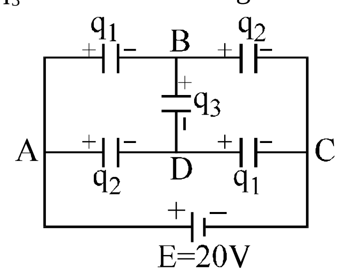
IIT – JEE - 2019 **TW TEST (3 Yrs.)** **MARKS:360**
TIME: 3 HRS. **DATE:24/10/18**
TOPIC:- ELECTROSTATICS, MAGNETISM, MODERN PHYSICS, HEAT &THERMODYNAMICS)

(Multiple Choice Questions)

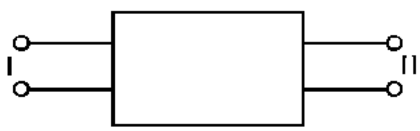
This section contains **90 multiple choice questions.** Each question has 4 choices (1), (2), (3) and (4) for its answer, out which **ONLY ONE** is correct. **(+4, -1)**

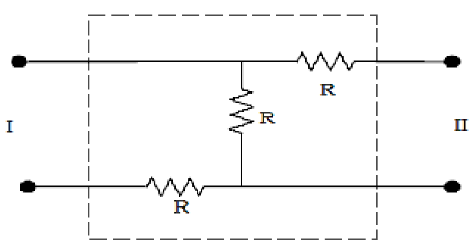
1. The value of charge q_1, q_2 and q_3 as shown in the figure can be

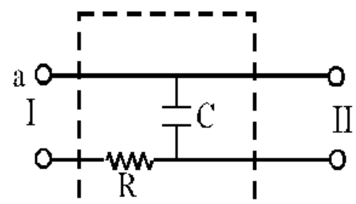


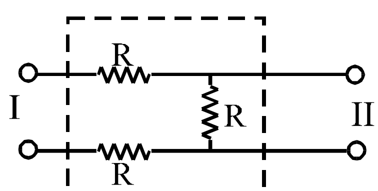
(1) $q_1 = 32\,mC; q_2 = 24\,mC; q_3 = 16\,mC$ (2) $q_1 = 48\,mC; q_2 = 16\,mC; q_3 = 8\,mC$
(3) $q_1 = 32\,mC; q_2 = 24\,mC; q_3 = 8\,mC$ (4) $q_1 = 3\,mC; q_2 = 4\,mC; q_3 = 2\,mC$

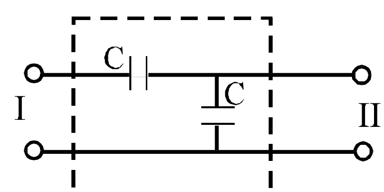
2. If a battery of voltage V is connected across terminals I of the block box shown in figure, an ideal voltmeter connected to terminals II gives a reading of V/2, while if the battery is connected to terminals II, a voltmeter across terminals I reads V. The black box may contain



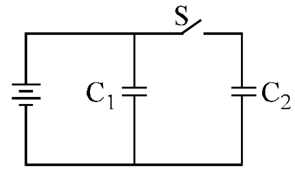
(1) 

(2) 

(3) 

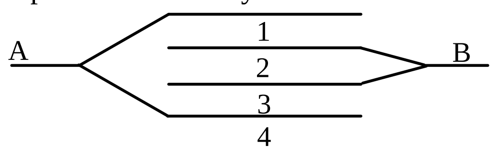
(4) 

3. Two capacitors of equal capacitance ($C_1 = C_2$) are shown in the figure. Initially, while the switch S is open, one of the capacitors is uncharged and the other carries charge Q_0. The energy stored in the charged capacitor is U_0. Sometimes after the switch is closed, the capacitors C_1 and C_2 carry charges Q_1 and Q_2, respectively; the voltages across the capacitors are V_1 and V_2; and the energies stored in the capacitors are U_1 and U_2. Which of the following statements is INCORRECT?



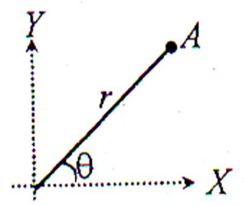
(1) $Q_0 = \frac{1}{2}(Q_1 + Q_2)$ (2) $Q_1 = Q_2$ (3) $V_1 = V_2$ (4) $U_0 = U_1 + U_2$

4. Four identical metal plates, each with a surface area A (on one side), are placed at a distance d from each other as shown in figure. The two plates are connected to point B and the other two plates to another point A. Then, the capacitance of the system is



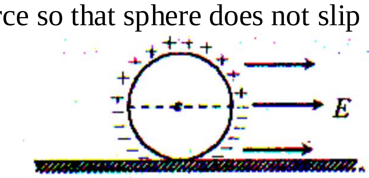
(1) $\varepsilon_0 A/d$ (2) $2\varepsilon_0 A/d$ (3) $3\varepsilon_0 A/d$ (4) $2\varepsilon_0 A/3d$

5. A short dipole is oriented along x–axis such that direction of dipole moment is along positive x–axis. It is observed that the magnitude of electric field and electric potential are equal at a point $\sqrt{5}$m from the centre of the dipole as shown. The value of θ is



(1) 30^o (2) 37^o (3) 53^o (4) 45^o

6. A non conducting spherical shell of radius R having charge distributions +q and –q is released from rest on a horizontal non conducting rough surface as shown in figure in a horizontal electric fied E. The initial value of friction force so that sphere does not slip is



(1) qE (2) $\frac{3qE}{5}$ (3) $\frac{qE}{4}$ (4) zero

7. A charge +q is placed at each of the points $x = x_0, x = 3x_0, x = 5x_0, ...$ on the x-axis, and a charge – q is placed at each of the points $x = 2x_0, x = 4x_0, ...$ Here, x_0 is a positive constant. The potential at the origin due to the above system of charges is

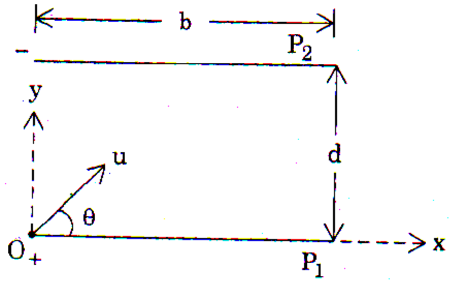
(1) zero (2) $\frac{q}{8\pi\varepsilon_0 x_0 \ell n2}$ (3) Infinite (4) $\frac{q\ell n2}{4\pi\varepsilon_0 x_0}$

8. In a regular polygon of n sides, each corner is at a distance r from the centre. Identical charges of magnitude Q are placed at $(n-1)$ corners. The electric field at the centre is

(where $k = \frac{1}{q\pi\varepsilon_0}$)

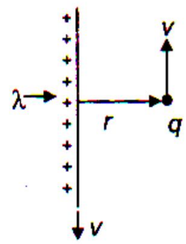
(1) $k\frac{Q}{r^2}$ (2) $(n-1)k\frac{Q}{r^2}$ (3) $\frac{n}{n-1}k\frac{Q}{r^2}$ (4) $\frac{n-1}{n}k\frac{Q}{r^2}$

9. Electrons are projected into the region of an electric field E between the plates P_1 and P_2 with velocity u making an angle θ with the horizontal plate P_1 at O, as shown in the figure. The minimum electric force which allows the electrons to leave the field region along the direction parallel to the plates P_1 and P_2 (i.e., along x - axis in the figure) is [Electron charge is e and mass is m]



(1) $\frac{mu^2}{2d}$ (2) $\frac{mu^2}{2b\left(1+\frac{b^2}{d^2}\right)}$ (3) $2b\left(1+\frac{b^2}{4d^2}\right)$ (4) $\frac{mu^2}{2d\left(1+\frac{b^2}{4d^2}\right)}$

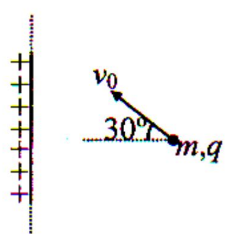
10. A long wire having linear charge density λ moving with constant velocity υ along its length. A point charge moving with same speed in opposite direction and at that instant it is *r* distance from the wire. The net force acting on the charge is given by



