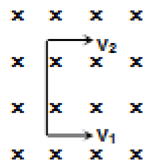
EXERCISE 02

SECTION : (A) - Single Correct Options

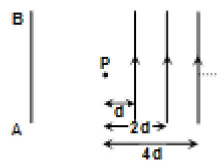
652. In a current carrying wire, the area of cross section (A) varies continuously. For a constant voltage across the wire, which of the following plots best represents the variation of current density (J)

653. In the figure magnetic field points into the plane of paper and the rod of length ℓ is moving in this field such that the bottom most point has a velocity v_1 and the topmost point has the velocity v_2 ($v_2 > v_1$). The emf induced is given by



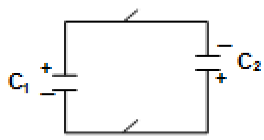
(A) $Bv_1\ell$ (B) $Bv_2\ell$ (C) $\frac{1}{2}B(v_2 + v_1)\ell$ (D) $\frac{1}{2}B(v_2 - v_1)\ell$

654. Infinite number of wires each having infinite length and carrying current i are placed as shown. A wire AB of infinite length carrying same current i is placed at a distance ℓ from P, the direction of current in wire AB and distance ℓ so that magnetic field at P is zero will be



(A) same direction, d
(B) same direction, d/2
(C) opposite direction, d
(D) opposite direction, d/2

655. Two capacitors $c_1 = 1\ \mu F$ and $c_2 = 3\ \mu F$ are charged to potential difference 20 v and 30 v by batteries. They are then disconnected from the batteries and connected across each other as shown i.e. their plates are connected with opposite polarity, then final potential difference is

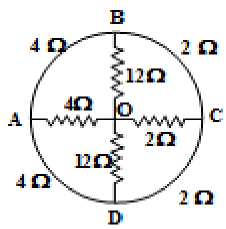


(A) 13.75 V (B) 27.9 V (C) 17.5 V (D) none of these

656. A narrow electron beam passes undeviated through an electric field $E = 3 \times 10^4$ V/m and an overlapping magnetic field $B = 2 \times 10^{-3}$ wb/m^2. Which are perpendicular to each other, then speed of the electron is

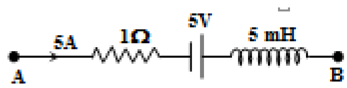
(A) 60 m/s (B) 10.3×10^7 m/s (C) 1.5×10^7 m/s (D) 0.67×10^{-7} m/s

657. The resistance between OA is given by



(A) 1 Ω (B) 2 Ω (C) 3 Ω (D) 4 Ω

658. The circuit segment shown is a part of a network. The current is 5A and is increasing at the rate of 10^3 A/s. The potential difference $V_A - V_B$ is

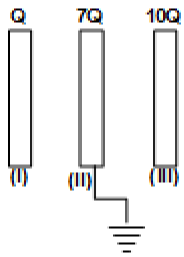


(A) 10 V (B) zero (C) –10 V (D) 5 V

659. Electric field in a region is given by $\vec{E} = (2\hat{i} + 3\hat{j} - 4\hat{k})$ v/m. Another electric field due to a uniformly and positively charged infinite plane is superposed on the given field. The resultant field is observed to be $\vec{E} = (\hat{i} + \hat{j} - 4\hat{k})$ v/m. the surface charge density of the plane is

(A) $2\sqrt{3}\varepsilon_0$ (B) $2\sqrt{5}\varepsilon_0$ (C) $3\sqrt{2}\varepsilon_0$ (D) $\sqrt{5}\varepsilon_0$

660. Three very large identical metal plates are given charges as shown. After earthing the plate II, final charge on the left side of I plate will be

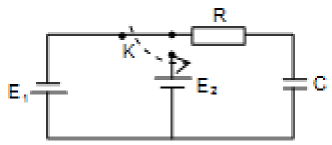


(A) –8Q (B) 9Q (C) Q/2 (D) none of these

661. Ends of two wires A and B having resistivity $\rho_A = 3 \times 10^{-5}$ Ωm and $\rho_B = 6 \times 10^{-5}$ Ωm of same cross section area are joined together to form a single wire. If the resistance of the joined wire does not change with temperature, then find the ratio of their lengths, given that temperature coefficient of resistivity of wire A and B is $\alpha_A = 4 \times 10^{-5}$ / ^{0}C and $\alpha_B = -6 \times 10^{-6}$ /^{0}C. Assume that mechanical dimensions do not change with temperature.

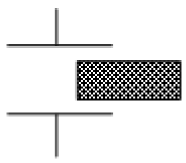
(A) $\frac{3}{7}$ (B) $\frac{10}{3}$ (C) $\frac{3}{10}$ (D) $\frac{1}{2}$

662. Two batteries of emf E_1 and E_2, a capacitor of capacitance C, and a resistor R are connected in a circuit as shown in figure. Then, the amount of heat Q liberated in the resistor after switching the key k will be

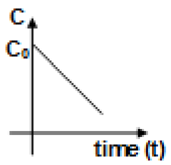


(A) $C(E_1 + E_2)^2$ (B) $\frac{C(E_1+E_2)^2}{2}$ (C) $\frac{C}{4}(E_1+E_2)^2$ (D) $\frac{1}{2}CE_1^2$

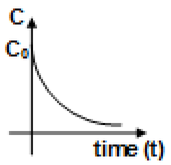
663. A parallel plate capacitor has a dielectric slab of dielectric constant k in it. The slab just fills the space inside the capacitor. The capacitor is charged by a battery and then battery is disconnected. Now the slab is pulled out slowly at t = 0 with constant velocity v. If at time t =0 capacitance of the capacitor is C_0, then the curve between C and time t will be



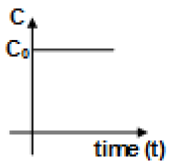
(A)



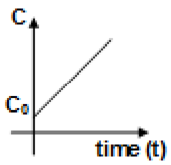
(B)



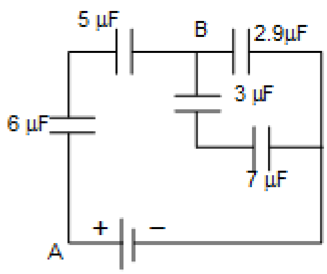
(C)



(D)



664. In the circuit shown if in steady state the potential difference between points A and B is 11V, then potential difference across 7 μ F capacitor is



(A) 1.8 V (B) 2.4 V (C) 3.6 V (D) 3.6 V

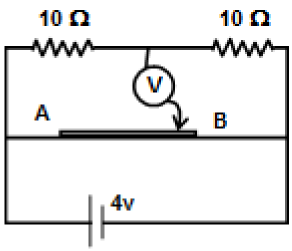
665. Three charges q, q and -2q are fixed on the vertices of an equilateral triangular plate of edge length a. This plate is in equilibrium between two very large plates having surface charge density σ_1 and σ_2 respectively. Find time period of small angular oscillation about an axis passing through its centroid and perpendicular to plane. Moment of inertia of the system about this axis is I.

