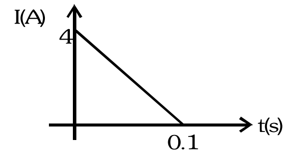
ELECTROMAGNETIC INDUCTION & A.C.

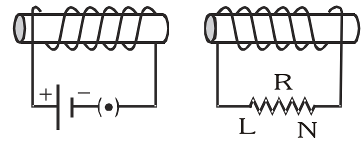
<u>Select the correct alternative (only one correct answer)</u>

1. When magnetic flux through a coil is changed, the variation of induced current in the coil with time is as shown in graph. If resistance of coil is 10 Ω, then the total change in flux of coil will be–



(A) 4 (B) 8
(C) 2 (D) 6

2. Two co–axial solenoids shown in figure. If key of primary suddenly opened then direction of instantaneous induced current in resistance 'R' which connected in secondary :–



(A) L to N (B) N to L
(C) alternating (D) zero

3. A coil having 500 square loops each of side 10 cm is placed normal to a magnetic field which increased at a rate of 1.0 T/sec. The induced e.m.f. (in volt) is :–

(A) 0.1 (B) 0.5 (C) 1.0 (D) 5.0

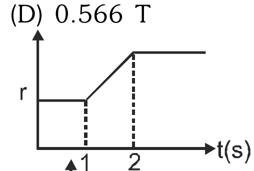
4. The magnetic field in a coil of 100 turns and 40 cm^2 an area is increased from 1 tesla to 6 tesla in 2 second. The magnetic field is perpendicular to the coil. The e.m.f. generated in it is :–

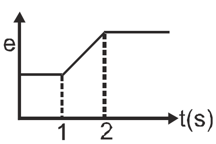
(A) 10^4 V (B) 1.2 V (C) 1.0 V (D) 10^{-2} V

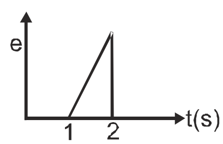
5. One coil of resistance 40Ω is connected to a galvanometer of 160Ω resistance. The coil has radius 6mm and turns 100. This coil is placed between the poles of a magnet such that magnetic field is perpendicular to coil. If coil is dragged out then the charge through the galvanometer is 32μC. The magnetic field is :–

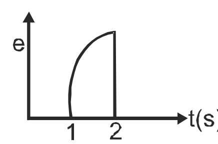
(A) 6.55 T (B) 5.66 T (C) 0.655 T (D) 0.566 T

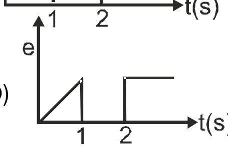
6. A flexible wire bent in the form of a circle is placed in a uniform magnetic field perpendicular to the plane of the coil. The radius of the coil changes with time as shown figure. The induced emf in the coil is :



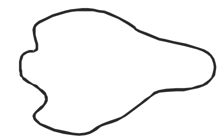
(A) 

(B) 

(C) 

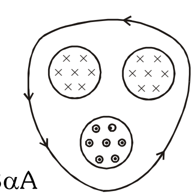
(D) 

7. As a result of change in the magnetic flux linked to the closed loop shown in the figure, an e.m.f. . V volt is induced in the loop. The work done (joules) in taking a charge Q coulomb once along the loop is :–



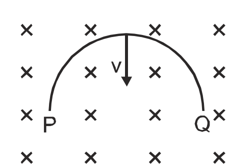
(A) QV (B) zero (C) 2QV (D) QV/2

8. Figure shows three regions of magnetic field, each of area A, and in each region magnitude of magnetic field decreases at a constant rate α. If $\vec{E}$ is induced electric field then value of line integral $\oint \vec{E}.d\vec{r}$ along the given loop is equal to–



(A) αA (B) $-\alpha$A (C) 3αA (D) -3αA

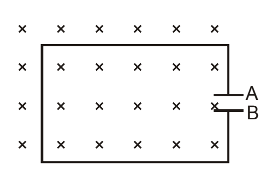
9. A semicircle loop PQ of radius 'R' is moved with velocity 'v' in transverse magnetic field as shown in figure. The value of induced emf. across the ends PQ of the loop is



(A) Bv (πr), end 'P' at high potential (B) 2 BRv, end P at high potential

(C) 2 BRv, end Q at high potential (D) $B\frac{\pi R^2}{2}$ v, end P at high potential

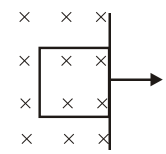
10. In the given figure if the magnetic field, which is perpendicular to the plane of the paper in the inward direction increases, then–



(A) Plate B of the capacitor will become positively charged
(B) Plate A of the capacitor will become positively charged.
(C) The capacitor will not be charged.
(D) Both plates will be charged alternately.

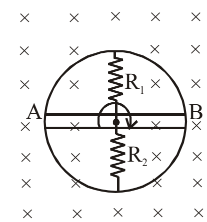
11. Two identical cycle wheels (geometrically) have different number of spokes connected from centre to rim. One is having 20 spokes and other having only 10(the rim and the spokes are resistanceless). One resistance of value R is connected between centre and rim. The current in R will be–
(A) double in first wheel than in the second wheel
(B) four times in first wheel than in the second wheel
(C) will be double in second wheel than that of the first wheel
(D) will be equal in both these wheels

12. A square loop of area $2.5\quad 10^{-3}m^2$ and having 100 turns with a total resistance of $100\ \Omega$ is moved out of a uniform magnetic field of 0.40 T in 1 sec with a constant speed. Then work done, in pulling the loop is–



(A) zero (B) 1 mJ (C) 1 μJ (D) 0.1 mJ

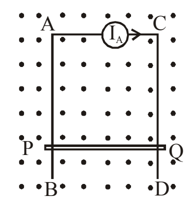
13. AB is resistanceless conducting rod which forms a diameter of a conducting ring of radius r rotating in a uniform magnetic field B as shown. The resistors R_1 and R_2 do not rotate. Then current through the resistor R_1 is–



(A) $\frac{B\omega r^2}{2R_1}$ (B) $\frac{B\omega r^2}{2R_2}$

(C) $\frac{B\omega r^2}{2R_1R_2}(R_1+R_2)$ (D) $\frac{B\omega r^2}{2(R_1+R_2)}$

14. AB and CD are fixed conducting smooth rails placed in a vertical plane and joined by a constant current source at its upper end. PQ is a conducting rod which is free to slide on the rails. A horizontal uniform magnetic field exists in space as shown. If the rod PQ in released from rest then,



(A) The rod PQ will move downward with constant acceleration
(B) The rod PQ will move upward with constant acceleration
(C) The rod will move downward with decreasing acceleration and finally acquire a constant velocity
(D) Either A or B

15. 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) NABRω (B) NAB (C) NABR (D) NABω

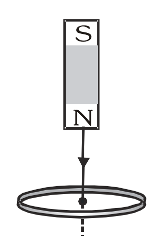
16. When the current changes from +2A to – 2A in 0.05 s, an emf of 8V is induced in a coil. The coefficient of self–induction of the coil is–
(A) 0.2 H (B) 0.4 H (C) 0.8 H (D) 0.1 H

17. Two identical circular coils A and B are placed parallel to each other with their centres on the same axis. The coil B carries a current I in the clock wise direction as seen from A. What would be the direction of the induced current in A seen from B when (i) The current in B is increased (ii) The coil B is moved towards A keeping the current in B constant
(A) clockwise, clockwise (B) clockwise, anti clockwise
(C) anti clockwise, clockwise (D) anti clockwise, anti clockwise