(1) $\frac{\lambda q}{2\pi r}\left[\frac{1}{\varepsilon_0}+v^2\mu_0\right]$ (2) $\frac{\lambda q}{2\pi r}\left[\frac{1}{\varepsilon_0}-\mu_0 v^2\right]$

(3) $\frac{\lambda q}{2\pi r}\sqrt{\left(\frac{1}{\varepsilon_0}\right)^2+v^4\mu_0^2}$ (4) zero

11. A particle of mass *m* and positive charge *q* is projected towards an infinitely long line of a charge (having linear density of charge $+\lambda$) from a distance r_0. The direction of initial velocity v_0 makes an angle 30^o with the normal to the line of charge as shown in figure. The minimum distance of approach of the charge particle with the line of charge will be (neglect gravity) Take $\lambda=\frac{\pi\varepsilon_0 m v_0^2}{4q}$

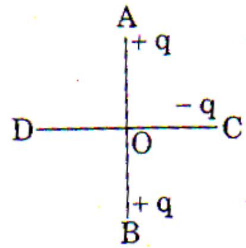


(1) $\frac{r_0}{e}$ (2) $\frac{r_0}{e^2}$ (3) $\frac{r_0}{e^3}$ (4) $\frac{r_0}{2}$

12. The electric potential V in volt in a region of space is given by $V=ax^2+ay^2+2az^2$, where a is a constant given by a $a=1.25\times10^3\ V/m^2$. What is the radius (in m) of the circle of the equipotential line corresponding to V = 6250 V and $z=\sqrt{2}$ m

(1) 2 (2) 1 (3) 0 (4) 4

13. Two fixed equal positive charge each of magnitude $5\times10^{-5}C$ are located at points A and B separated by a distance of 6 m. An equal and opposite charge moves towards them along the line COD, the perpendicular bisector of the line AB. The moving charge when it reaches the point C at a distance 4 m from O has a kinetic energy 4 J. The distance of the farthest point D from A which the negative charge will reach before returning to C is___

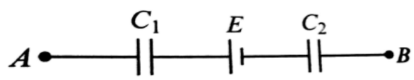


(1) 5 (2) 7 (3) 1 (4) 9

14. The plates of a parallel -plate capacitor are charged upto 100V. now , after removing the battery, a 2mm thick plate is inserted between the plates. Then, to maintain the same potential difference, the distance between the capacitor plates is increased by 1.6mm. Dielectric constant of the plate is

(1) 5 (2) 1.25 (3) 4 (4) 2.5

15. For section AB of a circuit shown in figure $C_1 = 1\mu F, C_2 = 2\mu F, E = 10\,V$, and the potential difference $V_A - V_B = -10\,V$. Charge on capacitor C_1 is

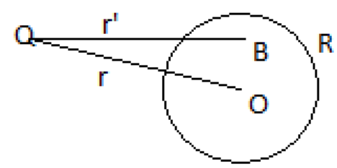


(1) $0\mu C$ (2) $20/3\mu C$ (3) $40/3\mu C$ (4) None of these

16. The potential in certain region is given as $V = 2x^2$, then the charge density of that region is

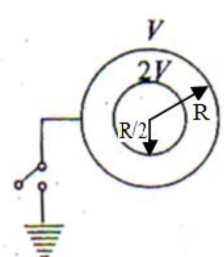
(1) $-\frac{4x}{\varepsilon_0}$ (2) $-\frac{4}{\varepsilon_0}$ (3) $-4\varepsilon_0$ (4) $-2\varepsilon_0$

17. A change Q is placed at a distance of *r* from the center of a neutral solid spherical conductor as shown. Find the potential at B due to induced charges present on surface of solid sphere [A is centre of the sphere and $k = 1/4\pi\varepsilon_0$]



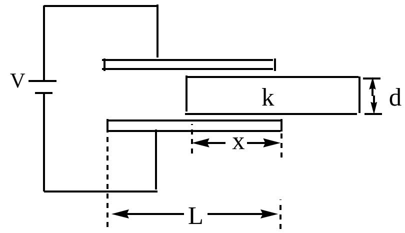
(1) $KQ\left(\frac{1}{r}-\frac{1}{r'}\right)$ (2) $\frac{KQ}{r'}$ (3) $\frac{KQ}{r}$ (4) Can't be determined

18. The diagram shows two concentric shells at the potentials as shown. The radius of the outer shell is R and the radius of the inner shell is R/2. What is the amount of heat generated on closing the switch? R/2 R



(1) $2\pi\varepsilon_0 R(V)^2$ (2) $4\pi\varepsilon_0 R(V)^2$ (3) $8\pi\varepsilon_0 R(V)^2$ (4) $\pi\varepsilon_0 R(V)^2$

19. A capacitor with the dielectric slab is connected to a battery as shown in the fig. The area of the plate and slab is A while their length is *l*. If the dielectric slab is released from rest in a situations shown in fig and it executes periodic motion, the time period of oscillations will be (Mass of the slab is 'm')

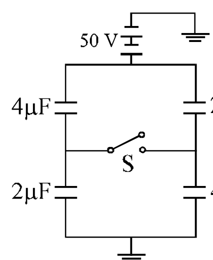


(1) $2\sqrt{\dfrac{xm\ell d}{\varepsilon_0 AV^2(k+1)}}$ (2) $4\sqrt{\dfrac{xm\ell d}{\varepsilon_0 AV^2(k-1)}}$

(3) $8\sqrt{\dfrac{(\ell-x)m\ell d}{\varepsilon_0 AV^2(k-1)}}$ (4) $12\sqrt{\dfrac{(\ell-x)m\ell d}{\varepsilon_0 AV^2 k}}$

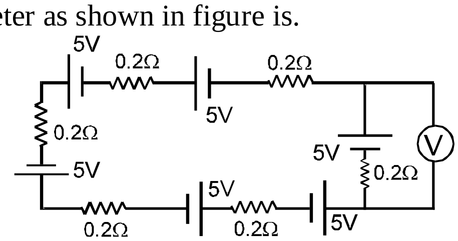
20. A parallel plate capacitor is charged and then disconnected from the source of potential difference. If the plates of the condenser are then moved farther apart by the use of insulated handle, which one of the following is true?
(1) The charge on the capacitor increases
(2) The charge on the capacitor decreases
(3) The capacitance of the capacitor increases
(4) The potential difference across the plate increases

21. The circuit was in the shown state from a long time. Now the switch S is closed. The charge that flows through the switch is



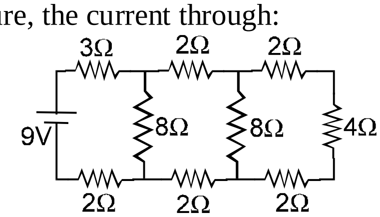
(1) $\dfrac{400}{3}\mu C$ (2) 100 mC (3) 50 mC (4) $\dfrac{100}{3}\mu C$

22. The reading of Ideal voltmeter as shown in figure is.



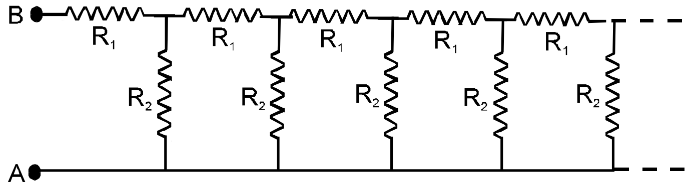
(1) 0 (2) 5 V (3) 2.5 V (4) None

23. In the circuit shown in the figure, the current through:



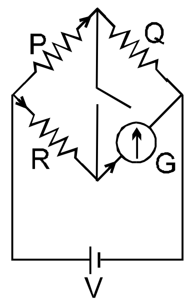
(1) The $3\,\Omega$ resistor is 0.50 A (2) The $3\,\Omega$ resistor is 0.25 A
(3) The $4\,\Omega$ resistor is 0.50 A (4) The $4\,\Omega$ resistor is 0.25 A

24. Consider an infinite ladder network shown in fig. A voltage is applied between points A and B. If the value of voltage is halved after each section, then ratio of R_1/R_2 will be:



(1) 1 : 1 (2) 1 : 2 (3) 2 : 1 (4) 2 : 5

25. In the circuit shown, $P \neq R$, the reading of the galvanometer is same with switch S open or closed. Then

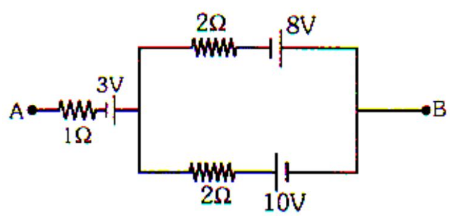


(1) $I_R = I_G$ (2) $I_P = I_G$ (3) $I_Q = I_G$ (4) $I_Q = I_R$

26. Suppose a voltmeter of resistance $660\,\Omega$ reads the voltage of a very old cell to be 1.32 volt while a potentiometer reads its voltage to be 1.44 volt. The internal resistance of the cell is:

(1) 30Ω (2) 60Ω (3) 6Ω (4) 0.6Ω

27. The net emf and internal resistance of three batteries as shown in figure is :

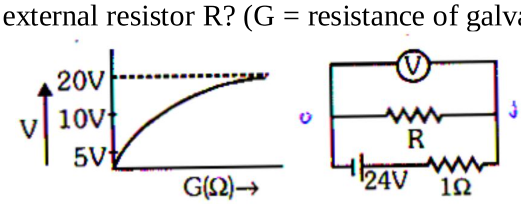


(1) $2V, 1\Omega$ (2) $2V, 2\Omega$ (3) $2V, 1.5\Omega$ (4) $4V, 2\Omega$

28. The work done in increasing the potential of a capacitor from volt to volt is W. Then, the work done in increasing the potential of the same capacitor from 2V volt to 4V volt will be

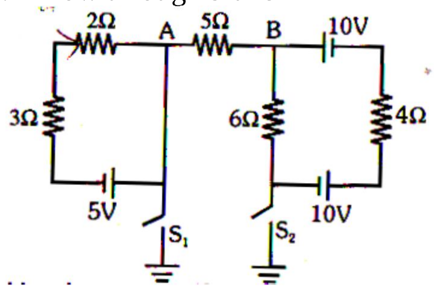
(1) W (2) 2W (3) 4W (4) 8W

29. A cell of internal resistance 1Ω is connected across a resistor. A voltmeter having variable resistance is used to measure potential difference across resistor. The plot of voltmeter reading V against G is shown. What is value of external resistor R? (G = resistance of galvanometer)



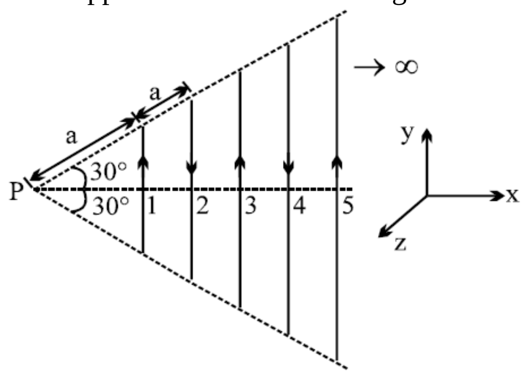
(1) 5Ω (2) 4Ω (3) 3Ω (4) Can't be determined

30. In the figure shown current will flow through branch A-B if



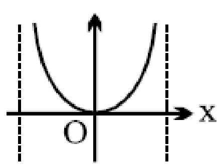
(1) Both S_1 and S_2 are open
(2) S_1 is open and S_2 is closes
(3) S_1 is closed and S_2 is open
(4) S_1 and S_2 both are closed

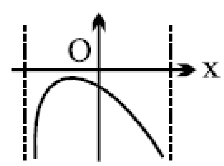
31. Infinite number of straight wires each carrying current I are equally placed as shown in the figure. Adjacent wires have current in opposite direction. Net magnetic field at point P is

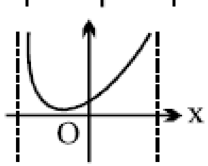


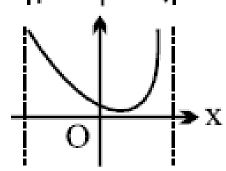
(1) $\frac{\mu_0 I}{4\pi}\frac{\ell n2}{\sqrt{3}a}\hat{k}$
(2) $\frac{\mu_0 I}{4\pi}\frac{\ell n4}{\sqrt{3}\,a}\hat{k}$
(3) $\frac{\mu_0 I}{4\pi}\frac{\ell n4}{\sqrt{3}a}\left(-\hat{k}\right)$
(4) Zero

32. Two very long straight parallel wires, parallel to y-axis, carry currents 4I and I, along +y direction and –y direction, respectively. The wires are passes through the x-axis at the points (d, 0, 0) and (-d, 0, 0) respectively. The graph of magnetic field z-component as one moves along the x-axis from $x = -d$ to $x = +d$, is best given by

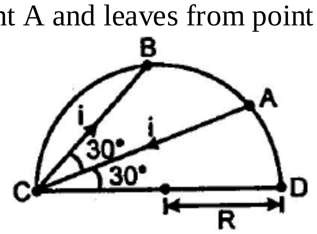
(1) 

(2) 

(3) 

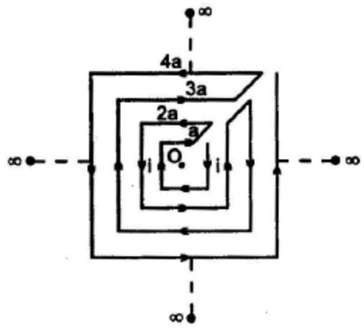
(4) 

33. A current carrying wire is placed in the grooves of an insulating semi circular disc of radius 'R' as shown. The current enters at point A and leaves from point B. Determine the magnetic field at point



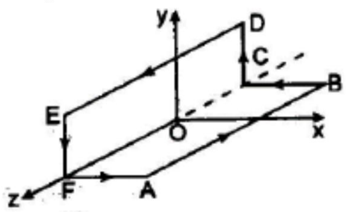
(1) $\frac{\mu_0 I}{8\pi R\sqrt{3}}$
(2) $\frac{\mu_0 I}{4\pi R\sqrt{3}}$
(3) $\frac{\sqrt{3}\mu_0 I}{4\pi R}$
(4) $\frac{\sqrt{3}\mu_0 I}{8\pi R}$

34. Determine the magnitude of magnetic field at the centre of the current carrying wire arrangement shown in the figure. The arrangement extends to infinite. (The wires joining the successive squares are along the line passing through the centre)



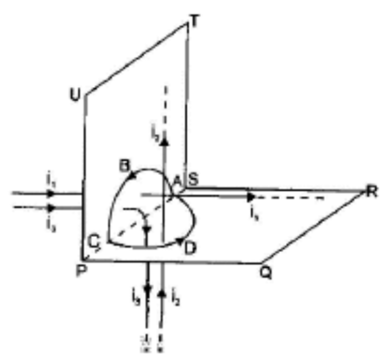
(1) $\frac{\mu_0 i}{\sqrt{2}\pi a}$ (2) 0 (3) $\frac{2\sqrt{2}\mu_0 i}{\pi a}\ln 2$ (4) $\frac{\sqrt{2}\mu_0 i}{\pi a}\ln(2)$

35. In the figure shown A B C D E F A was a square loop of side ℓ, but is folded two equal parts so that half of it lies in xz plane and the other lies in the yz plane. The origin 'O' is centre of the frame. The loop carries current 'i'. The magnetic field at the centre is:



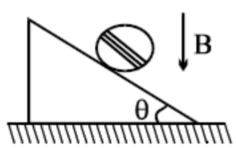
(1) $\frac{\mu_0 i}{2\sqrt{2}\pi\ell}(\hat{i}-\hat{j})$ (2) $\frac{\mu_0 i}{4\pi\ell}(-\hat{i}+\hat{j})$ (3) $\frac{\sqrt{2}\mu_0 i}{\pi\ell}(\hat{i}+\hat{j})$ (4) $\frac{\mu_0 i}{\sqrt{2}\pi\ell}(\hat{i}+\hat{j})$