(A) $2\pi\sqrt{\dfrac{\varepsilon_0 I}{q_a\,|\sigma_1-\sigma_2|}}$ (B) $2\pi\sqrt{\dfrac{\varepsilon_0 I}{2q_a\,|\sigma_1-\sigma_2|}}$ (C) $2\pi\sqrt{\dfrac{2\varepsilon_0 I}{\sqrt{3}q_a\,|\sigma_1-\sigma_2|}}$ (D) $2\pi\sqrt{\dfrac{2\varepsilon_0 I}{q_a\,|\sigma_1-\sigma_2|}}$

666. A resistor of resistance R, capacitor of capacitance C and inductor of inductance L are connected in parallel to AC power source of voltage $\varepsilon_0 \sin \omega t$. The maximum current through the resistance is half of the maximum current through the power source. Then value of R is

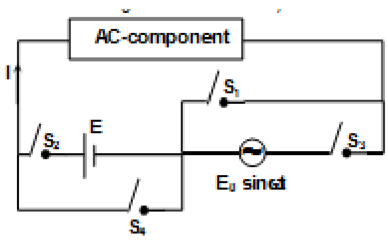
(A) $\dfrac{\sqrt{3}}{\left|\omega C-\dfrac{1}{\omega L}\right|}$ (B) $\sqrt{3}\left|\dfrac{1}{\omega C}-\omega L\right|$ (C) $\sqrt{5}\left|\dfrac{1}{\omega C}-\omega L\right|$ (D) none of these

667. A potentiometer wire AB as shown is 40 cm long of resistance 50 Ω/m free end of an ideal voltmeter is touching the potentiometer wire. What should be the velocity of the jockey as a function of time so that reading in voltmeter is varying with time as (2 sinπt). (Assuming negative terminal of the battery at zero potentially)



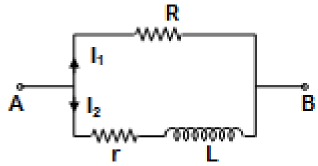
(A) $10\pi \sin \pi t$ cm/s (B) $10\pi \cos \pi t$ cm/s (C) $20\pi \sin \pi t$ cm/s (D) $20\pi \cos \pi t$ cm/s

668. In the given circuit if switches S_3 and S_4 are open, keeping S_1 and S_2 closed, the value of I is I_0. If switches S_1 and S_2 are open, keeping S_3 and S_4 closed, the value of I is $I_0 \sin \omega t$. Now, if switches S_1 and S_4 are open keeping S_2 and S_3 closed, the value of rms current through the AC-component, during one complete cycle, is



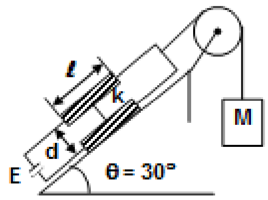
(A) $I_0\left(1+\dfrac{1}{\sqrt{2}}\right)$ (B) $\dfrac{I_0}{\sqrt{2}}$ (C) $I_0\left(1-\dfrac{1}{\sqrt{2}}\right)$ (D) $\sqrt{\dfrac{3}{2}}I_0$

669. A sinusoidal voltage is applied across the point A and B and it is observed that the total current through the circuit lags behind the external voltage by an angle 30°. If the peak value of current I_2 is 2A and it lags behind the external voltage by 45°, calculate the peak value of the total current.



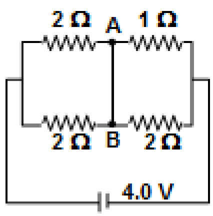
(A) 2A (B) 2√2A (C) √2A (D) none of these

670. The capacitor plates are fixed on an inclined plane and connected to a battery of emf e. The capacitor plates have plate area A, length ℓ and the distance between them is d. A dielectric slab of mass m and dielectric constant K is inserted into the capacitor and tied to a mass M by a massless string as shown in the figure. Find the value of M for which the slab will stay in equilibrium. There is no friction between slab and plates.



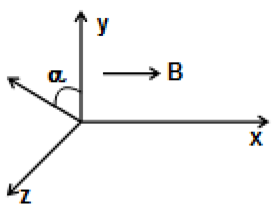
(A) $\frac{m}{2}+\frac{E^2\varepsilon_0 A(k-1)}{2\ell gd}$ (B) $\frac{m}{2}-\frac{E^2\varepsilon_0 A(k-1)}{2\ell gd}$ (C) $\frac{m}{2}+\frac{E^2\varepsilon_0 A(k-1)}{\ell gd}$ (D) $\frac{m}{2}-\frac{E^2\varepsilon_0 A(k-1)}{\ell gd}$

671. In the figure shown, points A and B are connected by a perfectly conducting wire. Calculate the current through AB.



(A) 2A (B) 1A (C) 1.5 A (D) 2.5 A

672. In a region of space, a uniform magnetic field B exists in the x direction. An electron is fired from the origin with its initial velocity u making an angle α with the y – direction in the yz plane. In the subsequent motion of the electron



(A) y – coordinate of the electron never be negative

(B) z – coordinate of the electron never be negative

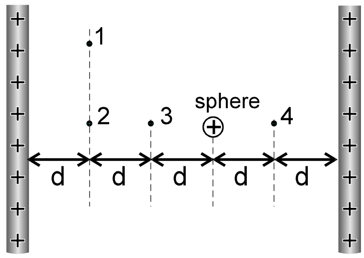
(C) x – coordinate of the electron never be negative.

(D) trajectory of the electron would be helical.

673. A non conducting ring of radius r and mass m has a uniformly distributed charge Q. A magnetic field perpendicular to the plane of the ring changes at the rate $\frac{dB}{dt} = k$. The angular velocity of the ring after a time internal Δt is,

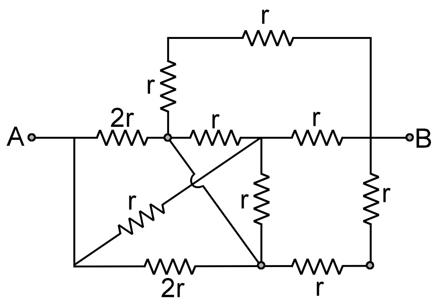
(A) zero (B) $\frac{Qk\Delta t}{m}$ (C) $\frac{Qk\Delta t}{2m}$ (D) $\frac{\pi Qk\Delta t}{m}$

674. The figure shows two large, closely placed, parallel, nonconducting sheets with identical (positive) uniform surface charge densities, and a sphere with a uniform (positive) volume charge density. Four points marked as 1, 2, 3 and 4 are shown in the space in between. If E_1, E_2, E_3 and E_4 are magnitude of net electric fields at these points respectively then :



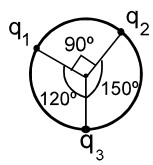
(A) $E_1 > E_2 > E_3 > E_4$ (B) $E_1 > E_2 > E_3 = E_4$ (C) $E_3 = E_4 > E_2 > E_1$ (D) $E_1 = E_2 = E_3 = E_4$

675. The equivalent resistance between A and B in the arrangement of resistances as shown, is :



(A) 4r (B) 3r (C) 2.5r (D) r

676. Three positive point charges q_1, q_2 and q_3 form an isolated system. Suppose the charges have generated a property due to which like charges attract. The charges are moving along a circle with same speed, maintaining angles as shown in the figure. The charge q_1 experiences a force f_1 due to other two charges. Similarly q_2 experiences a force f_2 and q_3, a force f_3. The ratio $f_1 : f_2 : f_3$ is

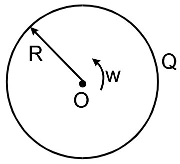


(A) 1 : 1 : 1 (B) $q_1 : q_2 : q_3$

(C) $1 : \sqrt{3} : 2$ (D) this ratio can not be calculated.

SECTION : (B) - More Than One Correct Options

677. A nonconducting disc having uniform positive charge Q, is rotating about its axis with uniform angular velocity ω. The magnetic field at the center of the disc is.



(A) directed outward

(B) having magnitude $\frac{\mu_0 Q\omega}{4\pi R}$

(C) directed inwards

(D) having magnitude $\frac{\mu_0 Q\omega}{2\pi R}$

678. A parallel plate capacitor of capacitance 10 μF is connected to a cell of emf 10 Volt and fully charged. Now a dielectric slab (k=3) of thickness equal to the gap between the plates, is completely filled in the gap, keeping the cell connected. During the filling process :

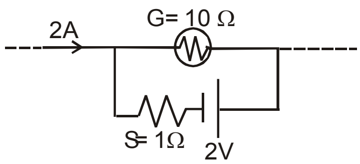
(A) The increase in charge on the capacitor is 200 μC.