18. A rectangular loop of sides 'a' and 'b' is placed in xy plane. A very long wire is also placed in xy plane such that sides of length 'a' of the loop is parallel to the wire. The distance between the wire and the nearest edge of the loop is 'd'. The mutual inductance of this system is proportional to–
(A) a (B) b (C) 1/d (D) current in wire

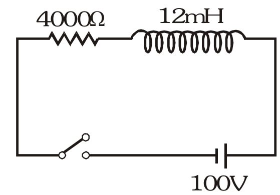
19. For a inductor coil L = 0.04 H then work done by source to establish a current of 5A in it is :–
(A) 0.5 J (B) 1.00 J (C) 100 J (D) 20 J

20. Consider a metal ring kept on a horizontal plane. A bar magnet is held above the ring with its length along the axis of the ring. If the magnet is dropped freely the acceleration of the falling magnet is (g is acceleration due to gravity)



(A) more than g (B) equal to g
(C) less than g (D) depend on mass of magnet

21. In the inductive circuit given in fig. the current rises after the switch is closed. At instant, when the current is 15 mA. Then potential difference across the inductor is :–



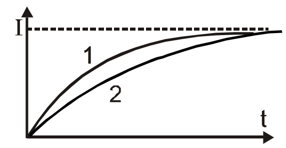
(A) 40 V (B) 80 V

(C) 160 V (D) 0

22 The time constant of an inductance coil is $2.0 \quad 10^{-3}$ s. When a 90 Ω resistance is joined in series, the time constant becomes $0.5 \quad 10^{-3}$ s. The inductance and resistance of the coil are :–

(A) 30 mH ; 30 Ω (B) 30 mH ; 60Ω (C) 60 mH ; 30Ω (D) 60mH ; 60Ω

23. When a certain circuit consisting of a constant emf 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, Lor R) is changed, the increase in current follows curve 2 when the circuit is closed second time. Which parameter was changed :–



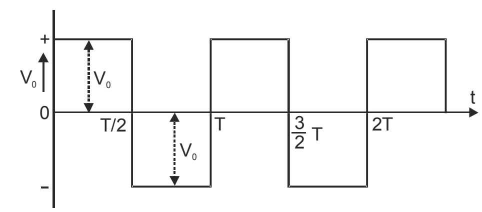
(A) L is increased (B) L is decreased

(C) R is increased (D) R is decreased

24. A coil of inductance 300 mH and resistance 2Ω is connected to a source of voltage 2V. The current reaches half of its steady state value in–

(A) 0.05 s (B) 0.1 s (C) 0.15 s (D) 0.3 s

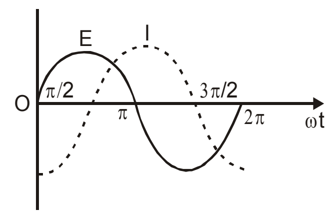
25. The average and rms value of voltage for square wave shown in fig. having peak value V_0 –



(A) $\frac{V_0}{\sqrt{2}}, \sqrt{2}V_0$ (B) $\sqrt{2}V_0, \frac{V_0}{\sqrt{2}}$

(C) V_0, V_0 (D) Zero, V_0

26. The variation of the instantaneous current (I) and the instantaneous emf (E) in a circuit is as shown in fig. Which of the following statements is correct –



(A) The voltage lags behind the current by π/2

(B) The voltage leads the current by π/2

(C) The voltage and the current are in phase

(D) The voltage leads the current by π

27. The current in a circuit varies with time as $I = 2\sqrt{t}$. Then the rms value of the current for the interval t = 2 to t = 4 sec is

(A) $\sqrt{3}$A (B) $2\sqrt{3}$A (C) $\sqrt{3}/2$A (D) $(4-2\sqrt{2})$ A 7

28. In ac circuit when ac ammeter is connected it reads i current if a student uses dc ammeter in plane of ac ammeter the reading in the dc ammeter will be

(A) $\frac{i}{\sqrt{2}}$ (B) $\sqrt{2}i$ (C) 0.637 i (D) zero

29. An AC current is given by $I = I_0 + I_1 \sin \omega t$ then its rms value will be

(A) $\sqrt{I_0^2 + 0.5I_1^2}$ (B) $\sqrt{I_0^2 + 0.5I_0^2}$ (C) 0 (D) $\frac{I_0}{\sqrt{2}}$

30. Alternating current is flowing in inductance L and resistance R. The frequency of source is $\frac{\omega}{2\pi}$. Which of the following statement is correct :–

(A) for low frequency the limiting value of impedance is L.

(B) for high frequency the limiting value of impedance is Lω.

(C) for high frequency the limiting value of impedance is R.

(D) for low frequency the limiting value of impedance is Lω.

31. The self inductance of a choke coil is 10 mH. when it is connected with a 10 V D.C. source, then the loss of power is 20 watt. When it is connected with 10 volt A.C. source loss of power is 10 watt. The frequency of A.C. source will be :–

(A) 50 Hz (B) 60 Hz (C) 80 Hz (D) 100 Hz

32. In an A.C. circuit capacitance of 5μF has a reactance as 1000 Ω. The frequency of A.C. will be :–

(A) $\frac{1000}{\pi}$ cycle/s (B) $\frac{100}{\pi}$ cycle/s (C) 200 cycle/s (D) 5000 cycle/s

33. A capacitor of capacitance 100 μF and a resistance of 100Ω is connected in series with AC supply of 220V, 50Hz. The current leads the voltage by :–

(A) $\tan^{-1}\left(\frac{1}{2\pi}\right)$ (B) $\tan^{-1}\left(\frac{1}{\pi}\right)$ (C) $\tan^{-1}\left(\frac{2}{\pi}\right)$ (D) $\tan^{-1}\left(\frac{4}{\pi}\right)$

34. In an AC Circuit decrease in impedance with increase in frequency is indicates that circuit has/have :–

(A) only resistance. (B) resistance and inductance.
(C) resistance and capacitance (D) resistance, capacitance and inductance.

35. 200 Ω resistance and 1H inductance are connected in series with an A.C. circuit. The frequency of the source is $\frac{200}{2\pi}$ Hz. Then phase difference in between V and I will be :–

(A) 30 (B) 60 (C) 45 (D) 90

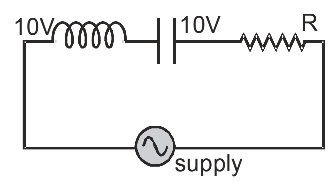
36. The phase difference between current and voltage in an AC circuit is $\frac{\pi}{4}$ radian, If the frequency of AC is 50 Hz, then the phase difference is equivalent to the time difference :–

(A) 0.78 s (B) 15.7 ms (C) 2.5 s (D) 2.5 ms

37. A student connects a long air cored – coil of magnanin wire to a 100 V D.C. supply and records a current of 25 amp. When the same coil is connected across 100 V. 50 Hz A.C. the current reduces to 20 A , the reactance of the coil is :–

(A) 4 Ω (B) 3 Ω (C) 5 Ω (D) None

38. If value of R is changed, then :–



(A) voltage across L remains same
(B) voltage across C remains same
(C) voltage across LC combination remains same
(D) voltage across LC combination changes

39. In a circuit L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45 . The value of C is :–

(A) $\frac{1}{2\pi f(2\pi f L - R)}$ (B) $\frac{1}{2\pi f(2\pi f L + R)}$ (C) $\frac{1}{\pi f(2\pi f L - R)}$ (D) $\frac{1}{\pi f(2\pi f L + R)}$

40. In an LCR series ac circuit, the voltage across each of the components. L, C and R is 50 V. The voltage across the LC combination will be–

