rotation of the generator.

New, speed=$\frac{120}{100}\times 1500\,rpm=1800\,rpm$

185 **(c)**

E.m.f. or current induces only when flux linked with the coil changes

186 **(c)**

The efficiency of transformer

$¿\,Energy\ obtained\ ¿the\ secondary\ coil\,\frac{¿}{Energy\ giv}$

or $\eta=\frac{Output\ power}{input\ power}$

or $\eta=\frac{V_s I_s}{V_p I_p}$

Given, $V_s I_s=100\,W, V_p=V, I_p=0.5\,A$

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

187 **(c)**

$\frac{V_s}{V_p}=\frac{N_s}{N_p}\Rightarrow V_s=\frac{N_s}{N_p}\times V_p=\frac{10}{200}\times 240=12\,volts$

188 **(d)**

Whenever a magnet is moved either towards or away from a conducting coil, the magnetic flux linked with the coil changes and therefore, an emf is induced in the coil. The magnitude of induced emf

$e=-N\frac{d\phi}{dt}$

$e=-N\frac{d(BA)}{dt}$

Time intervaldt, depends on the speed with which the magnet is moved.

Therefore, the induced emf is independent of the resistance of the coil.

189 **(c)**

In case of motional emf, the motion of the conductor in the field exerts a force on the free charge in the conductor , so that one end of the conductor becomes positive, while the other negative resulting in a potential difference across its ends due to which a non-conservative electric field is set up in the conductor. In steady state the magnetic force on the free charge is balanced by the electric force due to induced field.

$qE=qvB$

or $q\left(\frac{V}{l}\right)=qvB$

$ie,\qquad V=Bvl$

So, the induced emf between tip of nose and tail of helicopter is given by

$e=Bvl$

$¿5\times 10^{-3}\times 10\times 100=5\,V$

190 **(a)**

$\because L\propto N^2 r;\ \frac{L_1}{L_2}=\left(\frac{N_1}{N_2}\right)^2\times\frac{r_1}{r_2}$

$\Rightarrow\frac{L}{L_2}=\left(\frac{1}{2}\right)^2\times\left(\frac{r}{r/2}\right)=\frac{1}{2};\ L_2=2L$

191 **(a)**

According to Gauss's theorem in magnetism, surface integral of magnetic field intensity over a surface (closed or open) is always zero,ie,

$\oint B.dA=0$

192 **(a)**

Induced e.m.f. $\varepsilon=\frac{d\phi}{dt}=-(100t)$

Induced current i at $t=2\,sec$

$¿\left|\frac{\varepsilon}{R}\right|=\frac{+100\times 2}{400}=+0.5\,Amp$

193 **(a)**

$|e|=M\frac{di}{dt}\Rightarrow 8\times 10^{-3}=M\times 3\Rightarrow M=2.66\,mH$

194 **(a)**

In a transformer

$\therefore \frac{N_P}{N_S}=\frac{I_S}{I_P}$

$\frac{50}{200}=\frac{I_S}{4}$

$\Rightarrow I_s=1\,A$

195 **(b)**

$e_0=\omega NBA=(2\pi v)NB(\pi r^2)=2\times\pi^2 v NB r^2$

$¿2\times(3.14)^2\times\frac{1800}{60}\times 4000\times 0.5\times 10^{-4}\times(7\times 10^{-2}$

$¿0.58\,V$

196 **(b)**

The electric field induced by changing magnetic field depends upon the rate of change of magnetic flux, hence it is non-conservative.

198 **(b)**

$L=\frac{\mu_0 N^2 A}{l}=\frac{4\pi\times 10^{-7}\times(500)^2\times 20\times 10^{-4}}{0.5}$

$¿1.25\,mH$

199 **(d)**

$U=\frac{1}{2}Li^2\Rightarrow U=\frac{1}{2}\times 5\times\left(\frac{100}{10}\right)^2=250\,J$

200 **(d)**

$|e|=\frac{d\phi}{dt}$

$¿\frac{8\times 10^{-4}}{0.4}=2\times 10^{-3}\,V$

201 **(a)**

$e=-L\frac{di}{dt};$

$\frac{di}{dt}=10\times 100\pi\cos(100\,\pi t)$

$L=\frac{e}{\frac{di}{dt}}=\frac{5\pi}{10\times 100\pi}=5\times 10^{-3}\,H=5\,mH$

202 **(c)**

$|e|=L\frac{di}{dt}\Rightarrow 30=L\times\frac{(6-0)}{0.3}\Rightarrow L=1.5\,H$

203 **(c)**

When key k is pressed, current through the electromagnet start increasing, $i.e.$, flux linked with ring increases which produces repulsion effect

204 **(b)**

$e=\frac{d\phi}{dt}=6t+4+0$

At $t=2\,s$, $e=6\times 2+4=16\,V$

207 **(a)**

Self inductance of a solenoid

$L=\frac{\mu_0 N^2 A}{l}=\frac{\mu_0 N^2\pi r^2}{l}$

Where l is the length of the solenoid, N is the total number of turns of the solenoid and A is the area of cross-section of the solenoid

$\therefore \frac{L_1}{L_2}=\left(\frac{N_1}{N_2}\right)^2\left(\frac{r_1}{r_2}\right)^2\left(\frac{l_2}{l_1}\right)$

Here, $N_1=N_2, \frac{l_1}{l_2}=\frac{1}{2}, \frac{r_1}{r_2}=\frac{1}{2}$

$\therefore \frac{L_1}{L_2}=\left(\frac{1}{2}\right)^2\left(\frac{2}{1}\right)=\frac{1}{2}$

208 **(a)**

Since, electron is moving from left to right, the flux linked with loop will first increase and then decrease as the electron passes by. Therefore, induced current I in the loop will be first clockwise and then will move in anticlockwise direction as the electron passes by.

209 **(b)**

$e=-M\frac{di}{dt}=-1.5\frac{(1-0)}{(T/4)}=\frac{-6}{T}, T=\frac{2\pi}{\omega}=\frac{2\pi}{200}=\frac{\pi}{10}$

$\Rightarrow|e|=\frac{600}{\pi}=190.9\,V\approx 191\,V$

210 **(c)**

The energy stored in an inductor

$U=\frac{1}{2}LI^2$

211 **(b)**

Induced emf $e=\frac{-NA(B_2-B_1)\cos\theta}{\Delta t}$

$¿\frac{50\times\pi\times(3\times 10^{-2})^2[0.35-0.10]\cos 0°}{2\times 10^{-3}}$

$¿17.7\,V$

212 **(a)**

$\frac{V_s}{V_p}=\frac{N_s}{N_p}\Rightarrow\frac{V_s}{20}=\frac{5000}{500}\Rightarrow V_s=200V$

Frequency remains unchanged

213 **(d)**

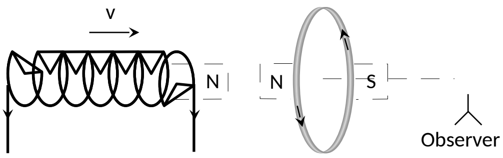
$q=\frac{-N}{R}(B_2-B_1)A\cos\theta$

$32\times10^{-6}=\frac{-100}{(160+40)}(0-B)\times\pi\times(6\times10^{-3})^2\times\cos$

$\Rightarrow B=0.565T$

214 **(b)**

The direction of current in the solenoid is anti-clockwise as seen by observer. On displacing it towards the loop a current in the loop will be induced in a direction so as to oppose the approach of solenoid. Therefore the direction of induced current as observed by the observer will be clockwise



215 **(b)**

$\Delta Q=\frac{\Delta\phi}{R}=\frac{(10-2)}{2}=4C$

216 **(b)**

A choke coil is an electrical appliance used for controlling current in an a.c. circuit. In a choke coil $R\ll X_L$ to avoid power dissipation

218 **(a)**

Mutual inductance between coils is

$M=K\sqrt{L_1L_2}$

$\Rightarrow M=1\sqrt{2\times10^{-3}\times8\times10^{-3}}[\because K=1]$

¿$4\times10^{-3}=4\,mH$

220 **(d)**

Conductor cuts the flux only when it moves in the direction of M

221 **(a)**

$\frac{V_s}{V_p}=\frac{N_s}{N_p}=k\Rightarrow\frac{V_s}{30}=\frac{3}{2}\Rightarrow V_s=45V$