(B) The heat produced is zero.

(C) Energy supplied by the cell = increase in stored potential energy + work done on the person who is filling the dielectric slab.

(D) Energy supplied by the cell = increase in stored potential energy + work done on the person who is filling the dielectric slab + heat produced.

679. The galvanometer shown in the figure has resistance 10Ω .It is shunted by a series combination of a resistance S = 1Ω and an ideal cell of emf 2V. A current 2A passes as shown.



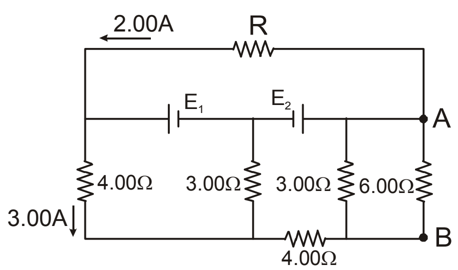
(A) The reading of the galvanometer is 1A

(B) The reading of the galvanometer is zero

(C) The potential difference across the resistance S is 1.5 V

(D) The potential difference across the resistance S is 2 V

680. In the circuit shown in figure, E_1 and E_2 are two ideal sources of unknown emfs. Some currents are shown. Potential difference appearing across 6Ω resistance is $V_A - V_B = 10V$.



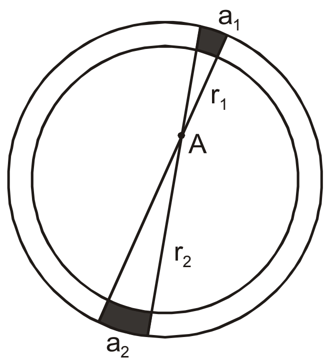
(A) The current in the 4.00 Ω resistor is 5A.

(B) The unknown emf E_1 is 36 V.

(C) The unknown emf E_2 is 54 V.

(D) The resistance R is equal to 9 Ω.

681. A wire having a uniform linear charge density λ, is bent in the form of a ring of radius R. Point A as shown in the figure, is in the plane of the ring but not at the centre. Two elements of the ring of lengths a_1 and a_2 subtend very small same angle at the point A. They are at distances r_1 and r_2 from the point A respectively.



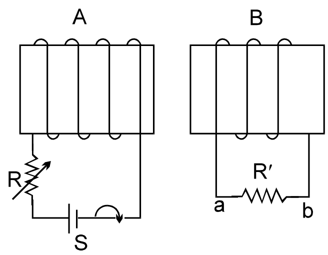
(A) The ratio of charge of elements a_1 and a_2 is r_1/r_2.

(B) The element a_1 produced greater magnitude of electric field at A than element a_2.

(C) The elements a_1 and a_2 produce same potential at A.

(D) The direction of net electric field at A is towards element a_2.

682. For the given electromagnetically coupled circuits: (S is initially in closed state)



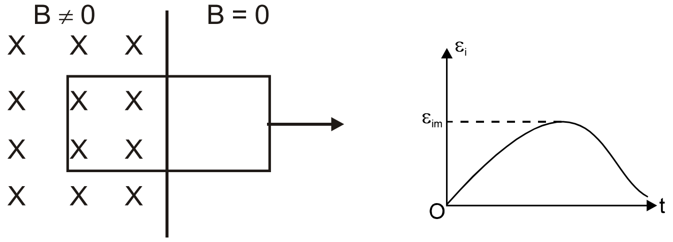
(A) When switch S is opened current in R′ flows from a to b

(B) When switch S is opened current in R′ flows from b to a

(C) When coil B is brought closer to coil A current in R′ flows from b to a

(D) When R is decreased then current in R′ flows from b to a

683. A plane rectangular loop is placed in a magnetic field. The emf induced in the loop due to this field is ε_i whose maximum value is ε_{im}. The loop was pulled out of the magnetic field at a variable velocity. Assume the $\vec{B}$ is uniform and constant. ε_i is plotted against time t as shown in the graph. Which of the following are/is correct statement(s):



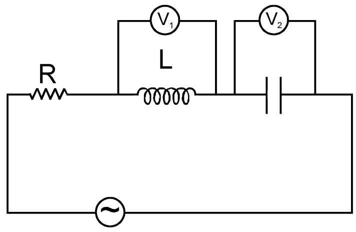
(A) ε_{im} is independent of rate of removal of coil from the field.

(B) The total charge that passes through any point of the loop in the process of complete removal of the loop does not depend on velocity of removal.

(C) The total area under the curve (ε_i vs t) is independent of rate of removal of coil from the field.

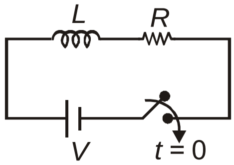
(D) The area under the curve is dependent on the rate of removal of the coil.

684. In the figure shows R = 100 Ω, $L = \frac{2}{\pi}$ H and $C = \frac{8}{\pi}\mu F$ are connected in series with an a.c. source of 200 volt and frequency 'f'. V_1 and V_2 are two hot-wire voltmeters. If the readings of V_1 and V_2 are same then:



(A) f = 125 Hz
(B) f = 250 π Hz
(C) current through R is 2A
(D*) $V_1 = V_2$ = 1000 volt

685. The switch is closed at t = 0, in the LR circuit shown



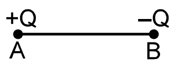
(A) At t = 0, voltage across inductor is V

(B) At t = 0, energy stored by the inductor is zero

(C) At $t = \frac{L}{R}$, energy stored by the inductor is less than half of the energy stored by the inductor at $t = \infty$

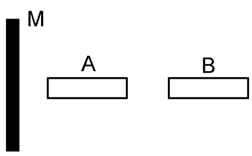
(D) At $t = \frac{L}{R}$, rate of heat dissipation in the circuit is more than half of the rate of heat dissipation at $t = \infty$

686. Two point charges of the same magnitude and opposite sign are fixed at points A and B. A third point charge is to be balanced at point P by the electrostatic force due to these two charges. The point P cannot lie at:



(A) the perpendicular bisector of line AB
(B) the mid point of line AB
(C) the left of A
(D) none of these.

687. A large nonconducting sheet M is given a uniform charge density. Two uncharged small metal rods A and B are placed near the sheet as shown in figure.



(A) M attracts A
(B) M attracts B
(C) A attracts B
(D) B attracts A

688. At distance of 5cm and 10cm outwards from the surface of a uniformly charged solid sphere, the potentials are 100V and 75V respectively. Then

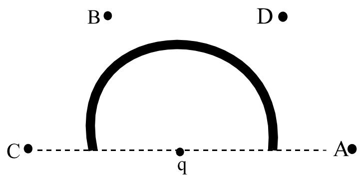
(A) potential at its surface is 150V.

(B) the charge on the sphere is (5/3) × 10^{-9}C.

(C) the electric field on the surface is 1500 V/m.

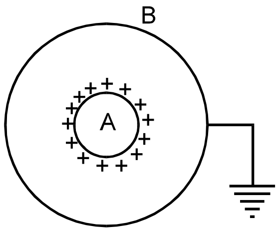
(D) the electric potential at its centre is 225V.

689. Figure shows a charge q placed at the centre of a hemisphere. A second charge Q is placed at one of the positions A, B, C and D. In which position(s) of this second charge, the flux of the electric field through the hemisphere remains unchanged ?