(A) 50 V (B) $50\sqrt{2}$ V (C) 100 V (D) 0

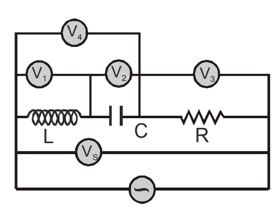
41. In an LCR circuit, capacitance is changed from C to 2C. For the resonant frequency to remain unchanged, the inductance should be changed from L to–

(A) 4 L (B) 2L (C) L/2 (D) L/4

42. In a series resonant LCR circuit, the voltage across R is 100 volts and R = 1 kΩ with C = 2μF. The resonant frequency ω is 200 rad/s. At resonance the voltage across L is–

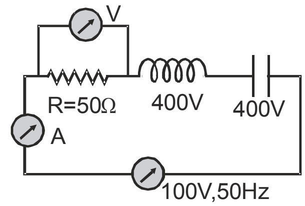
(A) 2.5 10^{-2} V (B) 40 V (C) 250 V (D) 4 10^{-3} V

43. In the adjoining A.C. circuit the voltmeter whose reading will be zero at resonance is :–



(A) V_1
(B) V_2
(C) V_3
(D) V_4

44. In given LCR circuit, the voltage across the terminals of a resistance and current will be :–

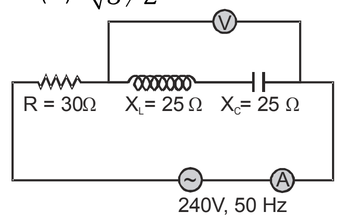


(A) 400V, 2A
(B) 800V, 2A
(C) 100V, 2A
(D) 100V, 4A

45. An ac source of angular frequency ω is fed across a resistor R and a capacitor C in series. The current registered is I. If now the frequency of source is changed to ω/3 (but maintaining the same voltage), the current in the circuit is found to be halved. Then the ratio of reactance to resistance at the original frequency ω is :

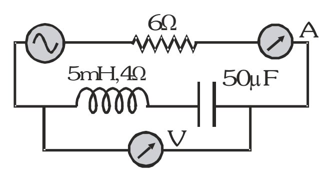
(A) $\sqrt{3/5}$ (B) $\sqrt{5/3}$ (C) $\sqrt{2/3}$ (D) $\sqrt{3/2}$

46. In the circuit shown in the figure, neglecting source resistance, the voltmeter and ammeter readings will respectively be–



(A) 0 V, 8 A
(B) 150 V, 8 A
(C) 150 V, 3 A
(D) 0 V, 3 A

47. In the circuit shown in the figure, the A.C. source gives a voltage V = 20 cos (2000 t) volt neglecting source resistance, the voltmeter and ammeter readings will be :–



(A) 0V, 1.4A
(B) 5.6V, 1.4A
(C) 0V, 0.47 A
(D) 1.68 V, 0.47 A

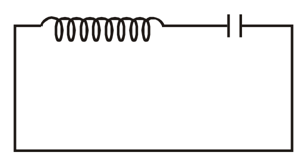
48. In an AC circuit the voltage applied is $E = E_0 \sin\omega t$. The resulting current in the circuit is $I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$. The power consumption in the circuit is given by :–

(A) $P=\frac{E_0 I_0}{\sqrt{2}}$ (B) P=zero (C) $P=\frac{E_0 I_0}{2}$ (D) $P=\sqrt{2}\, E_0 I_0$

49. A coil has an inductance of 0.7 henry and is joined in series with a resistance of 220 Ω. When the alternating emf of 220 V at 50 Hz is applied to it then the phase through which current lags behind the applied emf and the wattless component of maximum current in the circuit will be respectively :–

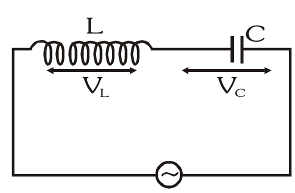
(A) 30 , 1 A (B) 45 , 0.5 A (C) 60 , 1.5 A (D) None of these

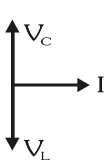
50. In an LC circuit, the capacitor has maximum charge q_0. The value of $\left.\frac{di}{dt}\right|_{max}$ is

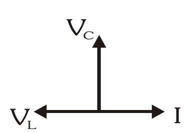


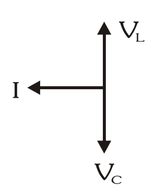
(A) $\frac{q_0}{LC}$ (B) $\frac{q_0}{\sqrt{LC}}$ (C) $\frac{q_0}{LC}-1$ (D) None of these

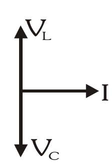
51. The current I, potential difference V_L across the inductor and potential difference V_C across the capacitor in circuit as shown in the figure are best represented vectorially as :–



(A) 

(B) 

(C) 

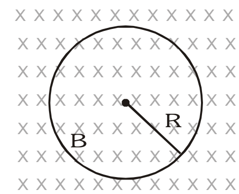
(D) 

52. In an oscillating LC 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 fields is–

(A) Q/2 (B) $Q/\sqrt{3}$ (C) $Q/\sqrt{2}$ (D) Q

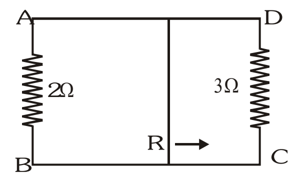
53. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon–
(A) the rates at which currents are changing in the two coils
(B) relative position and orientation of the two coils
(C) the materials of the wires of the coils
(D) the currents in the two coils

54. A conductor loop of radius R is present in a uniform magnetic field B perpendicular the plane of the ring. If radius R varies as a function of time 't', as $R = R_0 + t$. The e.m.f. induced in the loop is



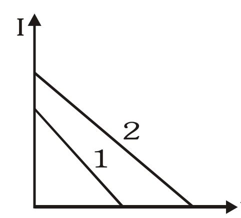
(A) $2\pi(R_0 + t)$ B clockwise
(B) $\pi(R_0 + t)$B clockwise
(C) $2\pi(R_0 + t)$ B anticlockwise
(D) zero

55. A rectangular loop with a sliding connector of length 10 cm is situated in uniform magnetic field perpendicular to plane of loop. The magnetic induction is 0.1 tesla and resistance of connector (R) is 1 ohm. The sides AB and CD have resistances 2 ohm and 3 ohm respectively. Find the current in the connector during its motion with constant velocity one metre / sec.



(A) $\frac{1}{110}$A
(B) $\frac{1}{220}$A
(C) $\frac{1}{55}$A
(D) $\frac{1}{440}$A

56. Two identical inductance carry currents that vary with time according to linear laws (as shown in figure). In which of two inductance is the self induction emf greater?



(A) 1
(B) 2
(C) same
(D) data are insufficient to decide

57. L,C and R represent physical quantities inductance, capacitance and resistance. The combination which has the dimensions of frequency is

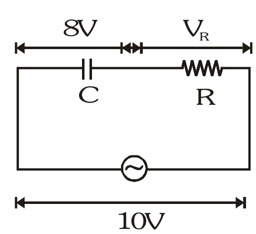
(A) $\frac{1}{RC}$ and $\frac{R}{L}$
(B) $\frac{1}{\sqrt{RC}}$ and $\sqrt{\frac{R}{L}}$
(C) $\sqrt{LC}$
(D) $\frac{C}{L}$

58. An inductor coil stores U energy when i current is passed through it and dissipates energy at the rate of P. The time constant of the circuit, when this coil is connected across a battery of zero internal resistance is

(A) $\frac{4U}{P}$
(B) $\frac{U}{P}$
(C) $\frac{2U}{P}$
(D) $\frac{2P}{U}$

59. In a series CR circuit shown in figure, the applied voltage is 10V and the voltage

voltage across capacitor is found to be 8V. then the voltage across R, and the phase difference between current and the applied voltage will respectively be