222 **(b)**

$e=M\frac{di}{dt}\Rightarrow M=\frac{15000}{3}\times0.001=5H$

224 **(c)**

$P_s=V_si_s\Rightarrow1000=V_s\times8\Rightarrow V_s=\frac{1000}{8}$

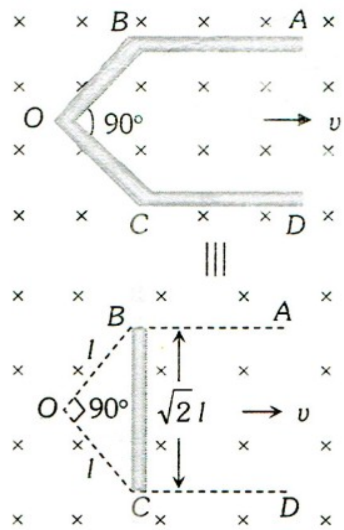
$\frac{V_p}{V_s}=\frac{N_p}{N_s}\Rightarrow\frac{(1000/8)}{500}=\frac{100}{N_s}\Rightarrow N_s=400$

225 **(b)**

This is the case of periodic EMI

226 **(b)**

There is no induced emf in the part AB and CD because they are moving along their length while emf induced between B and C *i.e.*, between A and D can be calculated as follows



Induced emf between B and $C=$¿ Induced emf between A and

$B=Bv(\sqrt{2}l)=1\times1\times1\times\sqrt{2}=1.41\,volt$

227 **(d)**

When switch S is closed magnetic field lines passing through Q increases in the direction from right to left. So, according to Lenz's law induced current in Q *i.e.* I_{Q_1} will flow in such a direction so that the magnetic field lines due to I_{Q_1} passes from left to right through Q. This is possible when I_{Q_1} flows in anticlockwise direction as seen by E. Opposite is the case when switch S is opened, *i.e.*, I_{Q_2} will be clockwise as seen by E

231 **(d)**

The emf generated would be maximum when flux (cutting) would be maximum *ie*, angle between area vector of coil and magnetic field is $0°$. The emf generated is given by [as a function of time]

$e=NBA\omega\cos\omega t$

$\Rightarrow e_{max}=NAB\omega$

232 **(a)**

$\frac{V_s}{V_p}=\frac{i_p}{i_s}\Rightarrow i_p=\frac{11000\times2}{220}=100A$

233 **(d)**

The emf induces when there is change of flux. As in this case there is no change of flux, hence no emf will be induces in the wire

234 **(a)**

$L\propto n$ (Number of turns). For straight conductor $n=0$, hence $L=0$

235 **(a)**

As, $I = \frac{E}{R} = \frac{d\phi}{Rdt}$

or $Idt = \frac{d\phi}{R}$

Integrating

$\int Idt = \int \frac{d\phi}{R}$

or $q = \frac{\phi}{R}$

If coil contains N turns, then $q ¿ \frac{N\phi}{R}$

If there is flux change $\Delta\phi$, then

$q = \frac{N\Delta\phi}{R}$

$¿ \frac{1}{7} \times (1.35 - 0.79) = 0.08\,C$

236 **(d)**

$d = L\frac{di}{dt} \Rightarrow 12 = L \times \frac{45}{60} \Rightarrow L = 16\,H$

237 **(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, so net inductance is

$$L = L_1 + L_2 = L + L$$

From Faraday's law of electromagnetic induction

$\phi = Li$, where ϕ is flux and i the current

$\therefore L = \frac{-\phi}{i} + \frac{\phi}{i}$

$\Rightarrow L = 0$

238 **(d)**

If at any instant, current through the circuit is i then applying Kirchhoffs voltage law,

$iR + e = E \Rightarrow e = E - iR$. Therefore, graph between e and i will be a straight line having negative slope and having a positive intercept

239 **(a)**

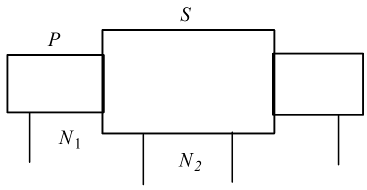
The induced emf is given by

$e = -M\frac{di}{dt}$ …(i)

Where M is coefficient of mutual inductance, $\frac{di}{dt}$ is rate of change of current.

Also, mutual inductance of two coaxial solenoids is given by

$M = \frac{\mu_0 N_1 N_2 A}{l}$ …(ii)



From Eqs. (i) and (ii), we get

$e = \frac{\mu_0 N_1 N_2 A}{l} \times \frac{di}{dt}$

Given, $N_1 = 2000, N_2 = 300, A = 1.2 \times 10^{-3}\,m^2$

$\frac{di}{dt} = \frac{2-(-2)}{0.25} = \frac{4}{0.25}$

$\therefore e = \frac{4\pi \times 10^{-7} \times 2000 \times 300 \times 1.2 \times 10^{-3} \times 4}{0.3 \times 0.25}$

$\Rightarrow e = \frac{4 \times 3.14 \times 2 \times 3 \times 1.2 \times 4 \times 10^{-5}}{0.3 \times 0.25}$

$\Rightarrow |e| = 4.8 \times 10^{-2}\,V$

240 **(b)**

Here, $l = 50\,m, v = 360\,km\,h^{-1} = 100\,m\,s^{-1}$

$B = 2 \times 10^{-4}\,Wb\,m^{-2}$

Potential difference

$e = Blv = 2 \times 10^{-4} \times 50 \times 100 = 1$V.

241 **(b)**

The emf induced between ends of conductor

$e = \frac{1}{2}B\omega L^2$

$¿ \frac{1}{2} \times 0.2 \times 10^{-4} \times 5 \times (1)^2$

$¿ 0.5 \times 10^{-4}\,V$

$¿ 5 \times 10^{-5}\,V = 50\,\mu V$

242 **(c)**

The induced emf is

$e = -L\frac{di}{dt}$

Here, $di = (2-10)\,A = -8\,A, dt = 0.1\,s, e = 3.28\,V$.

$\therefore 3.28 = \frac{-L(-8)}{0.1}$

$\therefore L = \frac{3.28 \times 0.1}{8} = 0.04\,H$

244 **(d)**

Emf induced in the wire is given by

$e = Blv$

Given, $l = 50\,cm = 0.5\,m$

$v = 300\, m - ¿\text{min}^{-1} = \frac{300}{60} = 5\, ms^{-1}$

$e = 2\, V$

Magnetic field, $B = \frac{e}{lv} = \frac{2}{0.5 \times 5} = 0.8\, T$

245 **(d)**

As transformers works only on AC, so when electrolytic DC cell of emf 2 V is connected to primary of transformer then there is no output across its output.

246 **(b)**

$I = t^2 e^{-t} \Rightarrow \frac{dI}{dt} = 2t e^{-t} - t^2 e^{-t} = t e^{-t}(2 - t)$

The induced emf is $\varepsilon = -L \frac{dI}{dt}$

According to given problem, $\varepsilon = 0 \Rightarrow \frac{dI}{dt} = 0$ [Since $L \neq 0$]

Or $e^{-t} t(2 - t) = 0$ either $t = 0$ or $t = 2\, s$

$t = 2\, s$ matches with the option (b)

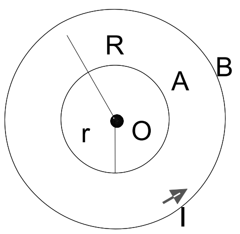
247 **(a)**

Mutual inductance for two concentric coplanar circular coils,

$M = \frac{\pi \mu N_1 N_2 r^2}{2R}$

Here, $N_1 = N_2 = 1$

$\therefore M = \frac{\pi \mu_0 r^2}{2R}$



248 **(c)**

$L = \mu_0 N^2 A / l$

249 **(b)**

$t = \tau = \frac{L}{R} = \frac{60}{30} = 2\, sec$

250 **(b)**

$N_p : N_s = 1 : 10$ and $V_s = 0.5 \times 200 = 100\, V$

$\frac{V_s}{V_p} = \frac{N_s}{N_p} \Rightarrow \frac{100}{V_p} = \frac{10}{1} \Rightarrow V_p = 10\, V$