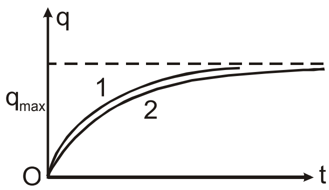
(A) A (B) B (C) C (D) D

690. A and B are two concentric spherical shells. A is given a charge Q while B is uncharged. If now B is earthed as shown in Figure.Then:



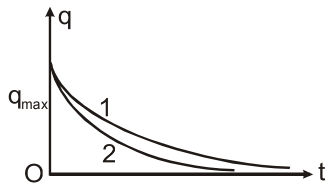
(A) The charge appearing on inner surface of B is -Q
(B) The field inside and outside A is zero
(C) The field between A and B is not zero
(D) The charge appearing on outer surface of B is zero

691. The charge on the capacitor in two different RC circuits 1 and 2 are plotted as shown in figure. Choose the correct statement(s) related to the two circuits.



(A) Both the capacitors are charged to the same magnitude of charge
(B) The emf's of cells in both the circuits are equal.
(C) The emf's of the cells may be different
(D) The emf E_1 is more than E_2

692. The instantaneous charge on a capacitor in two discharging RC circuits is plotted with respect to time in figure. Choose the correct statement(s) (where E_1 and E_2 are emf of two DC sources in two different charging circuits).



(A) $R_1C_1 > R_2C_2$ (B) $\frac{R_1}{R_2} < \frac{C_2}{C_1}$ (C) $R_1 > R_2$ if $E_1 = E_2$ (D) $C_2 > C_1$ if $E_1 = E_2$

693. *A parallel plate capacitor of capacitance 10 mF is connected to a cell of emf 10 Volt and fully charged. Now a dielectric slab (k=3) of thickness equal to the gap between the plates, is completely filled in the gap, keeping the cell connected. During the filling process :*

(A) The increase in charge on the capacitor is 200 μC.

(B) The heat produced is zero.

(C) Energy supplied by the cell = increase in stored potential energy + work done on the person who is filling the dielectric slab.

(D) Energy supplied by the cell = increase in stored potential energy + work done on the person who is filling the dielectric slab + heat produced.

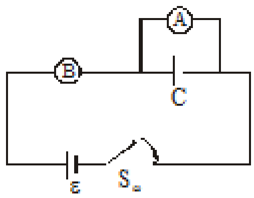
694. A capacitor of capacitance C is connected to two voltmeters A and B. A is an ideal voltmeter having infinite resistance, while B has resistance R. The capacitor is uncharged and then the switch S_ω is closed at t = 0,

(a) readings of B and A will be ε and zero at t = 0

(b) during time interval ($0 \le t < \infty$) readings of B and A are changing

(c) reading of A and B will be equal at t = RC ln 2

(d) none of these



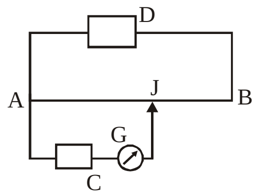
695. The figure shows a potentiometer arrangement. D is the driving cell while C is the cell whose emf is to be measured. AB is the potentiometer wire and G is a galvanometer. J is the jockey which can touch any point on AB. Which of the following is/are essential conditions for obtaining balance point

(a) the emf of D must be greater than the emf of C

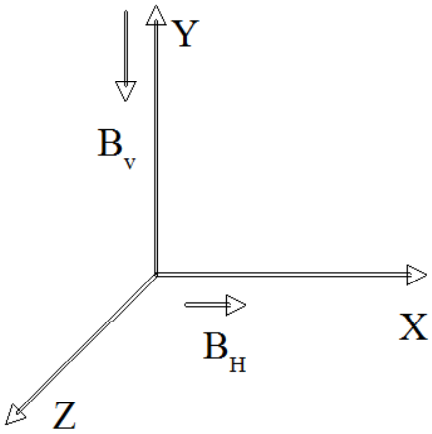
(b) either the positive terminals of both D and C or the negative terminals of both D and C must be joined to A

(c) the positive terminals of D and C must be joined to A

(d) the resistance of G must be less than the resistance of AB



696. At a given place horizontal and vertical component of earth's magnetic field B_H and B_v are along X and Y axis respectively. The total flux of earth's magnetic field associated with an area S is:



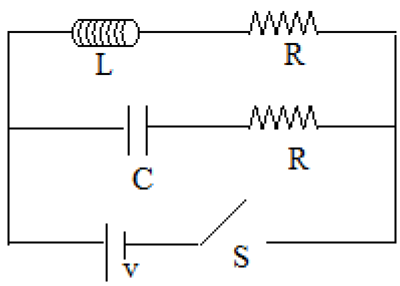
(a) Zero if area S is in X-Y plane.

(b) B_HS if area S is in Y-Z plane.

(c) - B_vS if area S is in X-Z plane.

(d)- B_HS if area S is in X-Z plane.

697. In the circuit shown $R = \sqrt{\frac{L}{C}}$, Switch S is closed at time t =0. The time constant of L-R and C-R, part of the circuit is τ_L and τ_C then :



(a) $\tau_L = \tau_C$

(b) $\tau_L = 2\tau_C$

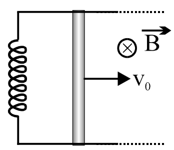
(c) After time t = CR ln 2, the current through capacitor and inductor will be equal.

(d) After time $t = \frac{L}{R\ln 2}$, the current through inductor and capacitor will be equal.

698. Which of the following(s) is/are conservative field(s) ?

(a) $\vec{E} = 4\hat{i} + 5\hat{j} + 6\hat{k}$ (b) $\vec{E} = \frac{x\hat{i} + y\hat{j} + z\hat{k}}{(x^2+y^2+z^2)^{3/2}}$ (c) $\vec{E} = 3x\hat{i}$ (d) $\vec{E} = x\hat{j} - y\hat{i}$

699. A loop is formed by two parallel conductors connected by a solenoid with inductance L and a conducting rod of mass M which can freely slide over the conductors. The conductors are located in a uniform magnetic field with induction B perpendicular to the plane of loop. The distance between conductors is *l*. At t = 0, the rod is given a velocity v_0 directed towards right and the current through the inductor is initially zero.



(a) The maximum current in circuit during the motion of rod is $v_0\sqrt{\frac{M}{L}}$.

(b) The rod moves for some distance and comes to permanently rest.

(c) The velocity of rod when current in the circuit is half of maximum is $\frac{\sqrt{3}}{2}v_0$.

(d) The rod oscillates in SHM.

700. Capacitor C_1 of capacitance 1μF and capacitor C_2 of capacitance 2μF are separately charged fully by a common battery. The two capacitors are then separately allowed to discharge through equal resistors at time t = 0.

(a) The current in each of the two discharging circuits is zero at t = 0

(b) The currents in the two discharging circuits at t = 0 are equal but not zero

(c) The currents in the two discharging circuits at t = 0 are unequal

(d) Capacitor C_1, loses 50% of its initial charge sooner than C_2 loses 50% of its initial charge

701. In the series L – C – R circuit, the voltage across resistance, capacitance and inductance are 30V each at frequency $f = f_0$.

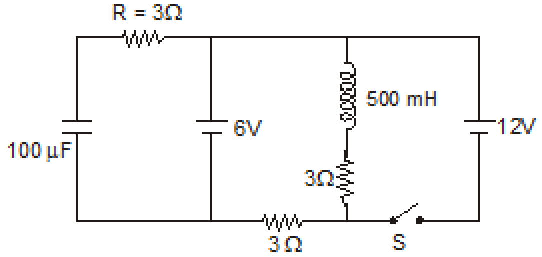
(a) It the inductor is short-circuited, the voltage across the capacitor will be $30\sqrt{2}$ V.

(b) If the capacitor is short-circuited, the voltage drop across the inductor will be $\frac{30}{\sqrt{2}}$ V.