(A) 6V, $\tan^{-1}\left(\frac{4}{3}\right)$
(B) 3V, $\tan^{-1}\left(\frac{3}{4}\right)$
(C) 6V, $\tan^{-1}\left(\frac{5}{3}\right)$
(D) None

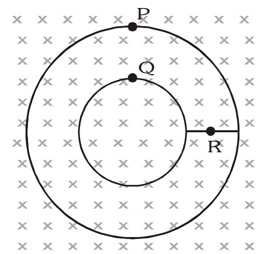
60. The effective value of current $i = 2 \sin 100\pi\, t + 2 \sin (100\pi t + 30)$ is

(A) $\sqrt{2}$A
(B) $2\sqrt{2+\sqrt{3}}$
(C) 4
(D) None

61. In series LR circuit X_L=3R and R is resistance. Now a capacitor with X_C = R is added in series. Ratio of new to old power factor is

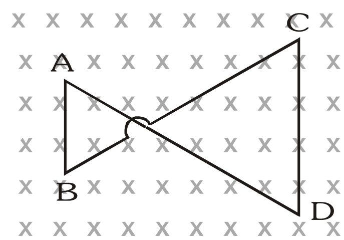
(A) 1 (B) 2 (C) $\frac{1}{\sqrt{2}}$ (D) $\sqrt{2}$

62. Figure shows plane figure made of a conductor located in a magnetic field along the inward normal to the plane of the figure. The magnetic field starts diminishing. Then select incorrect statement.



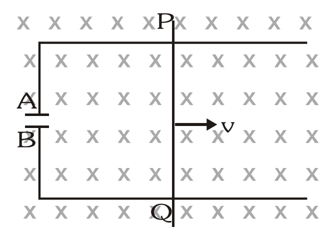
(A) the induced current at point P is clockwise
(B) the induced current at point Q is anticlockwise
(C) the induced current at point Q is clockwise
(D) the induced current at point R is zero

63. A conducting wire frame is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a constant rate. The directions of induced currents in wires AB and CD are



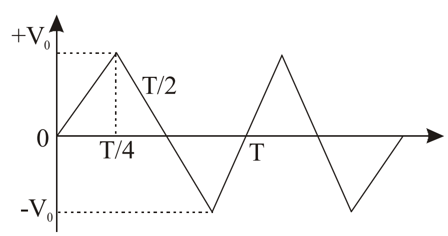
(A) B to A and D to C (B) A to B and C to D
(C) A to B and D to C (D) B to A and C to D

64. A conducting rod PQ of length L = 1.0 m is moving with a uniform speed v = 20 m/s in a uniform magnetic field B = 4.0 T directed into the paper. A capacitor of capacity C = 10 μF is connected as shown in figure. Then



(A) q_A = + 800 μC and q_B = - 800 μC
(B) q_A = - 800 μC and q_B = + 800 μC
(C) q_A = 0 = q_B
(D) charge stored in the capacitor increases exponentially with time

65. The voltage time (V–t) graph for triangle wave having peak value. V_0 is as shown in figure : The rms value of V in time interval from t = 0 to T/4 is



(A) $\frac{V_0}{\sqrt{3}}$ (B) $\frac{V_0}{2}$ (C) $\frac{V_0}{\sqrt{2}}$ (D) None of these

ANSWER KEY — LEVEL 1

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	A	D	C	D	B	A	B	C	A	D	D	A	D	D	D	A	A	B	C
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	A	C	A	B	D	B	B	D	A	B	C	B	B	C	C	D	B	C	B	D
Que.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	C	C	D	C	A	A	B	B	B	A	D	C	B	C	B	A	A	C	A	D
Que.	61	62	63	64	65															
Ans.	D	B	A	A	A															

ELECTROMAGNETIC INDUCTION & A.C. LEVEL 2

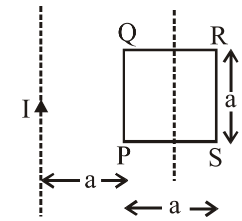
Select the correct alternatives (one or more than one correct answers)

1. A conducting loop is placed in a uniform magnetic field with its plane perpendicular to the field. An emf is induced in the loop if :–

(A) It is translated within magnetic field (B) It is rotated about its axis

(C) It is rotated about a diameter (D) It is deformed

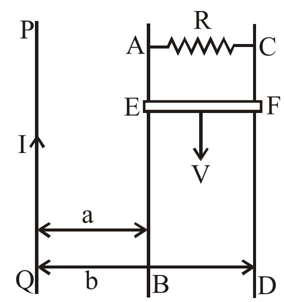
2. In the figure shown a square loop PQRS of side 'a' and resistance 'r' is placed in near an infinitely long wire carrying a constant current I. The sides PQ and RS are parallel to the wire. The wire and the loop are in the same plane. The loop is rotated by 180 about an axis parallel to the long wire and passing through the mid point of the side QR and PS. The total amount of charge which passes through any point of the loop during rotation is–



(A) $\frac{\mu_0 Ia}{2\pi r}\ell n2$ (B) $\frac{\mu_0 Ia}{\pi r}\ell n2$ (C) $\frac{\mu_0 Ia^2}{2\pi r}$

(D) cannot be found because time of rotation not give

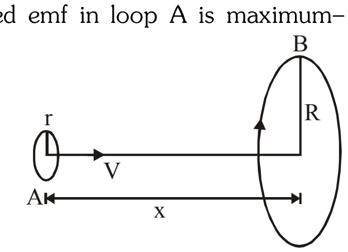
3. PQ is an infinite current carrying conductor. AB and CD are smooth conducting rods on which a conductor EF moves with constant velocity V as shown. The force needed to maintain constant speed of EF is–



(A) $\frac{1}{VR}\left[\frac{\mu_0 IV}{2\pi}\ell n\left(\frac{b}{a}\right)\right]^2$ (B) $\left[\frac{\mu_0 IV}{2\pi}\ell n\left(\frac{b}{a}\right)\right]^2\frac{1}{VR}$

(C) $\left[\frac{\mu_0 IV}{2\pi}\ell n\left(\frac{b}{a}\right)\right]^2\frac{V}{R}$ (D) $\frac{V}{R}\left[\frac{\mu_0 IV}{2\pi}\ell n\left(\frac{b}{a}\right)\right]^2$

4. Loop A of radius (r << R) moves towards loop B with a constant velocity V in such a way that their planes are always parallel. What is the distance between the two loops (x) when the induced emf in loop A is maximum–



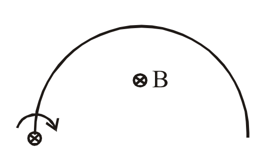
(A) R (B) $\frac{R}{\sqrt{2}}$

(C) $\frac{R}{2}$ (D) $R\left(1-\frac{1}{\sqrt{2}}\right)$

5. A superconducting loop of radius R has self inductance L. A uniform and constant magnetic field B is applied perpendicular to the plane of the loop. Initially current in this loop is zero. The loop is rotated by 180º. The current in the loop after rotation is equal to–

(A) zero (B) $\frac{B\pi R^2}{L}$ (C) $\frac{2B\pi R^2}{L}$ (D) $\frac{B\pi R^2}{2L}$

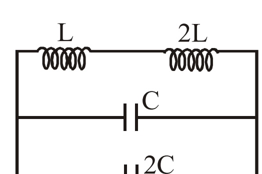
6. A semicircular wire of radius R is rotated with constant angular velocity ω about an axis passing through one end and perpendicular to the plane of the wire. There is a uniform magnetic field of strength B. The induced e.m.f. between the ends is–



(A) $B\ \omega R^2/2$ (B) $2B\ \omega R^2$

(C) is variable (D) none of these

7. The frequency of oscillation of current in the inductor is–



(A) $\frac{1}{3\sqrt{LC}}$ (B) $\frac{1}{6\pi\sqrt{LC}}$

(C) $\frac{1}{\sqrt{LC}}$ (D) $\frac{1}{2\pi\sqrt{LC}}$

8. An LCR series circuit with 100 Ω resistance is connected to an AC source of 200 V and angular frequency 300 radians per second. When only the capacitance is removed, the current lags behind the voltage by 60 . When only the inductance is removed, the current leads the voltage by 60 . Then the current and power dissipated in LCR circuit are respectively

(A) 1A, 200 watt. (B) 1A, 400 watt. (C) 2a, 200 watt. (D) 2A, 400 watt.