36. Figure shown an amperian path ABCDA. Part ABC is in vertical plane PSTU while part CDA is in horizontal plane PQRS. Direction of circumlation along the path is shown by an arrow near point B and at D. $\oint \vec{B}.d\vec{\ell}$ for this path according to Ampere's law will be:



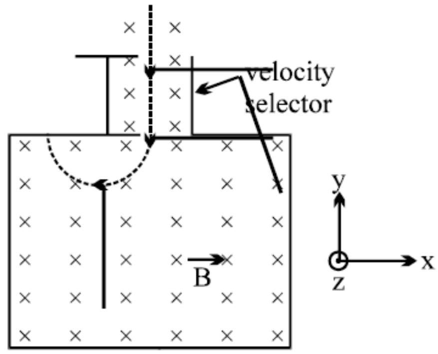
(1) $(i_1 - i_2 + i_3)\mu_0$ (2) $(-i_1 + i_2)\mu_0$ (3) $i_3\mu_0$ (4) $(i_1 + i_2)\mu_0$

37. In the figure shown a coil of single turn is would on a sphere of radius R and mass m. The plane of the coil is parallel to the plane and lies in the equatorial plane of the sphere. Current in the coil is i. The value of B if the sphere is in equilibrium is



(1) $\frac{mg\cos\theta}{\pi R}$ (2) $\frac{mg}{\pi R}$ (3) $\frac{mg\tan\theta}{\pi R}$ (4) $\frac{mg\sin\theta}{\pi R}$

38. Two charged particle A and B each of charge +e and asses 12 amu and 13 amu respectively follow a circular trajectory in chamber X after the velocity selector as shown in the figure. Both particles enter the velocity selector with speed $1.5\times10^{6}\,ms^{-1}$. A uniform magnetic field of strength 1.0 T is maintained within the chamber X and in the velocity selector.



(1) Electric field across the conducting plate of the velocity selector is $-10^{6}\,NC^{-1}\hat{i}$.

(2) Electric field across the conducting plate of the velocity selector is $10^{6}\,NC^{-1}\hat{i}$.

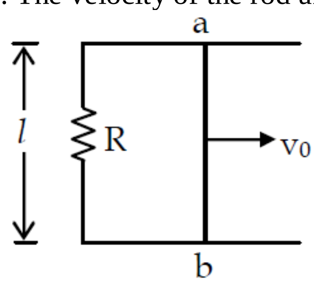
(3) The ratio r_A/r_B of the radii of the circular paths for the two particles is 12/13.

(4) The ratio r_A/r_B of the radii of the circular paths for the two particles is 13/12.

39. An electron is going with constant velocity $\overline{v}$ in a gravity free region containing uniform electric field $\overline{E}$ and magnetic field $\overline{B}$. Then

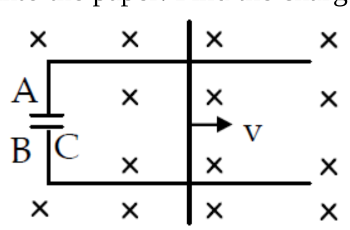
(1) $\overline{v}\perp\overline{E}$ (2) $\overline{v}\perp\overline{B}$ (3) $\overline{v}//\overline{E}$ (4) $\overline{v}//\overline{B}$

40. A conducting rod shown in figure of mass m and length 1 moves on two frictionless parallel rails. In the presence of a uniform magnetic field directed in the page. The rod is given an initial velocity v_0 to the right and is released at t = 0. The velocity of the rod after time t is



(1) $\upsilon=\upsilon_0 e^{t\lambda}$ (2) $\upsilon=\upsilon_0 e^{-t/\lambda}$ (3) $\upsilon=\upsilon_0\left(1-e^{-t/\lambda}\right)$ (4) $\upsilon=\upsilon_0\left(1-e^{-t\lambda}\right)$

41. A conducting rod PQ of length 1m is moving with a uniform speed of $v=2m/s$ in a uniform magnetic field B = 4T, directed into the paper. Find the charge on the capacitor plates $(C=10\mu F)$



(1) $80\mu F$ (2) $40\mu F$ (3) $100\mu F$ (4) Zero

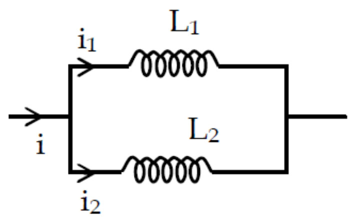
42. A square loop of side 0.5 m and resistance 10Ω is placed in a magnetic field of a magnitude B = 1T the work done in pulling the loop out of the field slowly and uniformly in 2 sec.

(1) $3.125\times10^{-3}J$ (2) $6.25\times10^{-3}J$ (3) $12.5\times10^{-3}J$ (4) Zero

43. A non conducting ring having charge q uniformly distributed over its circumference is placed on a rough horizontal surface. A vertical time varying magnetic field $B = 4t^2$ is switched on at time t = 0 mass of the ring is m and radius is R. The ring starts rotating after 2 seconds. The coefficient of friction between the ring and table is

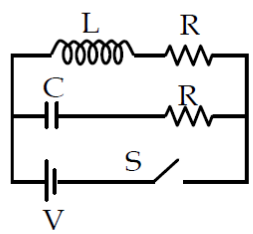
(1) $\frac{4\eta R}{mg}$ (2) $\frac{\eta R}{mg}$ (3) $\frac{2\eta R}{mg}$ (4) $\frac{8\eta R}{mg}$

44. Two inductors L_1 and L_2 are connected in parallel and a time varying current flows as shown. The ratio of currents at any instant is



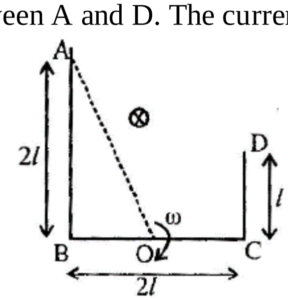
(1) $\frac{L_1}{L_2}$ (2) $\frac{L_2}{L_1}$ (3) $\sqrt{\frac{L_1}{L_2}}$ (4) $\sqrt{\frac{L_2}{L_1}}$

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



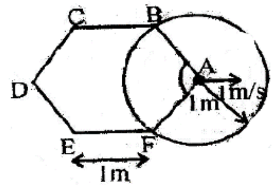
(1) $\frac{CR}{\ell n(2)}$ (2) $\frac{2CR}{\ln(2)}$ (3) $CR\ell n(2)$ (4) $2CR\ell n(2)$

46. ABCD, a wire frame of negligible resistance, is placed in a uniform magnetic field $(\vec{B})$ acting perpendicular to the plane of paper and that of wires frame as shown. If is rotated about point O in the same plane. The direction of angular velocity ω is perpendicular and into the plane of the paper. If a resistance R is connected between A and D. The current flowing through the resistance is



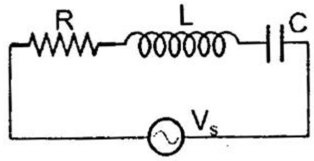
(1) $i = \frac{3B\omega l^2}{2R}$ (2) $i = \frac{B\omega l^2}{R}$ (3) $i = \frac{2B\omega l^2}{R}$ (4) $i = \frac{B\omega l^2}{2R}$

47. A cylindrical region of radius 1 m has instantaneous homogeneous magnetic field of 5T and it is increasing at a rate of 2T/s. The regular hexagonal loop ABCDEFA of side 1m is being drawn in to the region with a constant speed of 1m/s as shown in the figure. What is the magnitude of emf developed in the loop just after the shown instant when the corner A of the hexagon is coinciding with the centre of the circle?



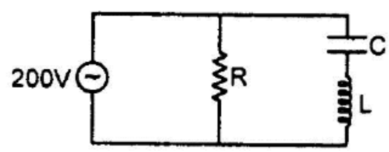
(1) $5\sqrt{3}V$ (2) $2\pi/3V$ (3) $\left(5\sqrt{3}+\frac{2\pi}{3}\right)V$ (4) $\left(5\sqrt{3}+\pi\right)V$

48. **Statement – 1:** In a series R, L, C circuit is V_R, V_L, and V_C denote rms voltage across R, L and C respectively and V_S is the rms voltage across the sources, then $V_S = V_R + V_L + V_C$.