(c) If the frequency is changed to $2f_0$, the ratio of reactance of the inductor to that of the capacitor is 4 : 1.

(d) If the frequency is changed to $2f_0$, the ratio of the reactance of the inductor to that of the capacitor is 1 : 4.

702. In the given circuit switch is closed at $t = 0$,



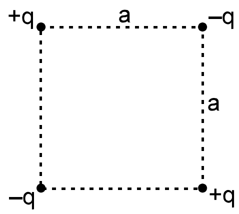
(a) Current in the inductor when the circuit reaches the steady state is 4 A.

(b) The net change in flux in the inductor is 1.5 Wb.

(c) The time constant of the circuit after closing S is 555.55 s.

(d) The charge stored in the capacitor in the steady state is 1.2 mC.

703. In a system of two dipoles placed in the way as shown in figure :



(A) It is possible to consider a spherical surface of radius a and whose centre lies within the square shown, through which total flux is + ve

(B) It is possible to consider a spherical surface of radius a and whose centre lies within the square shown through which total flux is – ve

(C) It is possible to consider a spherical surface of radius a and whose centre lies within the square shown through which total flux is zero

(D) There are two points within the square at which electric field is zero

704. Pick the correct statements.

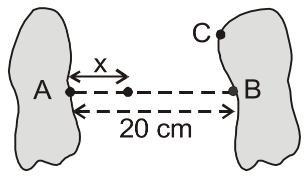
(A) If a point charge is placed off-centre inside an electrically neutral spherical metal shell then induced charge on its inner surface is uniformly distributed.

(B) If a point charge is placed off-centre inside an electrically neutral, isolated spherical metal shell, then induced charge on its outer surface is uniformly distributed.

(C) A non-metal shell of uniform charge attracts or repels a charged particle that is outside the shell as if all the shell's charge were concentrated at the centre of the shell.

(D) If a charged particle is located inside a non-metal shell of uniform charge, there is no electrostatic force on the particle due to the shell

705. Two metallic bodies separated by a distance 20 cm, are given equal and opposite charges of magnitude 0.88 μC. The component of electric field along the line AB, between the plates, varies as $E_x = 3x^2 + 0.4$ N/C, where x (in meters) is the distance from one body towards the other body as shown.



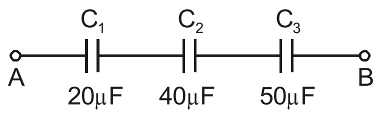
(A) The capacitance of the system is 10μF

(B) The capacitance of the system is 20μF

(C) The potential difference between A and C is 0.088 Volt.

(D) The potential difference between A and C cannot be determined from the given data.

706. In the arrangement shown, a potential difference is applied between points A and B. No capacitor can withstand a potential difference of more than 100 V.



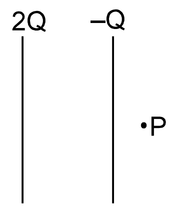
(A) The magnitude of the maximum potential difference that can exist between points A and B is 300 V.

(B) The maximum potential difference that can exist across C_2 is 50 V.

(C) The maximum charge that can be stored by C_3 is 2 mC.

(D) The maximum energy that can be stored in the three capacitor arrangement is 190 mJ

707. In the figure shown the plates of a parallel plate capacitor have unequal charges. Its capacitance is 'C'. P is a point outside the capacitor and close to the plate of charge –Q. The distance between the plates is 'd'.



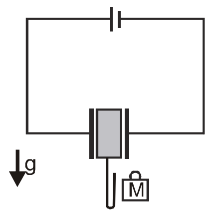
(A) A point charge at point 'P' will experience electric force due to capacitor

(B) The potential difference between the plates will be $\frac{3Q}{2C}$

(C) The energy stored in the electric field in the region between the plates is $\frac{9Q^2}{8C}$

(D) The force on one plate due to the other plate is $\frac{Q^2}{2\pi \epsilon_0 d^2}$

708. Figure shows a capacitor with its plates vertical and a hook is attached to a light dielectric slab and slab is initially at rest inside the plates of capacitor. Neglect the any frictional forces. Now a small block of mass *M* is brought close to the *U* shaped hook and released suddenly to hang it in the hook :



(A) The dielectric with block may oscillate.

(B) The dielectric with block may be fall down by some distance and will come to permanently rest at equilibrium position.

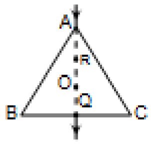
(C) The dielectric with block may continue to fall and come out of the capacitor.

(D) The block may come to rest at the bottom of hook and dielectric is not displaced at all.

SECTION : (C) -Passage Type Questions

PASSAGE 01:

The wire ABC shown in the figure forms an equilateral triangle of side a. The wires are identical. A current i is flowing in at point A and leaving out at point Q, just midway of wire BC as shown in the figure.



709. The magnetic field B at the centroid O of the wire is

(A) zero (B) $\frac{3\mu_0 i}{4\pi e}$ (C) $\frac{\mu_0 i}{2\pi e}$ (D) none of these

710. The magnetic field B at a point P just above the Q is

(A) zero (B) $\frac{\mu_0 i}{\pi e}$ (C) $\frac{\mu_0 i}{3\pi e}$ (D) none of these

711. The magnetic field B at point R, which lies on the line joining AO is

(A) zero (B) $\frac{\mu_0 i}{\pi e}$ (C) $\frac{\mu_0 i}{3\pi e}$ (D) none of these

PASSAGE 02:

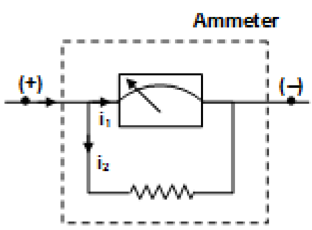
Ammeter is a device to measure an electric current. In order to convert a galvanometer into an ammeter, a resistance having small value is connected in parallel with the galvanometer coil.

This resistor is called the shunt. The current to be measured is passed through the ammeter by connecting it in series with the segment which carries the current

When the ammeter is connected in a segment of a circuit, the resistance of the segment increases. Which reduces the main current to be measured.

To minimize the error, the equivalent resistance of ammeter circuit should be small. This is one reason why the shunt having a small resistance r is connected in parallel to the coil.

A galvanometer of resistance 100 Ω gives a full scale deflection for a current of 1 mA



712. Shunt required to convert it into an ammeter giving full scale deflection for a current of 10 amp is

(A) $\frac{1}{100}\Omega$ (B) $\frac{100}{9999}\Omega$ (C) $\frac{100}{1999}\Omega$ (D) $\frac{100}{10001}\Omega$

713. When the current through ammeter is giving full scale deflection then heat generated by shunt per unit time is

(A) 1 Watt (B) 0.9999 Watt

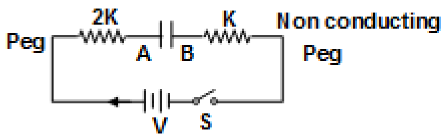
(C) 1.0001 Watt (D) no heat will be dissipated

714. When this ammeter is connected across the terminals of a battery a current of 4A flows through it. The current drops to 1amp when a resistance of 1.5 Ω is connected in series with the ammeter. The internal resistance of the battery is

(A) 5 Ω (B) 10.1 Ω (C) 0.49 Ω (D) 4.9 Ω

PASSAGE 03:

In the given circuit, two identical parallel conducting plates A and B are connected to a 25 V battery by metal springs of spring constant 2k and k, respectively. Initially the switch 's' is open and the plates are uncharged. In fact, the two plates from a capacitor. When the switch 's' is closed, distance between the plates becomes 2 mm and it is one third of initial distance between the plates. Also the electric potential energy stored in the capacitor is found to be 7.5×10^{-4} J.