9. A bulb is rated of 100 V, 100W, it can be treated as a resistor. Find out the inductance of an inductor (called choke coil) that should be connected in series with the bulb to operate the bulb at its rated power with the help of an ac source of 200V and 50 Hz

(A) $\frac{\pi}{\sqrt{3}}$ H (B) 100H (C) $\frac{\sqrt{2}}{\pi}$ H (D) $\frac{\sqrt{3}}{\pi}$ H

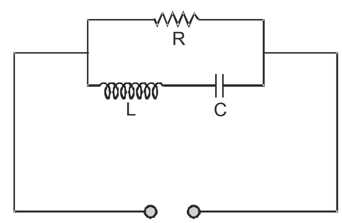
10. Two different coils have self–inductances L_1 = 8 mH and L_2 = 2mH. The current in one coil is increased at a constant rate. The current in the second coil is also increased at the same constant rate. At a certain instant of time, the power given to the two coils is the same. At that time, the current, the induced voltage and the energy stored in the first coil are i_1, V_1 and W_1 respectively. Corresponding values for the second coil at the same instant are i_2, V_2 and W_2 respectively. Then :

(A) $\frac{i_1}{i_2}=\frac{1}{4}$ (B) $\frac{i_1}{i_2}=4$ (C) $\frac{W_1}{W_2}=\frac{1}{4}$ (D) $\frac{V_1}{V_2}=4$

11. The capacitance of a telephone wire of length 300 km is 0.01 μF per km. If wire caries an ac of 5 kHz, what should be the value of an inductance required to be connected in series so that impedance is minimum–

(A) 0.36 mH (B) 3.6 mH (C) 0.6 H (D) 3.6 H

12. In the circuit shown, when dc of 250 V is applied, one ampere current passes through the circuit and when an alternating voltage source of 250 V and 2250 rad/s is applied, current of 1.25 A flows. If maximum current flows through the circuit at a frequency of 4500 rad/s, then the value of L and C will be respectively–



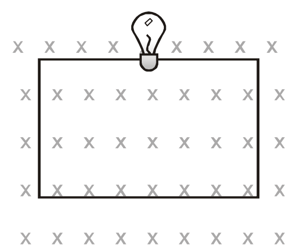
(A) 0.295 H, 10^{-4} F (B) 0.0752 H, 0.01 F
(C) 0.0392 H, 0.005 F (D) 0.0494 H, 10^{-6} F

13. An electron is moving in a circular orbit of radius R with an angular acceleration α. At the centre of the orbit is kept a conducting loop of radius r, (r<<R). The e.m.f. induced in the smaller loop due to the motion of the electron is

(A) zero, since charge on electron in constant (B) $\frac{\mu_0 e r^2}{4R}\alpha$

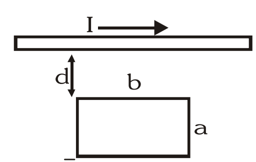
(C) $\frac{\mu_0 e r^2}{4\pi R}\alpha$ (D) None of these

14. A square wire loop of 10.0 cm side lies at right angles to a uniform magnetic field of 20T. A 10V light bulb is in a series with the loop as shown in the figure. The magnetic field is decreasing steadily to zero over a time interval ΔT. The bulb will shine with full brightness if Δt is equal to



(A) 20 ms (B) 0.02 ms
(C) 2 ms (D) 0.2 ms

15. A long straight wire is parallel to one edge as in figure. If the current in the long wire is varies in time as $I = I_0 e^{-t/\tau}$, what will be the induced emf in the loop?



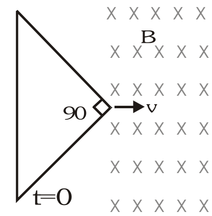
(A) $\frac{\mu_0 bI}{\pi\tau}\ell n\left(\frac{d+a}{d}\right)$ (B) $\frac{\mu_0 bI}{2\pi\tau}\ell n\left(\frac{d+a}{d}\right)$

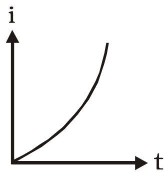
(C) $\frac{2\mu_0 bI}{\pi\tau}\ell n\left(\frac{d+a}{d}\right)$ (D) $\frac{\mu_0 bI}{\pi\tau}\ell n\left(\frac{d}{d+a}\right)$

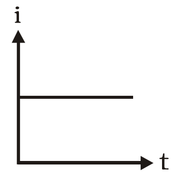
16. The magnetic flux through a stationary loop with resistance R varies during interval of time T as ϕ= at (T–t). The heat generated during this time neglecting the inductance of loop will be

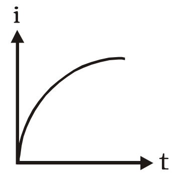
(A) $\frac{a^2T^3}{3R}$ (B) $\frac{a^2T^2}{3R}$ (C) $\frac{a^2T}{3R}$ (D) $\frac{a^2T^3}{R}$

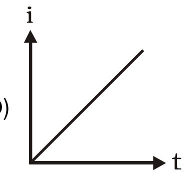
17. The figure shows an isosceles triangle wire frame with apex angle equal to $\pi/2$. The frame starts entering into the region of uniform magnetic field B with constant velocity v at t=0. The longest side of the frame is perpendicular to the direction of velocity. If i is the instantaneous current through the frame then choose the alternative showing the correct variation of i with time.



(A) 

(B) 

(C) 

(D) 

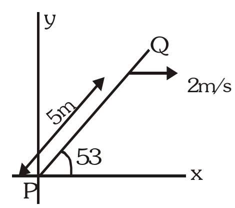
18. A square loop of side a and resistance R is moved in the region of uniform magnetic field B (loop remaining completely inside field), with a velocity v through a distance x. The work done is

(A) $\frac{B^2\ell^2vx}{R}$ (B) $\frac{2B^2\ell^2vx}{R}$ (C) $\frac{4B^2\ell^2vx}{R}$ (D) None

19. Two parallel long straight conductors lie on a smooth surface. Two other parallel conductors rest on them at right angles so as to form a square of side a initially. A uniform magnetic field B exists at right angles to the plane containing the conductors. They all start moving out with a constant velocity v. If r is the resistance per unit length of the wire the current in the circuit will be

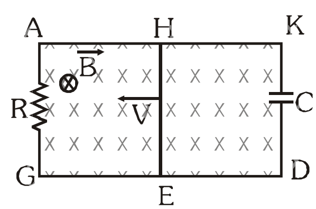
(A) $\frac{Bv}{r}$ (B) $\frac{Br}{v}$ (C) Bvr (D) Bv

20. A conducting rod PQ of length 5 m oriented as shown in figure is moving with velocity (2 m/s) $\tilde{i}$ without any rotation in a uniform magnetic field $\left(3\tilde{j}+4\tilde{k}\right)$ Tesla. Emf induced in the rod is



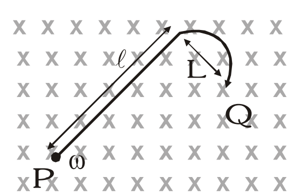
(A) 32 volt (B) 40 volt
(C) 50 volt (D) None