$\frac{i_p}{i_s} = \frac{N_s}{N_p} \Rightarrow \frac{i_p}{0.5} = \frac{10}{1}, i_p = 5\, amp$

251 **(a)**

$L_S = L_1 + L_2 = 10\, H$ …(i)

$L_P = \frac{L_1 L_2}{L_1 + L_2} = 2.4\, H$ …(ii)

On solving (i) and (ii) $L_1 L_2 = 24$ …(iii)

Also $(L_1 - L_2)^2 = (L_1 + L_2)^2 - 4 L_2 L_2$

$\Rightarrow (L_1 - L_2)^2 = (10)^2 - 4 \times 24 = 4 \Rightarrow L_1 - L_2 = 2\, H$

252 **(a)**

Current at any instant of time t after closing an L-R circuit is given by $I = I_0 \left[1 - e^{\frac{-R}{L} t}\right]$

Time constant $t = \frac{L}{R}$

$\therefore I = I_0 \left[1 - e^{\frac{-R}{L} \times \frac{L}{R}}\right] = I_0 (1 - e^{-1}) = I_0 \left(1 - \frac{1}{e}\right)$

¿ $I_0 \left(1 - \frac{1}{2.718}\right) = 0.63 I_0 = 63\%$ of I_0

253 **(c)**

According to Faraday's law, "the induced emf in a closed loop equals the time rate of change of magnetic flux through the loop."

$ie.,$ $e = \frac{-d\phi_B}{dt}$

Hence, induced emf in a coil depends on rate of change of flux.

254 **(d)**

Time constant ¿ $\frac{L}{R} = \frac{40}{8} = 5\, sec$

255 **(c)**

If there are no losses then $p_i = p_0$

256 **(c)**

For step-up transformer,

$V_s > V_p \wedge I_s < I_p$

For an ideal transformer,

$V_s I_s = V_p I_p$

$\therefore 240000\, I_s = 100 \times 4000$

or $I_s = 1.67\, A$

257 **(c)**

$\phi = \mu_r \mu_0 \frac{N^2}{l} Ai$

¿ $600 \times 4\pi \times 10^{-7} \times 50 \times 50\pi \times \frac{(7.5 \times 10^{-3})^2 \times 3}{6 \times 10^{-1}}$

¿ $1.66 \times 10^{-3}\, Wb = 1.66\, mWb$

258 **(d)**

$L = 50 \times 10^{-3}\, H$

$$\frac{dI}{dt}=\frac{(1-0)}{0.1}=10$$

$$\varepsilon=\frac{L.dI}{dt}=50\times10^{-3}\times10=50\times10^{-2}=0.5\,volt$$

259 **(b)**

$$\frac{N_s}{N_p}=\frac{i_p}{i_s} \text{ or } \frac{25}{1}=\frac{i_p}{2}\Rightarrow i_p=50\,A$$

260 **(d)**

$$\phi=NBA\cos\theta=10\,B\,a^2\cos\omega t$$

$$e=\frac{-d\phi}{dt}=\frac{-d}{dt}(10\,B\,a^2\cos\omega t)=10\,B\,a^2\,\omega\sin\omega t$$

262 **(d)**

Transformer doesn't work on dc

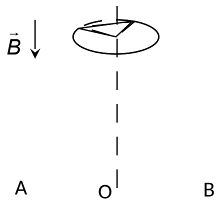
263 **(d)**

Potential difference between

O and A is $V_0-V_A=\frac{1}{2}Bl^2\omega$

O and B is $V_0-V_B=\frac{1}{2}Bl^2\omega$

So $V_A-V_B=0$



264 **(b)**

$$e=M\frac{di}{dt}=0.005\times\frac{d}{dt}(i_0\sin\omega t)=0.005\times i_0\,\omega\cos\omega$$

$$\therefore e_{max}=0.005\times10\times100\,\pi=5\,\pi$$

265 **(a)**

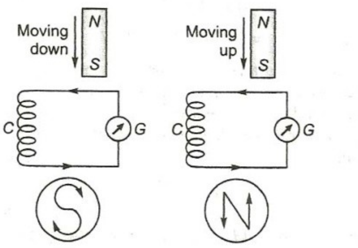
$$q=\frac{q\phi}{R}=\frac{NA(B_2-B_1)}{R}=\frac{N\pi r^2(B_2-B_1)}{R}$$

$$¿\frac{1000\times\pi\times10^{-4}\times(0.012-0)}{(200+400)}$$

$= 6.3\times10^{-6}C.=6.3\,\mu C$

266 **(b)**

When the S-pole of magnet is moved towards the coil, then by Lenz's law the face of coil, towards magnet becomes S-pole and the current flows clockwise to cancel change in the magnetic flux. So, to bring the magnet to the coil, more work has to be done against the force of repulsion produced between them. So, the galvanometer shows deflection to the left. Now when the S-pole is moved away, a current flows in anti-clockwise direction to make the face of the coil towards magnet, a *N*-pole. Thus, will try to attract the magnet. So, the galvanometer shows the deflection to the right. Since, flux varies hence, amplitude will not be constant and will decrease.



267 **(a)**

When the secondary coil circuit is open, the magnetic flux in the core is produced by the primary current only. When the secondary circuit is closed, the currents in the secondary coil also produce magnetic flux in the core but in opposite direction. This decreases the core flux and hence reduces the back *emf* more current is drawn in the primary coil. Hence, power factor is no longer zero. The power factor has increased or the phase difference is no longer $90°$, *i.e.*, phase difference has decreased. Thus, dynamic resistance has increased

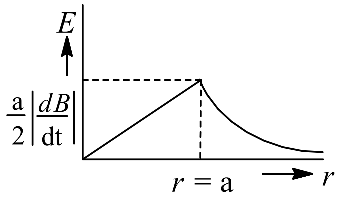
268 **(b)**

For $r\geq a$, $\oint \vec{E}\,d\vec{l}$

$$¿\left|\frac{d\phi}{dt}\right|=A\left|\frac{dB}{dt}\right|$$

$$E(2\pi r)=\pi\,a^2\left|\frac{dB}{dt}\right|\frac{a}{2}$$

$$E=\frac{a^2}{2r}\left|\frac{dB}{dt}\right|$$



$\therefore$Induced electric filed, $E\propto\frac{1}{r}$

269 **(a)**

With rise in current in coil A flux through B increases. According to Lenz's law repulsion occurs between A and B

270 **(a)**

$$N\phi=Li\Rightarrow\phi=\frac{Li}{N}=\frac{8\times10^{-3}\times5\times10^{-3}}{400}=10^{-7}=\frac{\mu_0}{4\pi}$$

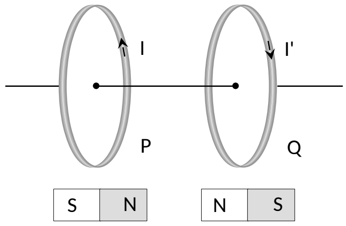
271 **(a)**

$$\frac{V_p}{V_s}=\frac{N_p}{N_s}\Rightarrow N_p=\left(\frac{220}{2200}\right)2000=200$$

272 **(a)**

The inductances are in parallel $\Rightarrow L_{eq}=\frac{L}{3}=\frac{3}{3}=1\,H$

273 **(b)**



274 **(b)**

Because there is no change in flux linked with coil

275 **(a)**

Induced current in the circuit $i=\frac{Bvl}{R}$

Magnetic force acting on the wire

$F_m=Bil=B\left(\frac{Bvl}{R}\right)l$

$\Rightarrow F_m=\frac{B^2vl^2}{R}$. External force needed to move the rod with constant velocity

$(F_m)=\frac{B^2vl^2}{R}=\frac{(0.15)^2\times(2)\times(0.5)^2}{3}=3.75\times10^{-3}N$

277 **(b)**

$\frac{N_s}{N_p}=\frac{V_s}{V_p}=\frac{2200}{220}=\frac{10}{1}$

278 **(b)**

$V=200V\,;r=10\Omega$

$R'=10+100\,\Omega=110\Omega$

$I=\frac{V}{R'}=\frac{220}{110}=2A$

$P=I^2R=4\times100=400W$

279 **(d)**

Induced EMF=$\frac{N\Delta\phi}{\Delta t}$

Peak value $=NBA\omega=100V$ …(i)

Here $2\pi r_1\times100=2\pi r_2\times N_2$

$N_2=\frac{r_1\times100}{r_2}=\frac{1\times100}{2}=50$

Now $e_0=\frac{N}{2}\times B\times4A\times\omega=200V$.