715. Initially, when the plates are uncharged, capacitance of the capacitor is

(A) 1.2 μF (B) 1 μF (C) 0.8 μF (D) 0.6 μF

716. Spring constant of the spring connected to plate A is

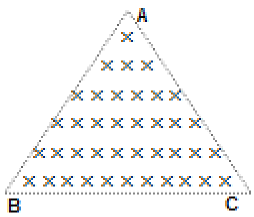
(A) 212.65 N/m (B) 281.25 N/m (C) 316.45 N/m (D) 463.75 N/m

717. Extension of the spring connected plate B is

(A) 2.67 mm (B) 3.22 mm (C) 4.33 mm (D) 1.33 mm

PASSAGE 04:

When a charge particle enters in a uniform magnetic field perpendicular to the magnetic field then its path becomes circular and its radius of curvature is given as $r = \frac{mv}{qB}$, where m is mass of the charge particle, v is the velocity and A uniform magnetic field is present in a region which is in the form of equilateral triangle (ΔABC) of side 'a' The magnetic field is in downwards direction and its intensity is 'B'. A positive point charge of mass 'm' and charge 'q' enters in the magnetic field with a certain speed along line BC. Then (q is the charge and B is magnetic intensity).



718. Maximum possible angular deviation is

(A) 60° (B) 90° (C) 120° (D) 180°

719. Speed of the charge particle for which angular deviation is maximum

(A) $\frac{9qB}{\sqrt{3}m}$ (B) $\frac{9qB}{m}$ (C) $\frac{\sqrt{3}9qB}{m}$ (D) $\frac{9qB}{3m}$

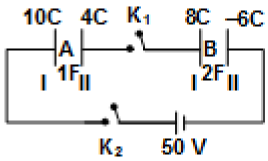
720. The speed of charge particle for which angular deviation is $\pi/2$.

(A) $\frac{qBq(\sqrt{3}-1)}{2m}$ (B) $\frac{\sqrt{3}9qB}{2m}$ (C) $\frac{\sqrt{3}(\sqrt{3}+1)9Bq}{2m}$ (D) $\frac{\sqrt{3}(\sqrt{3}-1)9Bq}{2m}$

PASSAGE 05:

A system of capacitors A and B is shown whose each plate have different charges are shown in the figure.

Initially switch K_1 B closed



721. The charge on inner side of first plate of capacitor A is

(A) –14C (B) –2C (C) +14 C (D) +2C

722. The charge on outer side of second plate of capacitor B is

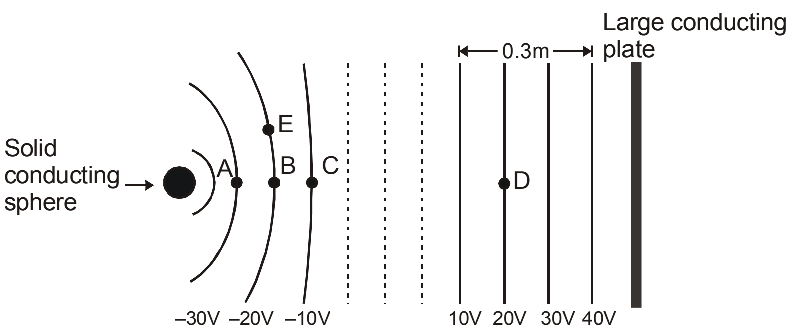
(A) +8 C (B) – 8C (C) +14 C (D) –14C

723. The amount of charge supplied by battery if both switches are closed

(A) +8/3 C (B) – 8/3C (C) +14/3 C (D) none of these

PASSAGE 06:

The sketch below shows cross-sections of equipotential surfaces between two charged conductors that are shown in solid black. Some points on the equipotential surfaces near the conductors are marked as A,B,C,........ . The arrangement lies in air. (Take $\epsilon_0 = 8.85 \times 10^{-12}$ $C^2/N\ m^2$]



724. Surface charge density of the plate is equal to

(A) 8.85×10^{-10} C/m² (B) -8.85×10^{-10} C/m²

(C) 17.7×10^{-10} C/m² (D) -17.7×10^{-10} C/m²

725. A positive charge is placed at B. When it is released :

(A) no force will be exerted on it. (B) it will move towards A.

(C) it will move towards C. (D) it will move towards E.

726. How much work is required to slowly move a – 1μC charge from E to D ?

(A) 2×10^{-5} J (B) -2×10^{-5} J (C) 4×10^{-5} J (D) -4×10^{-5} J

PASSAGE 07:

As a charged particle 'q' moving with a velocity $\vec{v}$ enters a uniform magnetic field $\vec{B}$, it experiences a force $\vec{F} = q(\vec{v} \times \vec{B})$.

For $\theta = 0^\circ$ or 180°, θ being the angle between $\vec{v}$ and $\vec{B}$, force experienced is zero and the particle passes undeflected. For $\theta = 90^\circ$, the particle moves along a circular arc and the magnetic force (qvB) provides the necessary centripetal force $\left(\frac{mv^2}{r}\right)$. For other values of θ ($\theta \neq 0^\circ, 180^\circ, 90^\circ$), the charged particle moves along a helical path which is the resultant motion of simultaneous circular and translational motions.

Suppose a particle, that carries a charge of magnitude q and has a mass 4×10^{-15} kg, is moving in a region containing a uniform magnetic field $\vec{B} = -0.4\,\hat{k}$ T. At some instant, velocity of the particle is $\vec{v} = (8\hat{i} - 6\hat{j} + 4\hat{k}) \times 10^6$ m/s and force acting on it has a magnitude 1.6 N.

Answer the following questions :

727. Motion of charged particle will be along a helical path with :

(A) A translational component along x-direction and a circular component in the y-z plane

(B) A translational component along y-direction and a circular component in the x-z plane

(C) A translational component along z-axis and a circular component in the x-y plane

(D) Direction of translational component and plane of circular component are uncertain

728. Angular frequency of rotation of particle, also called the 'cyclotron frequency' is :

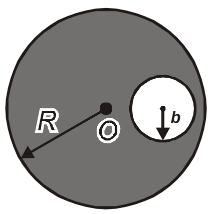
(A) 8×10^5 rad/s (B) 12.5×10^4 rad/s (C) 6.2×10^6 rad/s (D) 4×10^7 rad/s

729. If the coordinates of the particle at $t = 0$ are (2 m, 1 m, 0), coordinates at a time $t = 3T$, where T is the time period of circular component of motion, will be (take $\pi = 3.14$) :

(A) (2 m, 1 m, 400 m) (B) (0.142 m, 130 m, 0) (C) (2 m, 1 m, 1.884 m) (D) (142 m, 130 m, 628 m)

PASSAGE 08:

A non-conducting sphere of radius R has a uniform volume charge density ρ. A spherical cavity of radius b is created inside the sphere, whose centre lies at a distance a from the centre of sphere. It can be shown that field inside cavity will be uniform



730. What is electric field at any point inside the spherical cavity?

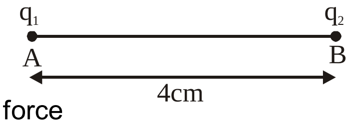
(A) $\frac{\rho a}{3\varepsilon_0}$ (B) $\frac{\rho b}{3\varepsilon_0}$ (C) $\frac{\rho(a-b)}{3\varepsilon_0}$ (D) Zero

731. What is magnitude of electric field at point O?

(A) Zero (B) $\frac{\rho b^3}{3\varepsilon_0 a^2}$ (C) $\frac{\rho b}{3\varepsilon_0}$ (D) $\frac{\rho a^3}{3\varepsilon_0 b^2}$

PASSAGE 09:

Two points charges q_1 = + 1μC and q_2 = – 2μC are placed at A and B respectively as shown in the figure. The distance between q_1 and q_2 is 4 cm.