21. In the circuit shown in figure, a conducting wire HE is moved with a constant speed V towards left. The complete circuit is placed in a uniform magnetic field $\vec{B}$ perpendicular to the plane of the circuit directed in inward direction. The current in HKDE is



(A) clockwise (B) anticlockwise
(C) alternating (D) zero

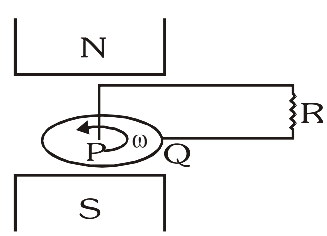
22. When a 'J' shaped conducting rod is rotating in its own plane with constant angular velocity ω, about one of its end P, in a uniform magnetic field $\vec{B}$ directed normally into the plane of paper) then magnitude of emf induced across it will be



(A) $B\omega\sqrt{L^2+\ell^2}$ (B) $\frac{1}{2}B\omega L^2$

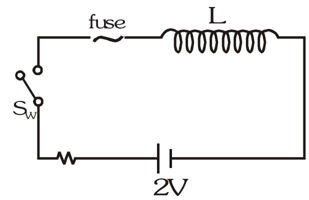
(C) $\frac{1}{2}B\omega\left(L^2+\ell^2\right)$ (D) $\frac{1}{2}B\omega\ell^2$

23. A metal disc rotates freely, between the poles of a magnet in the direction indicated. Brushes P and Q make contact with the edge of the disc and the metal axle. What current, if any, flows through R?



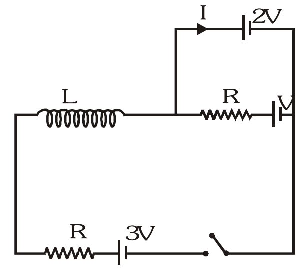
(A) a current from P to Q (B) a current from Q to P
(C) no current, because the emf in the disc is opposed by the back emf
(D) no current, because the emf induced in one side o the disc is opposed by the emf induced in the other side

24. In the circuit shown, the cell is ideal. the coil has an inductance of 4H and zero resistance. F is a fuse of zero resistance and will blow when the current through it reaches 5A. The switch is closed at t=0. The fuse will below:



(A) just after t=0 (B) after 2s
(C) after 5s (D) after 10s

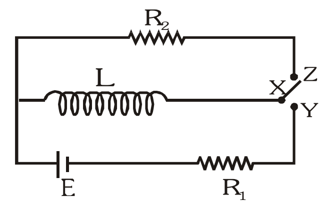
25. In the LR circuit shown, what is the variation of the current I as a function of time? The switch is closed at time t=0 sec.



(A) $\frac{V}{R}\left(1-e^{-\frac{Rt}{L}}\right)$ (B) $\frac{V}{R}e^{-\frac{Rt}{L}}$

(C) $-\frac{V}{R}e^{-\frac{Rt}{L}}$ (D) None

26. In the circuit shown, X is joined to Y for a long time and then X is joined to Z. The total heat produced in R_2 is

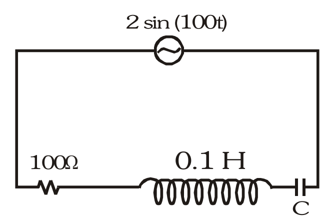


(A) $\frac{LE^2}{2R_1^2}$ (B) $\frac{LE^2}{2R_2^2}$ (C) $\frac{LE^2}{2R_1R_2}$ (D) $\frac{LE^2R_2}{2R_1^2}$

27. An induction coil stores 32 jouled of magnetic energy and dissipates energy as heat at the rate of 320 watts. When a current of 4 amperes is passed through it. Find the time constant of the circuit when the coil is joined across a battery.

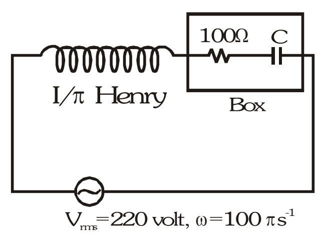
(A) 0.2 s (B) 0.1 s (C) 0.3s (D) 0.4 s

28. The power factor of the circuit is $\frac{1}{\sqrt{2}}$. The capacitance of the circuit is equal to



(A) 400 μF (B) 300 μF
(C) 500 μF (D) 200 μF

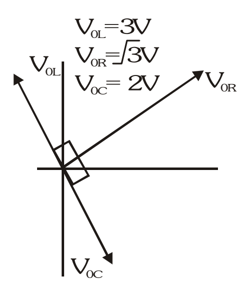
29. In the circuit, as shown in the figure, if the value of R.M.S. current is 2.2 ampere, the power factor of the box is



(A) $\frac{1}{\sqrt{2}}$ (B) 1

(C) $\frac{\sqrt{3}}{2}$ (D) $\frac{1}{2}$

30. The given figure represents the phasor diagram of a series LCR circuit connected to an ac source. At the instant t' when the source voltage is given by $V=V_0\cos\omega t'$, the current in the circuit will be



(A) $I=I_0 \cos(\omega t' + \pi/6)$
(B) $I=I_0 \cos(\omega t' - \pi/6)$
(C) $I = I_0 \cos(\omega t' + \pi/3)$
(D) $I = I_0 \cos(\omega t' - \pi/3)$

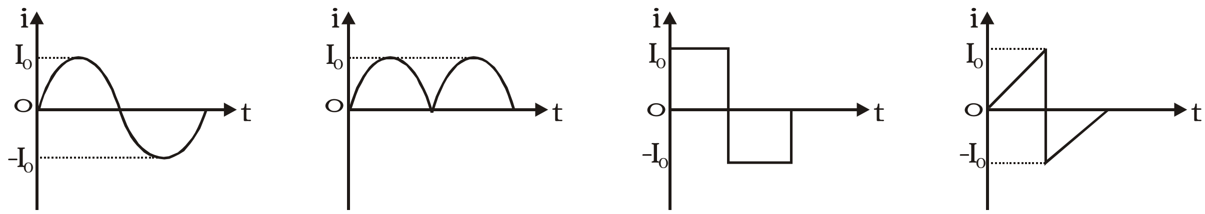
31. Power factor of an L–R series circuit is 0.6 and that of a C–R series circuit is 0.5. If the element (L,C, and R) of the two circuits are joined in series the power factor of this circuit is found to be 1. The ratio of the resistance in the L–R circuit to the resistance in the C–R circuit is

(A) $\frac{6}{5}$ (B) $\frac{5}{6}$ (C) $\frac{4}{3\sqrt{3}}$ (D) $\frac{3\sqrt{3}}{4}$

32. The effective value of current $i = 2\sin 100\pi\ t + 2\ \sin\ (100\pi t + 30\ )$ is

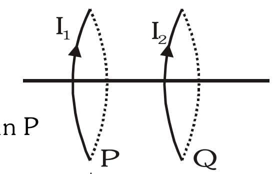
(A) $\sqrt{2}$ A (B) $2\sqrt{2+\sqrt{3}}$ (C) 4 (D) None

33. If I_1, I_2, I_3 and I_4 are the respective r.m.s. values of the time varying currents as shown in the four cases I, II, III and IV. Then identify the correct relations



(A) $I_1 = I_2 = I_3 = I_4$ (B) $I_3 > I_1 = I_2 > I_4$ (C) $I_3 > I_4 > I_2 = I_1$ (D) $I_3 > I_2 > I_1 > I_4$

34. Two circular coils P & Q are fixed coaxially & carry currents I_1 and I_2 respectively



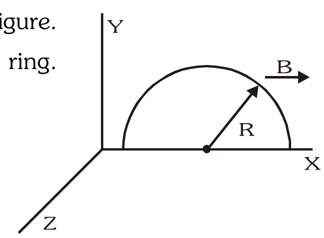
(A) If $I_2 = 0$ & P moves towards Q, a current in the same direction as I_1 is induced in Q

(B) If $I_1 = 0$ & Q moves towards P, a current in the opp. direction to that of I_2 is induced in P

(C) when I_1 # 0 and I_2 # 0 are in the same direction then the two coils tend to move apart.