Statement – 2: In AC circuits, kirchoff voltage law is correct at every instant of time.
(1) Statement – 1 is True, Statement -2 is True; Statement -2 is a correct explanation of Statement -1
(2) Statement -1 is True, Statement -2 is True; Statement -2 is NOT a correct explanation for Statement -1
(3) Statement -1 is True, Statement -2 is False
(4) Statement -1 is False, Statement -2 is True.

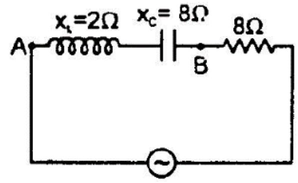
49. In the circuit diagram shown, $X_C = 100\Omega, X_L = 200\Omega, \& R = 100\Omega$. The effective current through the source is:



(1) 2A (2) $2\sqrt{2}A$ (3) 0.5 A (4) $\sqrt{0.4}A$

50. A high impedance AC voltmeter is connected in turn across the inductor, the capacitor and the resistor in a series circuit having an AC source of 100v (rms) and gives the same reading in volts in each case. This reading is:
(1) 100 V (2) 141 V (3) 150 V (4) 200 V

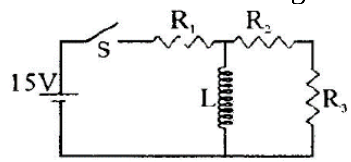
51. An inductor $\left(X_L = 2\Omega\right)$ a capacitor $\left(X_C = 8\Omega\right)$ and a resistance $\left(8\Omega\right)$ is connected in series with an ac source. The voltage output of A.C source is given by $v = 10\cos 100\pi t$. The instantaneous p.d. between A and B, when it is half of the voltage output from source at that instant will be:

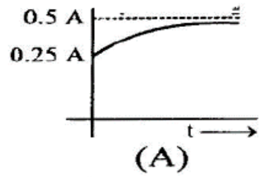


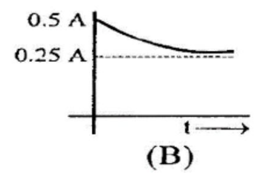
(1) $\frac{24}{7}$ volts (2) $\frac{24}{5}$ volts (3) $\frac{7}{24}$ volts (4) $\frac{5}{24}$ volts

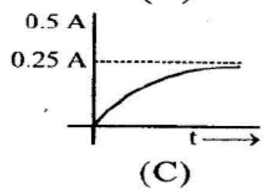
52. If the peak value of current through inductor (L), capacitor (C) and resistor (R) in parallel A. C. circuit are 2mA, 3mA and 5mA respectively. The peak value of current delivered by the source in the same circuit will be
(1) 20 mA (2) $5\sqrt{2}$mA (3) $\sqrt{26}$mA (4) 6mA

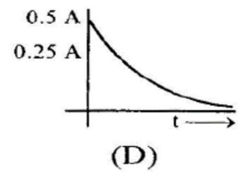
53. The figure shows a battery with emf 15V in a circuit with $R_1 = 30\Omega, R_2 = 10\Omega, R_3 = 20\Omega$ and $L = 3.0H$. The switch S is initially in the open position and is then closed at time t = 0. Then the graph which shows the correct variation of current through battery after switch S is closed.



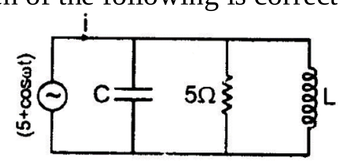
(1) 

(2) 

(3) 

(4) 

54. For the circuit shown, state which of the following is correct after a long time t.



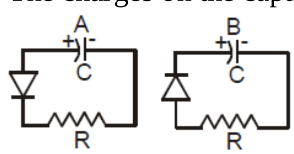
(1) The average value of ‘i’ is independent of the value of ‘C’.

(2) The average value of ‘i’ is independent of ‘L’ & ‘C’ for $\omega = \frac{1}{\sqrt{LC}}$ and has value 1A.

(3) The average value of current ‘i’ is independent of L.

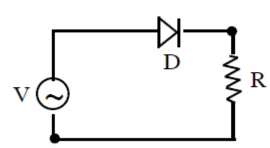
(4) None of these

55. Two identical capacitors A and B are charged to the same potential V and are connected in two circuits at t = 0 as shown in figure. The charges on the capacitors at a time $t = CR$ are, respectively,

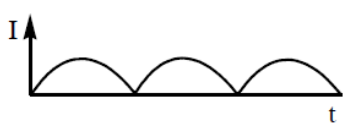


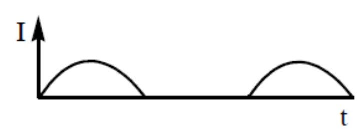
(1) VC, VC (2) VC/e, VC (3) VC, VC/e (4) VC/e, VC/e

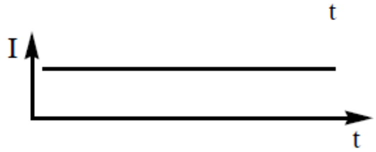
56. A p-n junction (D) shown in the figure can act as a rectifier. An alternating current source (V) is connected in the circuit.

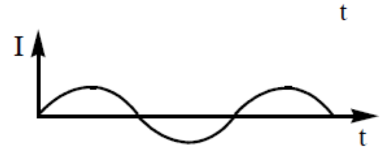


The current (I) in the resistor (R) can be shown by:

(1) 

(2) 

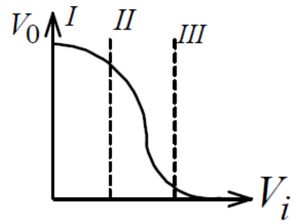
(3) 

(4) 

57. In saturation region of C – E circuit of a transistor

(1) Collector base junction is reverse biased while the base emitter junction is forward biased
(2) Collector base junction is forward biased while base emitter junction is reverse biased
(3) Collector base junction & base emitter junction reverse biased
(4) Collector base junction and base emitter junction forward biased

58. Transfer characteristics (output voltage V_0 input voltage V_i for a base biased transistor in CE configuration is as shown in the figure. For using transistor as a switch, it is used)

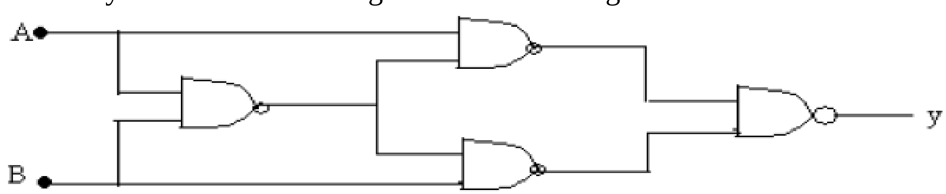


(1) in region II (2) In region I (3) In region III (4) Both in region (I) and (III)

59. A working transistor with its three legs marked P, Q and R is tested using a multimeter. No conduction is found between P and Q. By connecting the common (negative) terminal of the multimeter to R and the other (positive) terminal to P or Q, some resistance is seen on the multimeter. Which of following is true for the transistor?