732. A line of force emanates from q_1 making an angle 90° with AB. This line of force

(A) enters q_2 at an angle 90°
(B) enters q_2 at an angle 60°
(C) enters q_2 at an angle 45°
(D) does not enter q_2 but goes off to ∞

733. The net electric flux will be zero.

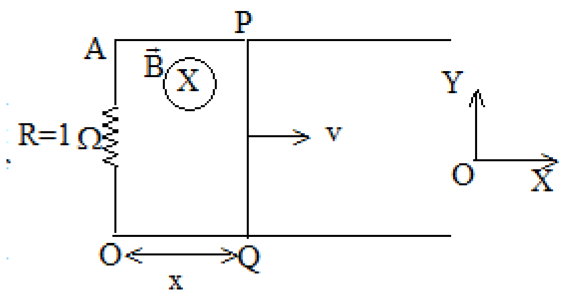
(A) over any surface that encloses a volume including A and B, but having very large radius
(B) over any surface that includes A twice and B once
(C) over any surface that encloses a volume excluding A and B
(D) only over a surface that encloses zero volume

734. The electrostatic potential is zero at

(A) a point on the line AB between q_1 and q_2 but closer to q_2
(B) a point on the line AB but not between A and B
(C) infinitely many point in space
(D) no point in space

PASSAGE 10:

Consider two parallel, conducting frictionles tracks are kept in gravity free space as shown in the figure. A movable conductor PQ, initially kept at OA, given a velocity 10 m/s towards right. If space contains a magnetic field which depends upon the distance moved by conductor PQ from OA line and given by



$\vec{B} = cx\left(-\hat{k}\right)\left[c = \text{constant} = 1\text{S.I.–unit}\right]$

The mass of conductor PQ is 1kg and length of PQ is 1 m. Answer the following questions based on above passage.

735. The distance travelled by conductor when its speed is 5 m/s is

(A) $\left(\frac{15}{2}\right)^{1/3}$
(B) $\left(\frac{5}{2}\right)^{1/3}$
(C) $(10)^{1/3}$
(D) None of the above

736. The heat loss during the time interval t = 0 to time t sec. When the speed of conductor is 5 m/s is

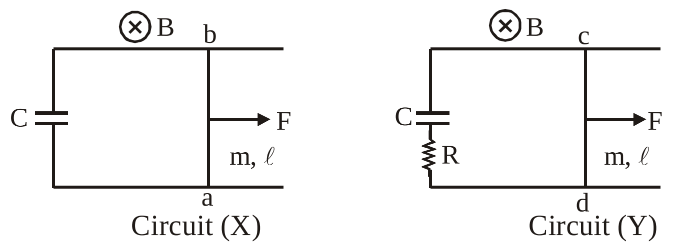
(A) 50 J
(B) 30J
(C) 10J
(D) none of the above

737. The work done by magnetic force acting on the conductor PQ during its motion in the time interval t=0 to t = t sec when the speed of conductor is 5 m/s is

(A) zero (B) 50 J (C) 10J (D) 30 J

PASSAGE 11:

For the two given circuits at t = 0, a constant force F acts at the middle points of the rigid conducting wires ab and cd. At t = 0 both wire are at rest. The electric resistance of the circuit (a) is zero, while for the circuit (b) electrical resistance is R. The electrical resistance of the horizontal rails is zero. There is no friction between rails and rigid wires ab and cd. Both the circuits are placed in a vertical constant magnetic field B (as shown in the figure). The mass and length of the each wire ab and cd is m, ℓ respectively



(Q. 738 - 740)

At $t = \sqrt{\dfrac{m\ell}{F}}$, electric current for circuit (X) is

(a) zero (b) $\dfrac{B\ell CF}{(m + B^2\ell^2 C)}$

(c) $\dfrac{B\ell CF}{m}$ (d) none of these

At t = 0, acceleration of wire cd for circuit Y is

(a) $\dfrac{F}{m}$ (b) $\dfrac{F}{(m + B^2\ell^2 C)}$

(c) $\dfrac{F}{B^2\ell^2 C}$ (d) none of these

At t = 0, acceleration of wire ab for circuit X is

(a) $\dfrac{F}{m}$ (b) $\dfrac{F}{(m + B^2\ell^2 C)}$

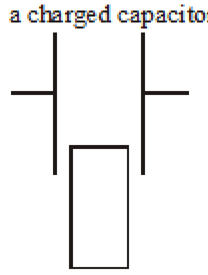
(c) $\dfrac{F}{B^2\ell^2 C}$ (d) none of these

SECTION : (D) - Matrix Match

741. In the series L - C - R circuit fed by a sinusoidal AC source

	Column A		**Column B**
(a)	If the circuit is purely reactive	(p)	Maximum Power loss.
(b)	Purely resistive	(q)	No power loss.
(c)	If the frequency $\frac{1}{2\pi}\sqrt{\frac{1}{LC}}$	(r)	Maximum Current.
(d)	Inductor in a choke coil of fluorescent tube is used because through inductor, there is	(s)	Current reduction

742. A parallel plate air capacitor is charged by connecting its plates to the terminals of a battery. The battery is disconnected and a dielectric slab is introduced partially between the plates, as shown in the figure. Consider the change in the value of each quantity mentioned in the first column below from the time when no dielectric slab was intruduced to the time when it was, and match it wit the nature of change in it as mentioned in column on the right.

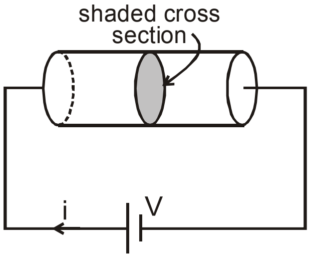


	Column A		**Column B**
(a)	Surface density of charge, σ	(p)	Increases.
(b)	Electric field intensity, E	(q)	Decreases.
(c)	Charge on the capacitor, q	(r)	Remains same.
(d)	Net force acting on either plate, F	(s)	Increase at some points decreases at others.

743. An electric dipole is placed in an electric field. The column I gives the description of electric field and the angle between the dipole moment $\vec{p}$ and the electric field intensity $\vec{E}$ and the Column II gives the effect of the electric field on the dipole. Match the description in Column I with the statements in Column II and indicate your answer by darkening appropriate bubbles in the 4 × 4 matrix given in the ORS.

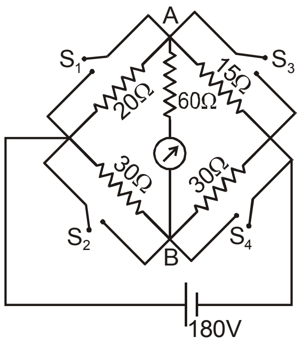
	Column I		**Column II**
(A)	Uniform electric field, $\theta = 0$	(p)	force = 0
(B)	Electric field due to a point charge, $\theta = 0$	(q)	Torque = 0
(C)	Electric field between the two oppositely charged large plates, $\theta = 90°$	(r)	$\vec{p} \cdot \vec{E} = 0$
(D)	Dipole moment parallel to uniformly charged long wire.	(s)	Force $\neq 0$

744. Column I gives physical quantities based on a situation in which an ideal cell of emf V is connected across a cylindrical rod of uniform cross-section area and conductivity (σ) as shown in figure. E, J, ϕ and i are electric field at, current density through, electric flux through and current through shaded cross-section respectively as shown in figure. Physical quantities in column II are related to those in column I. Match the expressions in Column I with the statements in Column II and indicate your answer by darkening appropriate bubbles in the 4 × 4 matrix given in the OMR.