(D) when I_1 # 0 and I_2 # 0 are in opposite directions then the coils tends to move apart

35. A semicircle conducting ring of radius R is placed in the xy plane, as shown in the figure. A uniform magnetic field is set up along the x–axis. No emf, will be induced in the ring. If



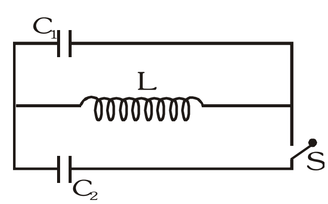
(A) it moves along the x–axis

(B) it moves along the y–axis

(C) it moves along the z–axis

(D) it remains stationary

36. At a moment (t=0) when charge on capacitor C_1 is zero, the switch is closed. If I_0 be the current through inductor at that instant, for t > 0,

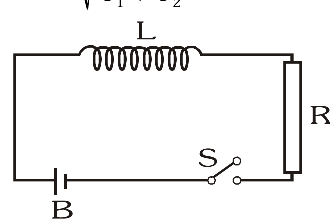


(A) maximum current through inductor equals $\frac{I_0}{2}$

(B) maximum current through inductor equals $\frac{C_1 I_0}{C_1 + C_2}$

(C) maximum charge on $C_1 = \frac{C_1 I_0 \sqrt{LC_1}}{C_1 + C_2}$ (D) maximum charge on $C_1 = I_0 C_1 \sqrt{\frac{L}{C_1 + C_2}}$

37. In figure, the switch S is closed so that a current flows in the iron–core inductor which has inductance L and the resistance R. When the switch is opened, spark is obtained in it at the contacts. The spark is due to

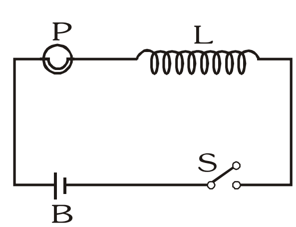


(A) a slow flux change in L

(B) a sudden increase in the emf of the battery B

(C) a rapid flux change in L (D) a rapid flux change in R

38. In figure, a lamp P is in series with an iron–core inductor L. When the switch S is closed, the brightness of the lamp rises relatively slowly to its full brightness than it would do without the inductor. This is due to



(A) the low resistance of P

(B) the induced –emf in L

(C) the low resistance of L (D) the high voltage of the battery B

39. Two coil A and B have coefficient of mutual inductance M=2H. The magnetic flux passing through coil A changes by 4 Weber in 10 seconds due to the change in current in B. Then

(A) change in current in B in this time interval is 0.5 A

(B) the change in current in B in this time interval is 2A

(C) the change in current in B in this time interval is 8A

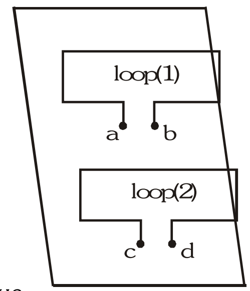
(D) a change in current of 1A in coil A will produce a change in flux passing through B by 4 Weber

40. An a.c. source of voltage V and of frequency 50Hz is connected to an inductor of 2H and negligible resistance. A current of r.m.s. value I flows in the coil. When the frequency of the voltage is changed to 400 Hz keeping the magnitude of V the same, the current is now

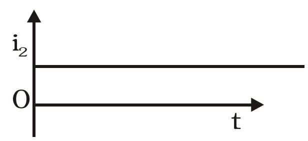
(A) 8I in phase with V (B) 4I and leading by 90 from V

(C) I/4 and lagging by 90^0 from V (D) I/8 and lagging by 90^0 from V

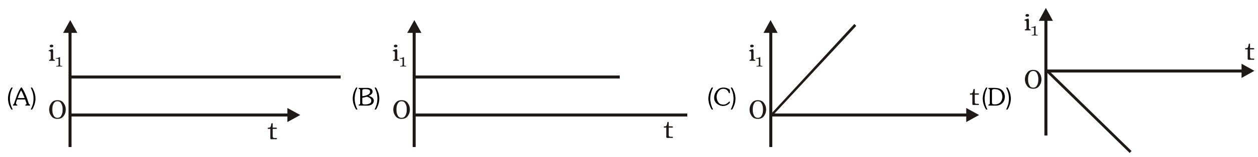
41. An electric current i_1 can flow either direction through loop (1) and induced current i_2 in loop (2). Positive i_1 is when current is from 'a' to 'b' in loop (1) and positive i_2 is when the current is from'c' to 'd' in loop (2). In an experiment,



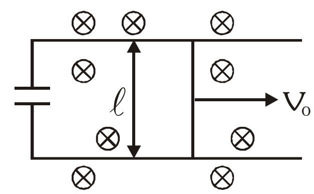
the graph of i_2 against time 't' is as shown below

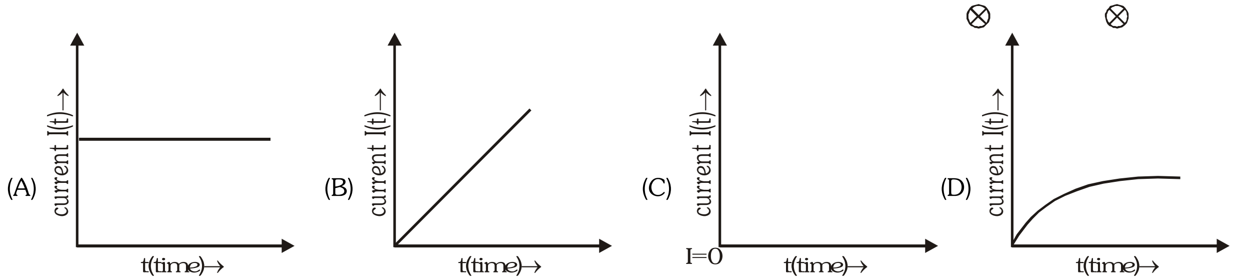


which one(s) of the following graphs could have caused i_2 to behave as give above

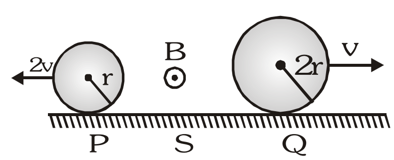


42. Two infinitely long conducting parallel rails are connected through a capacitor C as shown in the figure. A conductor of length ℓ is moved with constant speed v_0. Which of the following graph truly depicts the variation of current through the conductor with time?