(1) It is pnp transistor with R as collector
(2) It is a pnp transistor with R as emitter
(3) It is an npn transistor with R as collector
(4) It is an npn transistor with R as base

60. Truth table for system of four NAND gates as shown in figure is:



(1)

A	B	Y
0	0	0
1	1	1
1	0	1
1	1	0

(2)

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	1

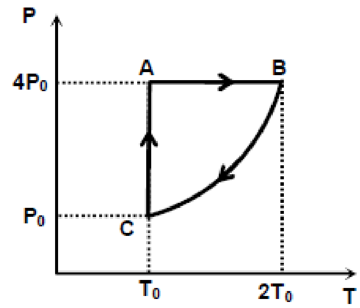
(3)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

(4)

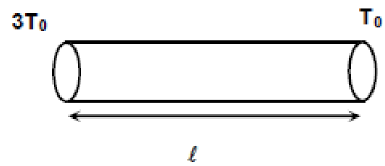
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

61. Two moles of an ideal monoatomic gas is taken through a cyclic process as shown in the P-T diagram. In the process BC, PT^{-2} = constant. Then the ratio of heat absorbed and heat released by the gas during the process AB and process BC respectively is



(1) 2 (2) 3 (3) 5 (4) 6

62. Two ends of a rod of uniform cross sectional area are kept at temperatures $3T_0$ and T_0 as shown. Thermal conductivity of rod varies as $k = \alpha T$, (where α is a constant and T is absolute temperature). In steady state, the temperature of the middle section of the rod is



(1) $\sqrt{7}T_0$ (2) $\sqrt{5}T_0$ (3) $2T_0$ (4) $\sqrt{3}T_0$

63. An ideal gas is taken through a process PT^3 = constant. The coefficient of thermal expansion of the gas in the given process is

(1) 1/T (2) 2/T (3) 3/T (4) 4/T

64. 4 kg of ice at $-20^\circ C$ is mixed with 5 kg of water at $40^\circ C$. The water content in the equilibrium mixture is (S_{water} = 1kcal/kg-C, S_{ice} = 0.5 kcal/kg-c, $L_{f(water)}$ = 80 kcal/kg)

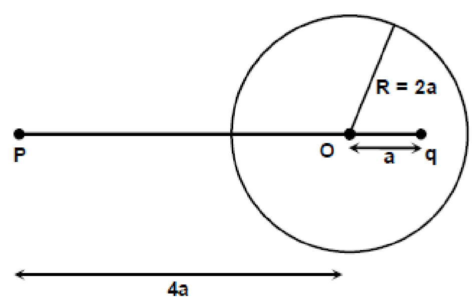
(1) 6 kg (2) 7 kg (3) 8 kg (4) 9 kg

65. The molar heat capacity of an ideal gas in a process varies as $C = C_V + \alpha T^2$(where C_V is molar heat capacity at constant volume and α is a constant). Then the equation of the process is

(1) $Ve^{-\left(\frac{\alpha T^2}{2R}\right)} = \text{constant}$ (2) $Ve^{-\left(\frac{\alpha T^2}{R}\right)} = \text{constant}$

(3) $Ve^{-\left(\frac{2\alpha T^2}{R}\right)} = \text{constant}$ (4) $Ve^{-\left(\frac{3\alpha T^2}{2R}\right)} = \text{constant}$

66. A point charge 'q' is placed at distance 'a' from the centre of an uncharged thin spherical conducting shell of radius R = 2a. A point 'P' is located at a distance '4a' from the centre of the conducting shell as shown. The electric potential due to induced charge on the inner surface of the conducting shell at point 'P' is

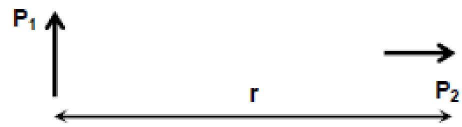


(1) $\frac{kq}{5a}$ (2) $-\frac{kq}{5a}$ (3) $\frac{kq}{4a}$ (4) $-\frac{kq}{4a}$

67. A solid sphere of radius 'R' density ' ρ ', and specific heat 'S' initially at temperature T_0 Kelvin is suspended in a surrounding at temperature 0K. Then the time required to decrease the temperature of the sphere from T_0 to $\frac{T_0}{2}$ Kelvin is (Assume sphere behaves like a black body)

(1) $\frac{\rho SR}{9\sigma T_0^3}$ (2) $\frac{5\rho SR}{9\sigma T_0^3}$ (3) $\frac{9\rho SR}{9\sigma T_0^3}$ (4) $\frac{8\rho SR}{9\sigma T_0^3}$

68. Two point electric dipoles with dipole moments 'P_1' and 'P_2' are separated by a distance 'r' with their dipole axes mutually perpendicular as shown. The force of interaction between the dipoles is $\left(\text{where, } k = \frac{1}{4\pi\varepsilon_0}\right)$

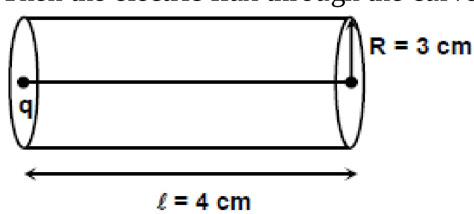


(1) $\frac{2kP_1P_2}{r^4}$ (2) $\frac{3kP_1P_2}{r^4}$ (3) $\frac{4kP_1P_2}{r^4}$ (4) $\frac{6kP_1P_2}{r^4}$

69. 4 moles of an ideal monoatomic gas is heated isobarically so that its absolute temperature increases 2 times. Then the entropy increment of the gas in this process is

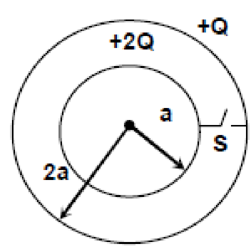
(1) 285. J/k (2) 42.5 J/k (3) 57.5 J/k (4) 76.5 J/k

70. A point charge 'q' is placed at the centre of left circular end of a cylinder of length ℓ = 4 cm and radius R = 3 cm as shown. Then the electric flux through the curved surface of the cylinder is



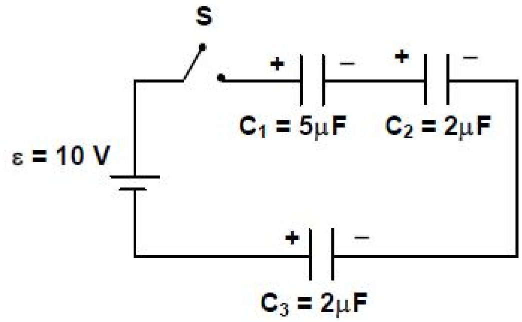
(1) $\frac{q}{5\varepsilon_0}$ (2) $\frac{2q}{5\varepsilon_0}$ (3) $\frac{3q}{5\varepsilon_0}$ (4) $\frac{4q}{5\varepsilon_0}$

71. Two concentric spherical conducting shells of radii 'a' and '2a' are initially given charges +2Q and +Q respectively as shown. The total heat dissipated after switch 'S' has been closed is (where $k = \frac{1}{4\pi\varepsilon_0}$)



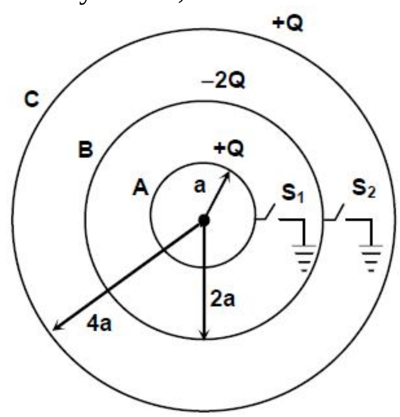
(1) $\frac{5kQ^2}{4a}$ (2) $\frac{kQ^2}{a}$ (3) $\frac{kQ^2}{2a}$ (4) $\frac{kQ^2}{4a}$

72. Three capacitors of capacitances 5 μF, 2 μF and 2 μF are charged to 20 V, 30 V and 10 V respectively and then connected in the circuit with polarities as shown. The magnitude of charge flown through the battery after closing the switch 'S' is



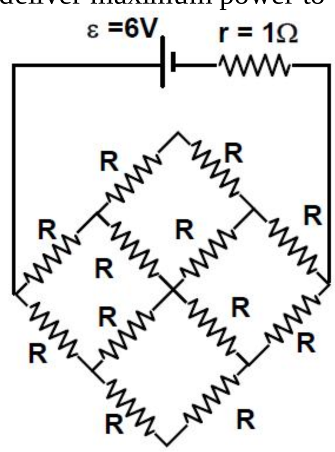
(1) 25μC (2) 40μC (3) 50μC (4) 75μC

73. Three concentric spherical conducting shells A, B and C of radii a, 2a and 4a are initially given charges +Q, -2Q and +Q respectively. The charge on the middle spherical shell 'B' after switches S_1 and S_2 are simultaneously closed, will be