280 **(b)**

As current is decreasing, magnetic flux linked with the loop in the upward direction (acceleration to right hand thumb rule) is decreasing. Current induced in loop must be anti-clock-wise to oppose the decrease in magnetic flux.

281 **(c)**

As magnetic flux linked with the loop is changing, emf induced in the loop is $e=BLv$.

282 **(c)**

As L corresponds to $m\wedge v$ corresponds to current i $\therefore mv\rightarrow L\times i$.

283 **(d)**

The rate of increase of current

¿$\frac{di}{dt}=\frac{d}{dt}i_0\left(1-e^{-Rt/L}\right)=\frac{d}{dt}i_0-\frac{d}{dt}i_0e^{-Rt/L}$

¿$0-i_0e^{-Rt/L}.\frac{d}{dt}\left(\frac{-Rt}{L}\right)=i_0\frac{R}{L}e^{-Rt/L}$

¿$\frac{50}{180}\times\frac{180}{5\times10^{-3}}\times e^{-(180\times0.001)/(5\times10^{-3})}=10^4\times e^{-36}A.$

284 **(a)**

Transformer works on ac only

285 **(d)**

Rod is moving towards east, so induced emf across it's end will be $e=B_V vl=(B_H\tan\phi)vl$

$\therefore e=3\times10^{-4}\times\frac{4}{3}\times(10\times10^{-2})\times0.25=10^{-5}V=1C$

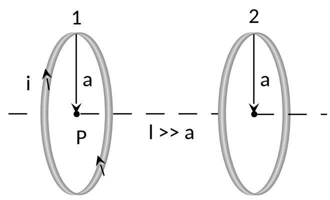
288 **(c)**

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

¿$(0.025)(2\pi)(2\times10^{-2})(10^{-3})=\pi\,\mu V$

290 **(d)**

Magnetic field at the location of coil (2) produced due to coil (1)



$B_1=\frac{\mu_o}{4\pi}.\frac{2M}{l^3}$

Flux linked with coil (2)

$\phi=B_1A_2=\frac{\mu_0}{4\pi}\frac{2i(\pi a^2)}{l^3}\times(\pi a^2)$

Also $\phi_2=Mi\Rightarrow M=\frac{\mu_0\pi a^4}{2l^3}$

291 **(c)**

Lenz's law restates the law of conservation of energy.

292 **(d)**

When two solenoids of inductance L_0 are connected in series at large distance and current i is passed through them, the total flux linkage $\phi_{total}$is the sum of the flux linkages L_0i and $L_0i, ie,$

$\phi_{total}=L_0i+L_0i$

If L be the equivalent inductance of the system, then

$\phi_{total}=Li$

$\therefore Li = L_0 i + L_0 i$

or $\quad L = 2L_0$

When solenoids are connected in series with one inside the other and senses of the turns coinciding, then there will be mutual inductance L between them. In this case the resultant induced emf in the coils is the sum of the emf se_1 and e_2 in the respective coils, ie,

$e = e_1 + e_2$

$¿\left(-L_0\frac{di}{dt} \pm L_0\frac{di}{dt}\right) + \left(-L_0\frac{di}{dt} \pm L_0\frac{di}{dt}\right)$

Where (+) sign is for positive coupling and (-) sign for negative coupling.

But, $\quad e = -L.\frac{di}{dt}$

$\therefore -L\frac{di}{dt} = -L_0\frac{di}{dt} - L_0\frac{di}{dt} \pm 2L_0\frac{di}{dt}$

$ie, L = L_0 + L_0 + 2L_0$

$¿ 4L_0$ (for positive coupling)

When solenoids are connected in series with one inside the other with senses of the turns opposite, then their is negative coupling.

So, $L = L_0 + L_2 - 2L_0 = 0$

293 **(a)**

Current in the inner coil $i = \frac{e}{R} = \frac{A_1}{R_1}\frac{dB}{dt}$

Length of the inner coil $¿ 2\pi a$

So it's resistance $R_1 = 50 \times 10^{-3} \times 2\pi(a)$

$\therefore i_1 = \frac{\pi a^2}{50 \times 10^{-3} \times 2\pi(a)} \times 0.1 \times 10^{-3} = 10^{-4} A$

According to lenz's law direction of i_1 is clockwise

Induced current in outer coil $i_2 = \frac{e_2}{R_2} = \frac{A_2}{R_2}\frac{dB}{dt}$

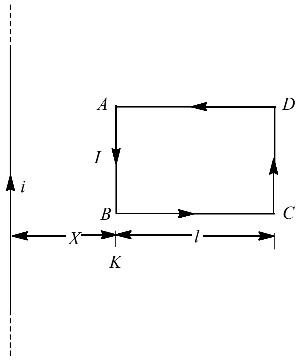
$\Rightarrow i_2 = \frac{\pi b^2}{50 \times 10^{-3} \times (2\pi b)} \times 0.1 \times 10^{-3} = 2 \times 10^{-4} A ($

294 **(b)**

$\frac{E_p}{E_s} = \frac{N_p}{N_s} \Rightarrow \frac{200}{E_s} = \frac{100}{20} \Rightarrow E_s = 40V$

295 **(d)**

We can show the situation as



Since, loop is moving away from the wire, so the direction of current in the loop will be as shown in the figure.

Net magnetic field on the loop due to wire

$B = \frac{\mu_0 i}{2\pi}\left(\frac{1}{x} - \frac{1}{l+x}\right)$

$¿ \frac{\mu_0 il}{2\pi x(l+x)}$

So, the magnitude of the emf in the loop

$e = vBb = \frac{\mu_0 il vb}{2\pi x(1+x)}$

297 **(c)**

Given, self inductance, $L = 1.8 \times 10^{-4} H$

Resistance, $R = 6\Omega$

When self inductance and resistance is broken up into identical coils.

Then, self inductance of each oil

$¿ \frac{1.8 \times 10^{-4}}{2} H$

Resistance of each oil

$¿ \frac{6\Omega}{2} = 3\Omega$

Coil are then connected in parallel

$\therefore L' = \frac{\frac{1.8}{2} \times 10^{-4} \times \frac{1.8}{2} \times 10^{-4}}{\frac{1.8}{2} \times 10^{-4} + \frac{1.8}{2} \times 10^{-4}}$

$¿ 0.45 \times 10^{-4} H$

and $R' = \frac{3 \times 3}{3+3} = 1.5\Omega$

Time constant$¿ \frac{L'}{R'}$

$¿ \frac{0.45 \times 10^{-4}}{1.5} = 0.3 \times 10^{-4} s$

298 **(b)**

Induced current are clockwise. Therefore, induced magnetic field is into the plane of the paper. As it opposes the increasing inducing filed, the inducing field must be out of the plane of the paper.

299 **(a)**

$A = 10^{-3} m^2$

$l = 31.4 = 31.4 \times 10^{-2} m$

$n = 10^{-3}$

$\phi = Li$

$BA = Li$

$\mu_0 NiA = Li$

$L = \mu_0 nlA$

$¿ 4\pi \times 10^{-7} \times 10^3 \times 31.4 \times 10^{-2}$

$¿ 4\, mH$

301 **(c)**

In a transformer

1. **Iron losses** In actual iron cores, inspite of lamination, eddy current are produced. The magnitude of eddy current may however be small and a part of energy is lost as the heat produced in the iron core.

2. **Copper losses** In practice, the coils of the transformer possess resistance. So, a part of the energy is lost the due to the heat produced in the resistance of the coil.

3. **Flux leakage** The coupling between the coils is seldom perfect. So whole of the magnetic flux produced by the primary coil is not linked up with the secondary coil.

And hysteresis loss, humming losses also occur in the transformer.