43. Two conducting rings P and Q of radii and r and 2r rotate uniformly in opposite directions with centre of mass velocities 2 v and v respectively on a conducting surface S. There is a uniform magnetic field of magnitude B perpendicular to the plane of the rings. The potential difference between the highest points of the two rings is

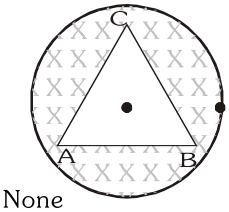


(A) zero (B) 4 Bvr (C) 8 Bvr (D) 16 Bvr

44. The magnetic field in a region is given by $\vec{B} = B_0\left(1+\frac{x}{a}\right)\tilde{k}$. A square loop of edge length d is placed with its edge along x & y axis. The loop is moved with constant velocity $\vec{V} = V_0\tilde{i}$. The emd induced in the loop is

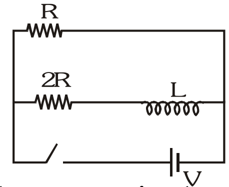
(A) $\frac{V_0B_0d^2}{a}$ (B) $\frac{V_0B_0d^2}{2a}$ (C) $\frac{V_0B_0a^2}{d}$ (D) none

45. A triangular wire frame (each side = 2m) is placed in a region of time variant magnetic field having $dB/dt = \sqrt{3}$ T/s. The magnetic field is perpendicular to the plane of the triangle. The base of the triangle AB has a resistance 1Ω while the other two sides have resistance 2Ω each. The magnitude of potential difference between the points A and B will be



(A) 0.4 V (B) 0.6 V (C) 1.2 V (D) None

46. The ratio of time constant in charging and discharging in the circuit shown in figure is

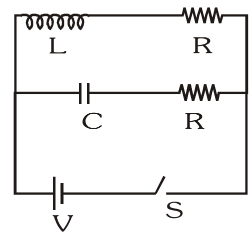


(A) 1:1 (B) 3:2
(C) 2:3 (D) 1:3

47. A long straight wire of circular cross-section is made of non-magnetic material. The wire is of radius a. The wire carries a current I which is uniformly distributed over its cross-section. The energy stored per unit length in the magnetic field contained within the wire is

(A) $U = \frac{\mu_0 I^2}{8\pi}$ (B) $U = \frac{\mu_0 I^2}{16\pi}$ (C) $U = \frac{\mu_0 I^2}{4\pi}$ (D) $U = \frac{\mu_0 I^2}{2\pi}$

48. In the circuit shown in the figure, $R = \sqrt{\frac{L}{C}}$. Switch S is closed at time t=0. The current through C and L would be equal after a time t equal to

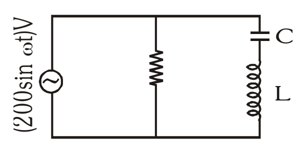


(A) CR (B) CR ℓn (2)

(C) $\frac{L}{R\ \ell n(2)}$ (D) LR

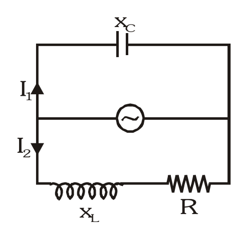
49. Let f = 50 Hz, and C=100 μF in an AC circuit containing a capacitor only. If the peak value of the current in the circuit is 1.57 A at t=0. The expression for the instantaneous voltage across the capacitor will be
(A) E = 50 sin (100πt - π/2) (B) E = 100 sin (50πt)
(C) E = 50 sin 100πt (D) E = 50 sin (100πt + π/2)

50. In the circuit diagram shown, $X_C = 100\Omega$, $X_L = 200\Omega$ and $R = 100\Omega$. The effective current through the source is



(A) 2A (B) $\sqrt{2}$A
(C) 0.5A (D) $2\sqrt{2}$A

51. In the shown AC circuit phase different between currents I_1 and I_2 is

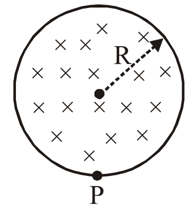


(A) $\frac{\pi}{2} - \tan^{-1}\frac{x_L}{R}$ (B) $\tan^{-1}\frac{x_L - x_C}{R}$

(C) $\frac{\pi}{2} + \tan^{-1}\frac{x_L}{R}$ (D) $\tan^{-1}\frac{x_L - x_C}{R} + \frac{\pi}{2}$

52. For L-R circuit, the time constant is equal to
(A) twice the ratio of the energy stored in the magnetic field to the rate of the dissipation of energy in the resistance
(B) the ratio of the energy stored in the magnetic field to the rate of dissipation of energy in the resistance
(C) half of the ratio of the energy stored in the magnetic field to the rate of dissipation of energy in the resistance
(D) square of the ratio of the energy stored in the magnetic field to the rate of dissipation energy in the resistance

53. A uniform magnetic field of induction B is confined to a cylindrical region of radius R. The magnetic field is increasing at a constant rate of $\frac{dB}{dt}$ (tesla/second). An electron of charge q, placed at the point P on the periphery of the field experiences an acceleration–



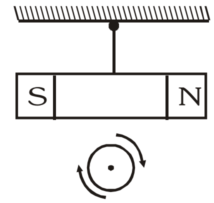
(A) $\frac{1}{2}\frac{eR}{m}\frac{dB}{dt}$ towards left (B) $\frac{1}{2}\frac{eR}{m}\frac{dB}{dt}$ toward right

(C) $\frac{eR}{m}\frac{dB}{dt}$ toward left (D) 0

54. A coil having n turns and resistance R Ω is connected with a galvanometer of resistance 4R Ω. This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is–

(A) $\frac{W_2 - W_1}{5Rnt}$ (B) $-\frac{n(W_2 - W_1)}{5Rt}$ (C) $-\frac{(W_2 - W_1)}{Rnt}$ (D) $-\frac{n(W_2 - W_1)}{Rt}$

55. A negative charge is given to a nonconducting loop and the loop is rotated in the plane of paper about its centre as shown in figure. The magnetic field produced by the ring affects a small magnet placed above the ring in the same plane :

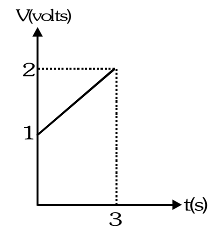


(A) the magnet does not rotate
(B) the magnetic rotates clockwise as seen from below
(C) the magnet rotates anticlockwise as seen from below
(D) no effect on magnet is there

56. A wire of fixed length is wound on a solenoid of length 'ℓ' and radius 'r'. Its self inductance is found to be L. Now if same wire is wound on a solenoid of length $\ell/2$ and radius r/2, then the self inductance will be–

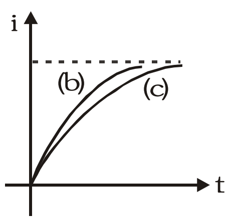
(A) 2 L (B) L (C) 4 L (D) 8 L

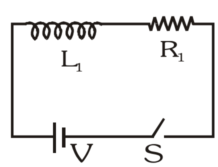
57. A circuit element is placed in a closed box. At time t=0, constant current generator supplying a current of 1 A, is connected across the box. Potential difference across the box varies according to graph shown in figure. The element in the box is

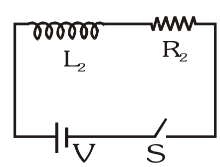


(A) resistance of 2Ω
(B) battery of emf 6V
(C) inductance of 2H
(D) capacitance of 0.5 F

58. Current growth in two L-R circuits (B) and (C) as shown in figure (A). Let L_1, L_2, R_1 and R_2 be the corresponding values in two circuits. Then

(A) 

(B) 

(C) 

(A) $R_1 > R_2$ (B) $R_1 = R_2$ (C) $L_1 > L_2$ (D) $L_1 < L_2$

59. For a LCR series circuit with an A.C. source of angular frequency ω :

(A) circuit will be capacitive if $\omega > \frac{1}{\sqrt{LC}}$ (B) circuit will be inductive if $\omega > \frac{1}{\sqrt{LC}}$

(C) power factor of circuit will by unity if capacitive reactance equals inductive reactance (D) current will be leading if $\omega > \frac{1}{\sqrt{LC}}$

ANSWER KEY LEVEL -2

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C,D	B	A	C	C	B	B	D	D	A,C,D	A	D	B	A	B	A	D	D	A	A
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	D	C	A	D	C	A	A	C	A	B	D	D	B	B,D	A,B,C,D	D	C	B	B	D
Que.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	
Ans.	D	C	C	A	A	B	B	B	C	A	C	A	A	B	B	A	D	BD	BC	