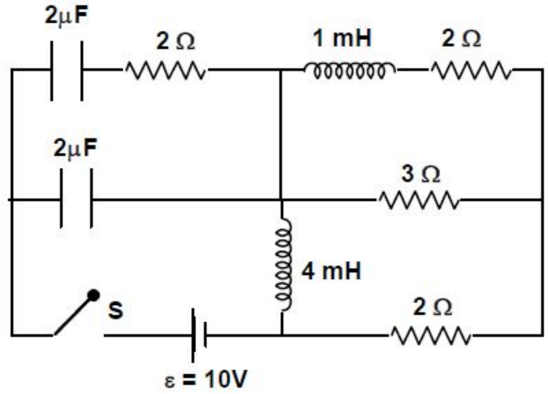
(1) –Q (2) $-\frac{Q}{2}$ (3) +Q (4) $\frac{+3Q}{2}$

74. In the circuit shown the cell will deliver maximum power to the network if the value of 'R' is



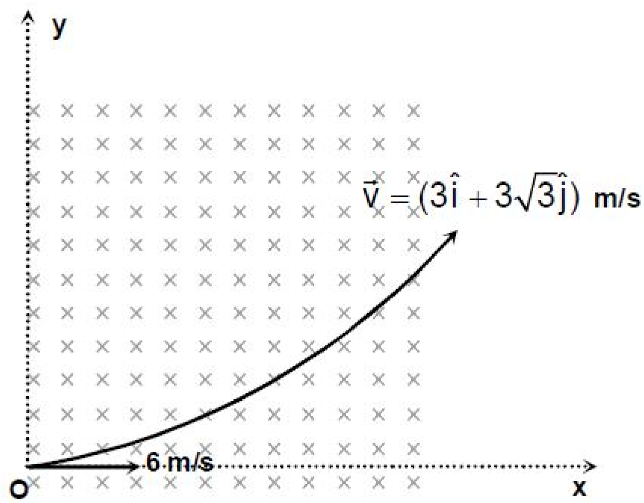
(1) $\frac{2}{3}\Omega$ (2) $\frac{4}{3}\Omega$ (3) $\frac{1}{3}\Omega$ (4) $\frac{5}{3}\Omega$

75. In the circuit shown, all the capacitors are initially uncharged. The current through the battery just after closing the switch 'S' is



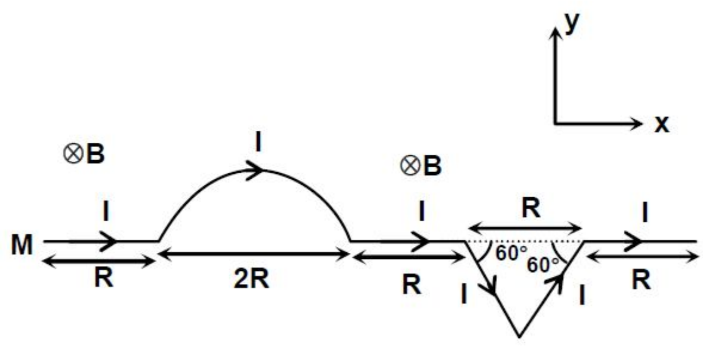
(1) 2 A (2) 4 A (3) 5 A (4) 10 A

76. A particle of charge 'q' and mass 'm' enters a uniform magnetic field region $\vec{B} = -B\hat{k}$ at origin 'O' with a velocity $\vec{v_0} = 6\hat{i}\ m/s$ and after some time it exits the magnetic field region with a velocity $\vec{v} = \left(3\hat{i} + 3\sqrt{3}\hat{j}\right) m/s$ as shown. The time interval for which the particle has moved in the magnetic field region is



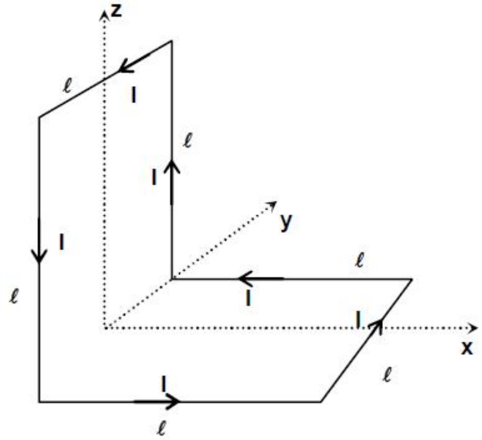
(1) $\frac{\pi m}{qB}$ (2) $\frac{\pi m}{2qB}$ (3) $\frac{\pi m}{3qB}$ (4) $\frac{\pi m}{4qB}$

77. A conducting wire MN carrying a current I is bent into the shape as shown and placed in xy plane. A uniform magnetic field $\vec{B} = -B\hat{k}$ is existing in the region. The net magnetic force experienced by the conducting wire MN is



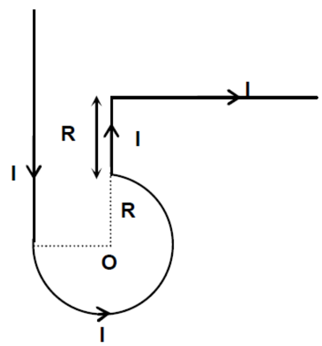
(1) 2BIR (2) 3BIR (3) 4BIR (4) 6BIR

78. A conducting loop carrying current 'I' is bent into two halves and placed in mutually perpendicular planes xy and yz planes as shown. A uniform magnetic field $\vec{B} = B\hat{j}$ is existing in the region. The net magnetic torque experienced by the loop is



(1) $BI\ell^2(\hat{k} - \hat{i})$ (2) $BI\ell^2(\hat{i} + \hat{j})$ (3) $BI\ell^2(\hat{j} - \hat{k})$ (4) $BI\ell^2(\hat{i} + \hat{k})$

79. A conducting wire carrying a current I is bent into the shape as shown. The net magnetic field at the centre 'O' of the circular arc of radius 'R' is

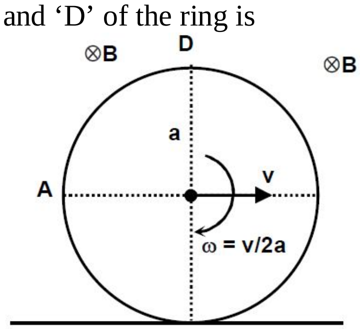


(1) $\frac{\mu_0 I}{2R}\left(\frac{1+3\pi}{\pi}\right)$ (2) $\frac{\mu_0 I}{4R}\left(\frac{1+3\pi}{\pi}\right)$ (3) $\frac{\mu_0 I}{8R}\left(\frac{1+3\pi}{\pi}\right)$ (4) $\frac{\mu_0 I}{8R}\left(\frac{2+3\pi}{\pi}\right)$

80. An infinitely long cylindrical wire of radius 'R' is carrying a current with current density $j = \alpha r^3$ (where α is constant and 'r' is the radial distance from the axis of the wire). If the magnetic field at $r = \frac{R}{2}$ is 'B_1' and at r = 2R is 'B_2' then the ratio $\frac{B_2}{B_1}$ is

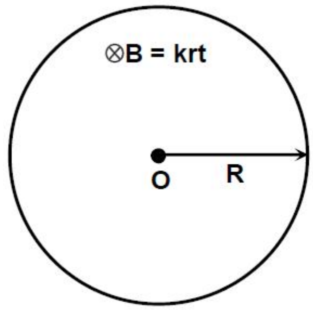
(1) 2 (2) 4 (3) 6 (4) 8

81. A circular conducting ring of radius 'a' is rolling with slipping on a horizontal surface as shown. A uniform magnetic field 'B' is existing perpendicular to the plane of motion of the ring. The emf induced between the points 'A' and 'D' of the ring is



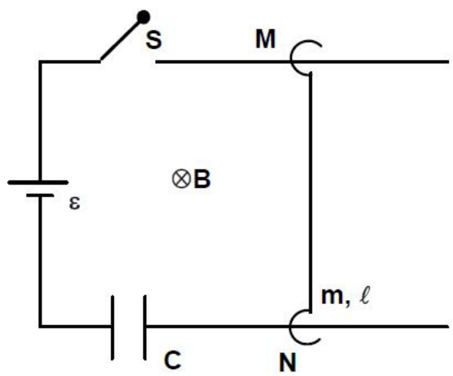
(1) $B\omega a^2$ (2) $2B\omega a^2$ (3) $4B\omega a^2$ (4) $6B\omega a^2$