302 **(a)**

$\frac{N_s}{N_p} = \frac{i_p}{i_s} \Rightarrow \frac{i_p}{i_s} = \frac{4}{5}$

303 **(b)**

$e_0 = nAB\omega$

$= 100 \times 0.1 \times 0.4 \times (2\pi \times 60) = 150\text{V}$

304 **(d)**

By Faraday's second law, induced emf

$e = \frac{-Nd\phi}{dt}$ which gives $e = -L\frac{dI}{dt}$

$\therefore |e| ¿ 2 \times 10^{-3} \times 20 \times 10^{-3} V = 40\, \mu V$

305 **(b)**

With the increasing speed, ω increases. Thus current reduces due to increase in the back e.m.f.

Moreover $i = \frac{V - K\omega}{R}$. More ω will lead to the lesser current

306 **(a)**

If bar magnet is falling vertically through the hollow region of long vertical copper tube then the magnetic flux linked with the copper tube (due to 'non-uniform' magnetic field of magnet) changes and eddy currents are generated in the body of the tube by Lenz's law. The eddy currents oppose the falling of the magnet which therefore experience a retarding force. The retarding force increases with increasing velocity of the magnet and finally equals the weight of the magnet. The magnet then attains a constant final terminal velocity $i.e.$, magnet ultimately falls with zero acceleration in the tube

307 **(d)**

When $5\,\Omega$ resistor is pulled left at $0.5\,m/sec$ induced emf in the said resistor

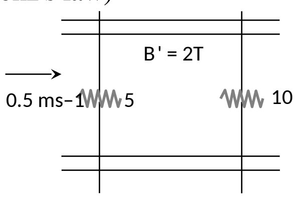
¿$e=vBl=0.5\times2\times0.1=0.1\,V$

Resistor $10\,\Omega$ is at rest so induced emf in it $(e=vBl)$ be zero

Now net emf in the circuit ¿$0.1\,V$ and equivalent resistance of the circuit $R=15\,\Omega$

Hence current $i=\frac{0.1}{15}amp=\frac{1}{150}amp$

And its direction will be anti-clockwise (according to Lenz's law)



308 **(b)**

$\phi=li$

$l=\frac{\phi}{i}=\frac{10\times10^{-6}}{2\times10^{-3}}=5\times10^{-3}=5\,mH$

309 **(b)**

Here, $\eta=\frac{e}{E}\times100$

$\frac{40}{100}=\frac{e}{E}$

$\Rightarrow e=\frac{2E}{5}=\frac{2\times200}{5}=80\,V$

But $I=\frac{E-e}{R}$

$\therefore 10=\frac{200-80}{R}$

$10R=120$

$\therefore R=12\,\Omega$

310 **(b)**

$i=i_0\left(1-e^{\frac{-R}{L}t}\right)$. At $t=0, i=0$

At $t\gg\tau($¿$L/R), i=i_0$

311 **(b)**

According to Lenz's law

312 **(a)**

On rotating the magnet, no change in flux is linked with the coil. Therefore, induced emf/ current is zero.

313 **(c)**

Induced emf $e=Bvl$

$v=velocity\ of\ train$

¿$72\times\frac{5}{18}=20\,ms^{-1}$

¿$2\times10^{-5}\times20\times1$

¿$2\times10^{-5}\times20$

¿$40\times10^{-5}\,V$

¿$40\times10^{-2}\,mV=0.4\,mV$

314 **(c)**

$|e|=L\frac{di}{dt}=L\times\frac{10}{0-9}$

$L=1.1\,H$

316 **(b)**

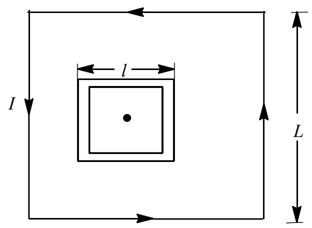
We know that for step down transformer

$V_p>V_s$ but $\frac{V_p}{V_s}=\frac{i_s}{i_p}\Rightarrow i_s>i_p$

Current in the secondary coil is greater than the primary

317 **(d)**

Considering the larger loop to be made up of four rods each of length L, the field at the centre, $i.e.$, at a distance $\left(\frac{L}{2}\right)$ from each rod, will be



$B=4\times\frac{\mu_0}{4\pi}\frac{l}{d}[\sin\alpha+\sin\beta]$

$ie, B=4\times\frac{\mu_0}{4\pi}\frac{I}{\left(\frac{L}{2}\right)}\times2\sin45°$

$ie, B_1=\frac{\mu_0}{4\pi}\frac{8\sqrt{2}}{L}I$

So, the flux with smaller loop

$\phi = B_1 S_2 = \frac{\mu_0}{4\pi} \frac{8\sqrt{2}}{L} l^2 I$

and hence, $M = \frac{\phi_2}{I} = 2\sqrt{2} \frac{\mu_0}{\pi} \frac{l^2}{L}$

or $M \propto \frac{l^2}{L}$

318 **(c)**

As per the phenomenon of mutual induction when two coils are placed near each other and current is passed through one of them then due to the phenomenon of electromagnetic induction current is induced in the other coil, in this case since, current in loop A increases with time, hence direction of current induced in loop B will be same as direction of current in loop A.

319 **(c)**

$|e| = L\left|\frac{di}{dt}\right| = 0.5 \times \frac{10}{2} = 2.5\,V$

320 **(a)**

$|e| = L\frac{di}{dt} \Rightarrow 1 = \frac{L \times [10-(-10)]}{0.5} \Rightarrow L = 25\,mH$

321 **(d)**

Induced change

$Q = \frac{-nBA}{R}(\cos\theta_2 - \cos\theta_1) = \frac{-nBA}{R}(\cos 180° - \cos$

323 **(c)**

$e = -N\left(\frac{\Delta B}{\Delta t}\right). A\cos\theta = -100 \times \frac{(6-1)}{2} \times (40 \times 10^{-}$

$\Rightarrow |e| = 1V$

324 **(a)**

Induced $e.m.f.\, e = M\frac{di}{dt} \Rightarrow 100 \times 10^{-3} = M\left(\frac{10}{0.1}\right)$

$\therefore M = 10^{-3} H = 1mH$

325 **(c)**

A uniformly moving charge produces both electric and magnetic fields. So, energy associated with it will be partially due to magnetic field and partially due to electric field.

326 **(c)**

$e = \frac{1}{2}B\omega r^2 = \frac{1}{2} \times 0.1 \times 2\pi \times 10 \times (0.1)^2 = \pi \times 10^{-2}\,V$

327 **(c)**

$\frac{N_s}{N_P} = \frac{I_P}{I_s} \Rightarrow \frac{2}{3} = \frac{3}{I_s} \Rightarrow I_s = \frac{3 \times 3}{2} \Rightarrow I_s = 4.5$

328 **(d)**

$\phi = t^2 + 3t - 7$

$\therefore$ Induced emf

$e = \frac{-d\phi}{dt} = -(3t^2+3) = -3t^2 - 3$

At $t = 0; e = -3V$

Therefore, shape of graph will be a parabola not through origin.

329 **(a)**

The emf induced in the inductor is given by

$|e| = L\frac{di}{dt}$

Here, induced current $= \frac{V}{R} = \frac{10}{5} = 2\,A$

Circuit switches off in 1 millisecond

Or $dt = 1 \times 10^{-3}\,s$

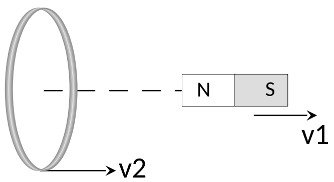
and $L = 10\,H$

$\therefore$ Induced emf in inductor is

$|e| = 10 \times \frac{2}{1 \times 10^{-3}} = 2 \times 10^4\,V$

330 **(a)**

Speed of the magnet



$v_1 = \frac{2}{1} = 2\,m/s$

Speed of the coil

$v_2 = \frac{1}{0.5} = 2\,m/s$

Relative speed between coil and magnet is zero, so there is no induced emf in the coil

331 **(b)**

According to Lenz's law

332 **(a)**

$N\phi = Li \Rightarrow L = \frac{N\phi}{i} = \frac{500 \times 4 \Rightarrow 10^{-3}}{2} = 1\,henry$

333 **(a)**

$\phi = NBA\cos\theta = 100 \times 0.2 \times 5 \times 10^{-4}\cos 60°$

¿ $5 \times 10^{-3}\,Wb$

334 **(a)**

$B = \mu_0 \ni ¿ \frac{}{2r} = \frac{4\pi \times 10^{-7} \times 100 \times 2 \times \sqrt{\pi}}{2 \times 10^{-2}} = 0.022\,wb$

335 **(b)**

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

¿ $- \frac{500 \times (0-0.1) \times 100 \times 10^{-4}\cos 0}{0.1} = 5\,V$

336 **(b)**

Energy stored in inductor

$E=\frac{1}{2}LI^2=\frac{1}{2}\times 40\times (2)^2 mJ$

= 80 mJ

337 **(c)**

According to Fleming's right hand rule, the direction of B will be perpendicular to the plane of paper and act downward

338 **(b)**

$q=\frac{N}{R}\phi=\frac{N}{R}(BA)$

$\Rightarrow B=\frac{qR}{NA}=\frac{2\times 10^{-4}\times 80}{40\times 4\times 10^{-4}}=1\, Wb\, m^{-2}$

339 **(d)**

As the coil rotated, angle θ (angle which normal to the coil makes with **B** at any instant t) changes, therefore magnetic flux ϕ linked with the coil changes and hence an emf is induced in the coil. At this instant t, if e is the emf induced in the coil, then

$e=\frac{-d\phi}{dt}=\frac{-d}{dt}(NAB\cos\omega t)$

Where N is number of turns in the coil.

or $e=-NAB\frac{d}{dt}(\cos\omega t)$

$¿-NAB(-\sin\omega t)\omega$

or $e=NAB\omega\sin\omega t$

The induced emf will be maximum

When $\sin\omega t=maximum=1$

$\therefore e_{max}=e_0=NAB\omega\times 1$

or $e=e_0\sin\omega t$

Therefore, e would be maximum, hence current is maximum (as $i_0=e_0/R¿$, when $\theta=90°$, ie, normal to plane of coil is perpendicular to the field or plane of coil is parallel to magnetic field.

340 **(d)**

As we know $e=\frac{-d\phi}{dt}=-L\frac{di}{dt}$

Work done against back e.m.f. e in time dt and current i is

$dW=-eidt=L\frac{di}{dt}idt=Li\,di\Rightarrow W=L\int_0^i i\,di=\frac{1}{2}Li^2$

341 **(b)**

Efficiency of transformer is given by

$\eta=\frac{Output\ power}{Input\ power}=\frac{E_sI_s}{E_pI_p}$

Here, $P_{output}=8\,kW,\eta=90\%$

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

342 **(a)**

$e_2=M\frac{di_1}{dt}\Rightarrow i_2R_2=M\frac{di_1}{dt}\Rightarrow 0.4\times 5=0.5\times\frac{di_1}{dt}$

$\Rightarrow\frac{di_1}{dt}=4\,A/sec$

343 **(c)**

$q=\frac{d\phi}{R}=BA¿¿$

$¿\frac{B\pi r^2(1-0)}{R}=\frac{B\pi r^2}{R}=\frac{2\times 3.143\times (10^{-1})^2}{0.01}$

$¿6.286\,C=6.3\,C$

344 **(b)**

$\frac{N_s}{N_p}=\frac{V_s}{V_p}=\frac{22000}{220}=100$

345 **(d)**

When loop enters in field between the pole pieces, flux linked with the coil first increases (constantly) so a constant emf induces. When coil enters completely within the field, there is no flux change, so $e=0$

When coil exists, flux linked with the coil decreases, hence again emf induces, but in opposite direction

347 **(b)**

Equivalent resistance of the given. Wheatstone bridge circuit (balanced) is $3\,\Omega$ so total resistance in circuit is $R=3+1=4\,\Omega$. The emf induced in the loop $e=Bvl$.

So induced current $i=\frac{e}{R}=\frac{Bvl}{R}$

$\Rightarrow 10^{-3}=\frac{2\times v\times(10\times 10^{-2})}{4}\Rightarrow v=2\,cm/sec$

348 **(b)**

The rate of change of flux or emf induced in the coil is

$e=-n\frac{d\phi}{dt}$

$\therefore$ induced current $i=\frac{e}{R'}=\frac{-n}{R'}\frac{d\phi}{dt}$

Given, $R'=R+4R=5R, d\phi=W_2-W_1, dt=t$.

(Here, W_1 and W_2 are flux associated with one turn).

Putting the given values is Eq.(i), we get

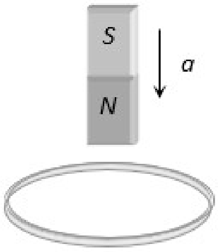
$\therefore i=\frac{-n}{5R}\frac{(W_2-W_1)}{t}$

350 **(b)**

Lenz's law of electromagnetic induction corresponds to the law of conservation of energy.

351 **(c)**

A metallic ring is attached with the wall of a room. When the north pole of a magnet is brought near to it, the induced current in the ring will be



352 **(b)**

From $i=i_0[1-e^{-RT/L}]$, where $i_0=\frac{5}{5}=1\,amp$

$\therefore i=1\left(1-e^{\frac{-5\times 2}{10}}\right)=(1-e^{-1})\,amp$

353 **(d)**

$e=\frac{-NBA(\cos\theta_2-\cos\theta_1)}{\Delta t}$

$¿-\frac{800\times 4\times 10^{-5}\times 0.05(\cos 90°-\cos 0°)}{0.1}=0.016$

354 **(a)**

If **B** =0 then

$\phi=B.A=0. if\ \phi=0\ then\ \phi=B.A=0, B$ may or may not be zero because angle between **B** and **A** may be 90°.

For same part ϕ may be positive and for remaining part, it may be negative so that the resultant ϕ becomes zero but **B** is non-zero.

355 **(c)**

When battery is disconnected current through the circuit starts decreasing exponentially according to $i=i_0e^{-Rt/L}$

$\Rightarrow 0.37\,i_0=i_0e^{-Rt/L}\Rightarrow 0.37=\frac{1}{e}=e^{-Rt/L}\Rightarrow t=\frac{L}{R}$

356 **(a)**

On moving the coils further apart initially the flux linked will reduced.

Then, according to Lenz's law current will increase in both the coils to increase the linked flux.

357 **(b)**

$e=\frac{d\phi}{dt}=\frac{d}{dt}(NBA)=NA\frac{dB}{dt}$

$= 500\times 10^{-2}\times 1=5.0$ V

358 **(c)**

At low frequency of 1 to 2 Hz, oscillations may be observed as our eyes will be able to detect it

359 **(b)**

From Faraday's law, induced emf is

$e=\frac{-d\phi}{dt}$

Given , $\phi=Xt^2$

$\therefore e=\frac{-d(Xt^2)}{dt}=-2tX$

Given, $t=3, e=9\,V$

$\therefore X=\frac{9}{3\times 2}=1.5\,Wb\,s^{-2}$

360 **(b)**

Effective length between A and B remains same

361 **(d)**

Induced emf, $|e|=L\frac{di}{dt}$

$¿(60\times 10^{-3})\times\frac{(1.5-1)}{0.1}$

$¿\frac{60\times 10^{-3}\times 0.5}{0.1}$

= 0.3 V

Induced current,

$i=\frac{e}{R}=\frac{0.3}{3}=0.1\,A$

362 **(d)**

$v=180\,km\,h^{-1}=\frac{180\times 1000}{60\times 60}=50\,m\,s^{-1}$

$l=1\,m, B=0.2\times 10^{-4}\,Wb\,m^{-2}$

$e=Blv=002\times 10^{-4}\times 1\times 50=10^{-3}$V=1mV

363 **(b)**

$\phi=\mu_0 niA=4\pi\times 10^{-7}\times\frac{3000}{1.5}\times 2\times\pi(2\times 10^{-2})^2$

$¿6.31\times 10^{-6}\,Wb$

364 **(c)**

Horizontal conductor intercepts vertical component $¿B_0\sin\delta$

$\therefore e=(B_0\sin\delta)lv$

365 **(a)**

$\phi=BA$

$\Rightarrow$ change in flux $d\phi=BdA=0.05(101-100)10^{-4}$

$¿5\times 10^{-6}\,Wb$

Now, charge $dQ=\frac{d\phi}{R}=\frac{5\times 10^{-6}}{2}=2.5\times 10^{-6}\,C$

366 **(d)**

During decay of current

$$i = i_0 e^{\frac{-Rt}{L}} = \frac{E}{R} e^{\frac{-Rt}{L}} = \frac{100}{100} e^{\frac{-100\times10^{-3}}{100\times10^{-3}}} = \frac{1}{e} A$$

367 **(d)**

Peak value of induced emf in a rectangular coil is

$e = nBA\omega\sin\theta$

¿ $300\times4\times10^{-2}\times(25\times10\times10^{-4})\times(2\pi\times50)\times$ sir

¿ $30\pi V$

368 **(d)**

$$M = \frac{\mu_0 N_1 \times N_2 \times A}{l}$$

Where, N_1=300 turns, N_2=400 turns, $A = 10\,cm^2$ and l=20cm.