82. A time varying magnetic field B = krt (where k is a constant, r is the radial distance from centre 'O') is existing in a circular region of radius 'R' as shown. If induced electric field at $r = \frac{R}{2}$ is E_1 and at $r = 2R$ is E_2 then the ratio $\frac{E_2}{E_1}$ is



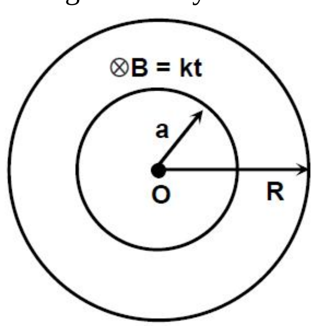
(1) 6 (2) 4 (3) 2 (4) 1

83. A conducting rod MN of mass 'm and length 'ℓ' is placed on parallel smooth conducting rails connected to an uncharged capacitor of capacitance 'C' and a battery of emf ε as shown. A uniform magnetic field 'B' is existing perpendicular to the plane of the rails. The steady state velocity acquired by the conducting rod MN after closing switch S is (neglect the resistance of the parallel rails and the conducting rod)



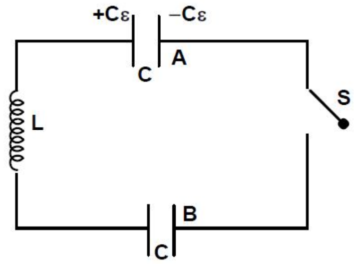
(1) $\frac{2CB\ell\varepsilon}{(m+CB^2\ell^2)}$ (2) $\frac{CB\ell\varepsilon}{(m+CB^2\ell^2)}$ (3) $\frac{CB\ell\varepsilon}{2(m+CB^2\ell^2)}$ (4) $\frac{CB\ell\varepsilon}{4(m+CB^2\ell^2)}$

84. Charge 'q' is uniformly distributed along the length of a non-conducting circular ring of mass 'm' and radius 'a'. The ring is placed concentrically on a rough horizontal circular surface of radius 'R'. A time varying magnetic field B = kt (where k is constant) is existing perpendicular to the plane of circular region of radius 'R' as shown. The minimum coefficient of friction between the ring and the surface required to keep the ring stationary is



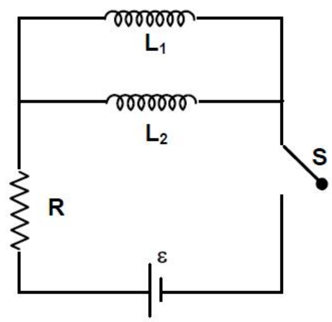
(1) $\frac{2kqa}{mg}$ (2) $\frac{kqa}{mg}$ (3) $\frac{kqa}{2mg}$ (4) $\frac{kqa}{4mg}$

85. Initially capacitor 'A' is charged to a potential drop 'ε' and capacitor B is uncharged. At t = 0, switch 'S' is closed, then the maximum current through the inductor is



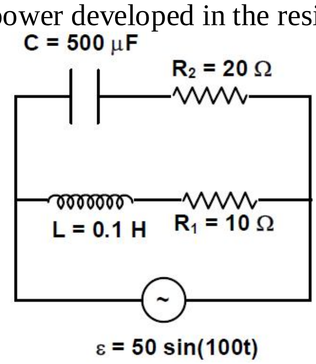
(1) $\varepsilon\sqrt{\frac{C}{2L}}$ (2) $\varepsilon\sqrt{\frac{C}{L}}$ (3) $2\varepsilon\sqrt{\frac{C}{L}}$ (4) $\frac{\varepsilon}{2}\sqrt{\frac{C}{L}}$

86. In the circuit shown, switch's is closed at t = 0. Then the ratio $\frac{U_1}{U_2}$ of potential energy stored in the inductors L_1 and L_2 in steady state is



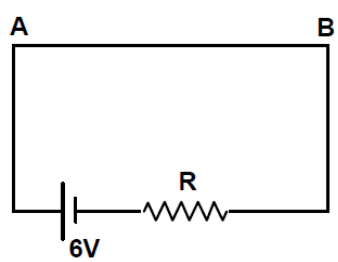
(1) $\frac{L_1}{L_2}$ (2) $\frac{L_2}{L_1}$ (3) $\left(\frac{L_1}{L_2}\right)^2$ (4) $\left(\frac{L_2}{L_1}\right)^2$

87. In the circuit shown the average power developed in the resistor 'R_1' is



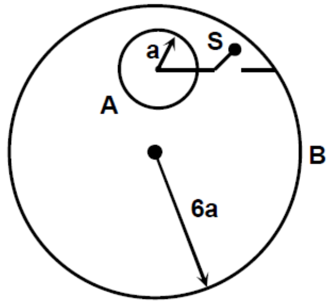
(1) 31.25 W (2) 62.50 W (3) 125 W (4) 250 W

88. A uniform potentiometer wire AB of length 100 cm has a resistance of 5Ω and it is connected in series with an external resistance 'R' and a cell of emf 6V and negligible internal resistance. If a source of potential drop 2V is balanced against a length of 60 cm of the potentiometer wire, the value of resistance 'R' is



(1) 1Ω (2) 2Ω (3) 4Ω (4) 6Ω

89. A small spherical conductor ‘A’ of radius ‘a’ is initially charged to a potential ‘V’ and then placed inside an uncharged spherical conducting shell ‘B’ of radius ‘6a’ as shown. The potential of the spherical conductor ‘A’ after closing the switch ‘S’ is



(1) V (2) $\frac{V}{3}$ (3) $\frac{V}{2}$ (4) $\frac{V}{6}$

90. Two moles of an ideal diatomic gas is taken through a process VT^2 = constant so that its temperature increases by $\Delta T = 300$ K. The ratio $\left(\frac{\Delta U}{\Delta Q}\right)$ of increase in internal energy and heat supplied to the gas during the process is

(1) 2 (2) 3 (3) 4 (4) 5

IIT – JEE - 2019 **TW TEST (3 Yrs.)**
ANSWER KEY **DATE:24/10/18**

TOPIC: ELECTROSTATICS, MAGNETISM, MODERN PHYSICS, HEAT & THERMODYNAMICS)

1.	(3)	2.	(4)	3.	(4)	4.	(2)	5.	(4)	6.	(4)	7.	(4)
8.	(1)	9.	(4)	10.	(1)	11.	(3)	12.	(2)	13.	(4)	14.	(1)
15.	(4)	16.	(3)	17.	(1)	18.	(1)	19.	(3)	20.	(4)	21.	(3)
22.	(1)	23.	(4)	24.	(2)	25.	(1)	26.	(2)	27.	(2)	28.	(3)
29.	(1)	30.	(4)	31.	(2)	32.	(3)	33.	(2)	34.	(3)	35.	(3)
36.	(4)	37.	(3)	38.	(3)	39.	(1)	40.	(2)	41.	(1)	42.	(1)
43.	(4)	44.	(2)	45.	(3)	46.	(1)	47.	(3)	48.	(4)	49.	(2)
50.	(1)	51.	(2)	52.	(3)	53.	(1)	54.	(2)	55.	(2)	56.	(2)
57.	(1)	58.	(4)	59.	(1)	60.	(1)	61.	(3)	62.	(2)	63.	(4)
64.	(2)	65.	(1)	66.	(2)	67.	(3)	68.	(2)	69.	(3)	70.	(2)
71.	(2)	72.	(1)	73.	(2)	74.	(1)	75.	(1)	76.	(3)	77.	(4)
78.	(1)	79.	(3)	80.	(4)	81.	(2)	82.	(3)	83.	(2)	84.	(3)
85.	(1)	86.	(2)	87.	(2)	88.	(3)	89.	(4)	90.	(4)		