Substituting the values in the given formula, we get

$M = 2.4\pi\times10^{-4} H$

369 **(b)**

$$\frac{V_p}{V_s} = \frac{i_s}{i_p} \Rightarrow i_s = 4\times\frac{140}{280} = 2A$$

370 **(c)**

$V_P = 220V, V_S = 2200V, I_P = 5A, I_S = ?$

Power loss=50%

Efficiency of transformer (η) is defined as the ratio of output power and input power.

$$ie, \eta\% = \frac{P_{out}}{P_{¿}}\times100 = \frac{V_S I_S}{V_P I_P}\times100$$

$$50 = \frac{2200\times I_S}{220\times5}\times100$$

$I_S = 0.25A$

371 **(c)**

According to $i - t$ graph, in the first half current is increasing uniformly so a constant negative emf induces in the circuit

In the second half current is decreasing uniformly so a constant positive emf induces

Hence graph (c) is correct

372 **(b)**

Given, $L = 0.04H, R = 12\Omega, V = 220$volt and $f = 50Hz$

The value of current

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

Or $$I = \frac{V}{\sqrt{R^2 + (\omega L)^2}}$$

Or $$I = \frac{V}{\sqrt{R^2 + (2\pi f L)^2}}$$

Or $$I = \frac{220}{\sqrt{144 + (2\pi\times50\times0.04)^2}}$$

Or $I = 12.7A$

373 **(c)**

$L = \mu_0 \frac{N^2}{l} A$. When N and l are doubled L is also doubled

374 **(a)**

$$dQ = \frac{d\phi}{R} = \frac{nAdB}{R} = \frac{100\times1\times10^{-3}\times2}{10} = 2\times10^{-2} C$$

375 **(b)**

$$\varepsilon \propto -\frac{di}{dt}$$

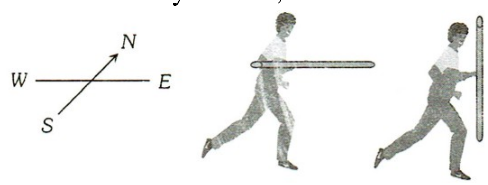
376 **(b)**

If player in running with rod in vertical position towards east, then rod cuts the magnetic field of earth perpendicularly (magnetic field of earth is south to north).

Hence Maximum emf induced is

$$e = Bvl - 4\times10^{-5}\times\frac{30\times1000}{3600}\times3 = 1\times10^{-3} volt$$

When he is running with rod in horizontal position, no field is cut by the rod, so $e = 0$



377 **(b)**

$$|e| = A.\frac{\Delta B}{\Delta t} = 2\times\frac{(4-1)}{2} = 3V$$

378 **(c)**

Amplitude of the current

$$i_0 = \frac{e_0}{R} = \frac{\omega NBA}{R} = \frac{2\pi\nu NB(\pi r^2)}{R}$$

$$i_0 = \frac{2\pi\times1\times10^{-2}\times\pi(0.3)^2}{\pi^2} = 6\times10^{-3}A = 6mA$$

379 **(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.

380 **(d)**

By Fleming's right hand rule

381 **(a)**

$$\Delta\phi = L\Delta I \Rightarrow L = \frac{\Delta\phi}{\Delta I} = \frac{2\times10^{-2}}{0.01} = 2H$$

382 **(a)**

$\phi = Li \Rightarrow NBA = Li$

Since magnetic field at the centre of circular coil carrying current is given by $B=\frac{\mu_0}{4\pi}.\frac{2\pi Ni}{r}$

$\therefore N.\frac{\mu_0}{4\pi}.\frac{2\pi Ni}{r}.\pi r^2=Li \Rightarrow L=\frac{\mu_0 N^2 \pi r}{2}$

Hence self inductance of a coil

¿ $\frac{4\pi\times10^{-7}\times500\times500\times\pi\times0.05}{2}=25\,mH$

384 **(c)**

According to Lenz's Law

385 **(b)**

$P=Fv=Bil\times v=B\left(\frac{Bvl}{R}\right)l\times v=\frac{B^2v^2l^2}{R}\Rightarrow P\propto v^2$

386 **(b)**

Induced emf in the coil is given by

$e=\frac{L\,dI}{dt}$

Or $e=10\times\frac{(10-5)}{0.2}$

$\Rightarrow e=250\,V$

388 **(b)**

$\frac{V_p}{V_s}=\frac{N_p}{N_s}=\frac{500}{2500}=\frac{1}{5}\Rightarrow V_p=\frac{200}{5}=40\,V$

Also $i_pV_p=i_sV_s\Rightarrow i_p=i_s\frac{V_s}{V_p}=8\times5=40\,A$

389 **(b)**

$e=\frac{d\phi}{dt}=\frac{(NBA\,cos\theta-0)}{t}$

¿ $\frac{1\times0.5\times25\times10^{-4}\cos60°-0}{0.2}$

$e=3.12\times10^{-3}$ V.

390 **(c)**

As per Faraday's Law of electromagnetic induction

$EMF=\frac{change \in flux}{time}=\frac{8\times10^{-4}\,Wb}{0.5\,sec}$

¿ $16\times10^{-4}\,volt=1.6\,mV$

393 **(c)**

Given; $\frac{N_P}{N_S}=\frac{1}{25}, V_P=230\,V, I_s=2\,A$

For an ideal transformer

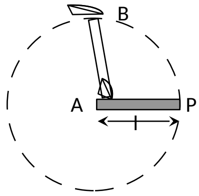
$\frac{N_P}{N_S}=\frac{V_P}{V_S}=\frac{I_S}{I_P}\vee\frac{N_P}{N_S}=\frac{I_S}{I_P}$

Or $I_P=I_S\times\frac{N_P}{N_S}=2\,A\times\frac{25}{1}=50\,A$

395 **(a)**

If in time t, the rod turns by an angle θ, the area generated by the rotation of rod will be

¿ $\frac{1}{2}l\times l\theta=\frac{1}{2}l^2\theta$



So the flux linked with the area generated by the rotation of rod

$\phi=B\left(\frac{1}{2}l^2\theta\right)\cos0=\frac{1}{2}Bl^2\theta=\frac{1}{2}Bl^2\omega t$

And so $e=\frac{d\phi}{dt}=\frac{d}{dt}\left(\frac{1}{2}Bl^2\omega t\right)=\frac{1}{2}Bl^2\omega$

396 **(d)**

Emf is induced in the ring and it opposes the motion. Hence due to the resistance of the ring all energy dissipates

397 **(b)**

$\Delta Q=\frac{NBA}{R}(\cos\theta_1-\cos\theta_2)$

¿ $\frac{500\times0.2\times0.1(\cos0-\cos180)}{50}=0.4\,C$

398 **(c)**

$e=-L\frac{di}{dt}\Rightarrow e=5\times\frac{1}{5}=1\,volt$

399 **(b)**

Maximum energy stored in the capacitor

$U_{max}=\frac{Q^2}{2C}$

The energy is stored equally in electric and magnetic fields

So, energy in electric field

$E=\frac{1}{2}\left(\frac{Q^2}{2C}\right)$

Now, $\frac{Q'^2}{2C}=\frac{1}{2}\frac{Q^2}{2C}$

$\Rightarrow Q'=\frac{Q}{\sqrt{2}}$

400 **(b)**

$e=-M\frac{di}{dt}=-5\times\frac{(-5)}{10^{-3}}=25000\,V$

401 **(d)**

Energy stored in a self-inductor, $E=\frac{1}{2}Li^2$

¿ $\frac{1}{2}\times200\times10^{-3}[4]^2=1.6\,J$

402 **(d)**

At B, flux is maximum, so from $|e|=\frac{d\phi}{dt}$ at $B|e|=0$

403 **(d)**

$$L=\frac{e}{di/dt}=\frac{5}{(3-2)/10^{-3}}=\frac{5}{1}\times 10^{-3}=5\,milli\,henry$$

404 **(b)**

When ring enters and leaves the field polarity of induced emf is opposite. Also during the stay of ring completely in the field there is no induction

405 **(a)**

$M=K\sqrt{L_1L_2}$

For perfect coupling $K=1$

$M_{12}=M_{21}$

406 **(a)**

Given, $B=0.30\times10^{-4}\,Wbm^{-2}, l=10\,m$ and $v=5.0\,ms^{-1}$

The induced potential gradient

$V=Bvl$

$V=-0.30\times10^{-4}\times5\times10$

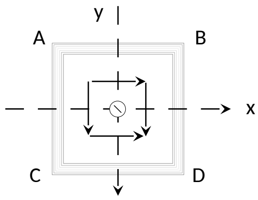
$V=-1.5\times10^{-3}\,Vm^{-1}$

From west to east,

$V=+1.5\times10^{-3}\,Vm^{-1}$

409 **(d)**

Magnetic lines are tangential to the coil as shown in figure. Thus net magnetic flux passing through the coil is always zero or the induced current will be zero



410 **(c)**

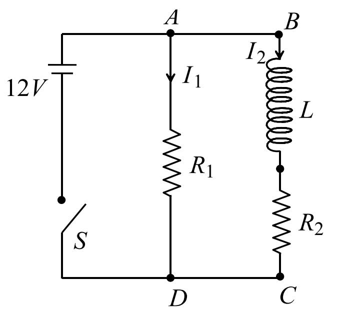
$e=Bvl \Rightarrow e\propto v\propto >$¿

411 **(b)**

$$L=\frac{e}{di/dt}=\frac{12}{48/60}=15\,H$$

412 **(d)**

E(across BC) ¿ $L\frac{dI_2}{dt}+R_2I_2$



$I_2=I_0(1-e^{-t/t_0})$

$$I_0=\frac{E}{R_2}=\frac{12}{2}=6\,A$$

$$\tau=t_0=\frac{L}{R}=\frac{400\times10^{-4}}{2\,\Omega}=0.2\,S$$

$\therefore I_2=6(1-e^{-t/0.2})$

Potential drop areas $L=E-R_2I_2$

¿ $12-2\times6(1-e^{-t/0.2})$

¿ $12e^{-t/0.2}=12e^{-5t}\,V$

413 **(c)**

$$i=i_0\left(1-e^{\frac{-Rt}{L}}\right)\Rightarrow\frac{di}{dt}=\frac{d}{dt}i_0-\frac{d}{dt}i_0e^{\frac{-Rt}{L}}$$

$$\Rightarrow\frac{di}{dt}=0-i_0\left(\frac{-R}{L}\right)e^{\frac{-Rt}{L}}=\frac{i_0R}{L}e^{\frac{-Rt}{L}}$$

Initially, $t=0\Rightarrow\frac{di}{dt}=\frac{i_0\times R}{L}=\frac{E}{L}=\frac{5}{2}=2.5\,amp/sec$

414 **(a)**

$$i=\frac{e}{R}=\frac{A}{R}\cdot\frac{dB}{dt}=\frac{(1\times10^{-2})^2}{16}\times20\times10^{-3}=1.25\times10$$

(Anti-clockwise)

415 **(b)**

For 100% efficiency $V_si_s=V_pi_p$

$\Rightarrow1100\times2=220\times i_p\Rightarrow i_p=10\,A$

416 **(d)**

Induced emf is given by

$e=BvI\sin\theta=0.1\times10\times4\sin30°=2\,volt$

417 **(a)**

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

$$\Rightarrow0.1=\frac{-50\times(0-2\times10^{-2})\times100\times10^{-4}\times\cos0°}{t}$$

$\Rightarrow t=0.1\,sec$

420 **(d)**

$L\propto N^2$

422 **(a)**

$$\frac{N_s}{N_p}=\frac{V_s}{V_p}\Rightarrow\frac{200}{100}=\frac{V_s}{120}\Rightarrow V_s=240\,V$$

Also $\frac{V_s}{V_p}=\frac{i_p}{i_s}\Rightarrow\frac{240}{120}=\frac{10}{i_s}\Rightarrow i_s=5\,A$

423 **(d)**

$$N\phi=Li\Rightarrow\frac{Nd\phi}{dt}=\frac{Ldi}{dt}\Rightarrow NB\frac{dA}{dt}=\frac{Ldi}{dt}$$

$$\Rightarrow\frac{1\times1\times5}{10^{-3}}=L\times\left(\frac{2-1}{2\times10^{-3}}\right)\Rightarrow L=10\,H$$

424 **(d)**

$e=200\sin100\pi t$

We have,

$e_0=200$,

$\omega=100\pi$

$\therefore BAN\omega=e_0$

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

$¿\frac{200}{(0.25\times0.25)\times1000\times100\pi}$

Or $B=0.01\,T$

426 **(b)**

The induction coil works on the principle of mutual induction.

428 **(c)**

$M=\frac{-e_2}{di_1/dt}=\frac{-e^2}{di_2/dt}$

Also $e_1=-L_1\frac{di_1}{dt}.e_2=-L_2\frac{di_2}{dt}$

$M^2=\frac{e_1e_2}{\left(\frac{di_1}{dt}\right)\left(\frac{di_2}{dt}\right)}=L_1L_2\Rightarrow M=\sqrt{L_1L_2}$

429 **(a)**

Back emf ∝ speed of motor

431 **(c)**

When loop is entering in the field, magnitude flux linked with the loop increases so induced emf in it

$e=Bvl=0.6\times10^{-2}\times5\times10^{-2}=3\times10^{-4}V$ (Negative).

When loop completely enters in the field (after $5\,sec$) flux linked with the loop remains constant, so $e=0$.

After $15\,sec$, loop begins to exist, linked magnetic flux decreases so induced emf $e=3\times10^{-4}V$ (Positive)

432 **(c)**

Given, magnetic flux, $\phi=5t^2+2t+3$

The value of induced emf $\frac{d\phi}{dt}=10t+2$

At $t=1$

The value of induced emf $\frac{d\phi}{dt}=12\,V$

433 **(a)**

$L\propto N^2$

435 **(b)**

There will be self induction effect when soft iron core is inserted

436 **(a)**

Magnetic flux linked with the ring changes so current flows through it

439 **(d)**

$V=-L\frac{di}{dt}$

Here $\frac{di}{dt}$ +ve for $\frac{T}{2}$ time and

$\frac{di}{dt}$ is -ve for next $\frac{T}{2}$ time

440 **(c)**

Time period of LC circuit oscillations

$T=2\pi\sqrt{LC}\Rightarrow$ dimensions of $\sqrt{LC}$ is time

441 **(d)**

$V_p=200\,V, V_s=6\,V$

$P_{out}=V_si_s\Rightarrow30=6\times i_s\Rightarrow i_s=5\,A$

From $\frac{V_s}{V_p}=\frac{i_p}{i_s}\Rightarrow\frac{6}{200}=\frac{i_p}{5}\Rightarrow i_p=0.15\,A$

442 **(b)**

Two coils are said to be magnetically coupled if full or a part of the flux produced by one links with the other. Let $L_1\wedge L_2$be the self- inductances of the coils and M be their mutual inductances, then

$k=\frac{M}{\sqrt{L_1L_2}}$

When 100% flux produced by one coil links with the other, then mutual inductance between the two is maximum and is given by

$M=\sqrt{L_1L_2}$

In that case, $k=1(unity)$