Column I	Column II
(A) $\frac{\phi}{i}$	(p) Conductivity of rod
(B) $\frac{E}{J}$	(q) Resistance of rod
(C) $\sigma\phi V$	(r) Resistivity of rod
(D) $\frac{V}{\sigma\phi}$	(s) Power delivered to rod

745. Consider the circuit shown. The resistance connected between the junction A and B is 60 Ω including the resistance of the galvanometer. The switches have no resistance when shorted and infinite resistance when opened. All the switches are initially open and they are closed as given in column I. Match the condition in column I with the direction of current through galvanometer and the value of the current through the battery in column II and indicate your answer by darkening appropriate bubbles in the 4 × 4 matrix given in the OMR.

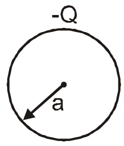


Column I	Column II
(A) Only switch S_1 is closed	(p) Current from A to B
(B) Only switch S_2 is closed	(q) Current from B to A
(C) Only switch S_3 is closed	(r) current through the battery is 12.0 A
(D) Only switch S_4 is closed	(s) current through the battery is 15.6 A

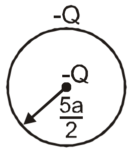
746. In each situation of column-I, some charge distributions are given with all details explained. In column -II The electrostatic potential energy and its nature is given situation in column -II. Then match situation in column-I with the corresponding results in column-II.

Column-I

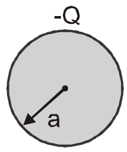
(A) A thin shell of radius a and having a charge – Q uniformly distributed over its surface as shown



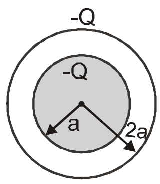
(B) A thin shell of radius $\frac{5a}{2}$ and having a charge – Q uniformly distributed over its surface and a point charge – Q placed at its centre as shown.



(C) A solid sphere of radius a and having a charge – Q uniformly distributed throughout its volume as shown.



(D) A solid sphere of radius a and having a charge – Q uniformly distributed throughout its volume. The solid sphere is surrounded by a concentric thin uniformly charged spherical shell of radius 2a and carrying charge –Q as shown



Column-II

(p) $\frac{1}{8\pi\epsilon_0}\frac{Q^2}{a}$ in magnitude

(q) $\frac{3}{20\pi\epsilon_0}\frac{Q^2}{a}$ in magnitude

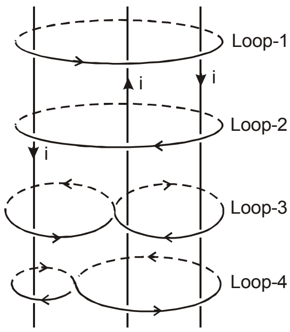
(r) $\frac{2}{5\pi\epsilon_0}\frac{Q^2}{a}$ in magnitude

(s) Positive in sign

747. In each situation of column-I some changes are made to a charged capacitor under conditions of constant potential difference or constant charge. Condition of constant potential difference means that the a cell is connected across the capacitor and condition of constant charge means that the capacitor is isolated. Match the conditions in column-I with corresponding results in column-II.

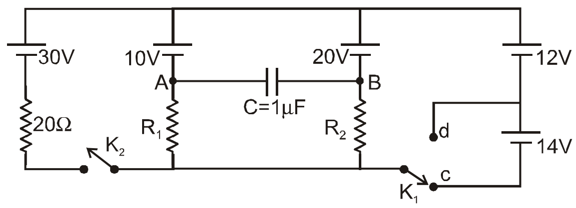
Column I		Column II	
(A)	For a capacitor maintained at constant potential difference, the separation between plates is increased.	(p)	Then electric field inside the capacitor decreases in comparison to what it was before the change.
(B)	For a capacitor maintained at constant charge, the separation between the plates is increased	(q)	Then electric field inside the capacitor remains same.
(C)	For a capacitor maintained at constant potential difference, area of the both the plates is doubled.	(r)	Then potential energy stored in the capacitor decreases in comparison to what it was before the change.
(D)	For a capacitor maintained at constant charge, area of both plates is doubled	(s)	The potential energy stored in the capacitor increases in comparison to what it was before the change

748. Three wires are carrying same constant current i in different directions. Four loops enclosing the wires in different manners are shown. The direction of $d\vec{\ell}$ is shown in the figure :



	Column–I	**Column–II**
(A)	Along closed Loop-1	(p) $\oint \vec{B}.d\vec{\ell} = \mu_0 i$
(B)	Along closed Loop-2	(q) $\oint \vec{B}.d\vec{\ell} = -\mu_0 i$
(C)	Along closed Loop-3	(r) $\oint \vec{B}.d\vec{\ell} = 0$
(D)	Along closed Loop-4	(s) net work done by the magnetic force to move along a unit charge the loop is zero.

749. A circuit involving five ideal cells , three resistors (R_1, R_2 and 20Ω) and a capacitor of capacitance C = 1 μF is shown. Match the conditions in column-I with results given in column-II.



column-I		**column-II**
(A) K_2 is open (off) and K_1 is in position C	(p)	Potential at point A is greater than potential at B
(B) K_2 is open (off) and K_1 is in position D	(q)	Current through R_1 is downward
(C) K_2 is closed (on) and K_1 is in position C	(r)	Current through R_2 is upward
(D) K_2 is closed (on) and K_1 is in position D	(s)	Charge on capacitor is 10μC.

750.

	List – I		**List - II**
(A)	The force on a point charge due to other point charge [F_{12}]is	(i)	Medium independent
(B)	The net force on a point charge [F_1] is	(ii)	Affected by the presence of another point charge
(C)	The electric field lines at a point are	(iii)	Not affected by the presence of another point charge
(D)	The electric field intensity at a point is	(iv)	Medium dependent

751. **Column-I and Column-II** contains four entries each. Entries of column-I are to be matched with some entries of column-II. One or more than one entries of column-I may have the matching with the same entries of column-II and one entry of column-I may have one or more than one matching with entries of column-II

On a capacitor of capacitance C_0 following steps are performed in the order as given in column-I.

(a) Capacitor is charged by connecting it across a battery of EMF V_0.

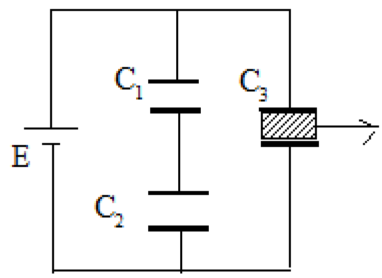
(b) Dielectric of dielectric constant 'k' and thickness 'd' is inserted.

(c) Capacitor is disconnected from battery.

(d) Separation between plates is doubled.

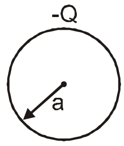
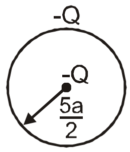
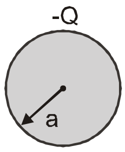
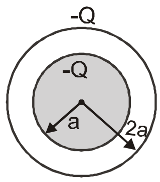
Column-I (Steps performed)		**Column-II (Final value of Quantity (Symbols have usual meaning))**	
(A)	(a) (d) (c) (b)	(P)	$Q = \frac{C_0 V_0}{2}$
(B)	(d) (a) (c) (b)	(Q)	$Q = \frac{k C_0 V_0}{k+1}$
(C)	(b) (a) (c) (d)	(R)	$C = \frac{k C_0}{k+1}$
(D)	(a) (b) (d) (c)	(S)	$V = \frac{V_0 (k+1)}{2k}$

752. Three capacitors C_1, C_2 & C_3 are connected to battery as shown. where $C_1 = C_3 = 1F$ & $C_2 = 2F$ with E= 10V. The capacitor C_3 consists of dielectric slab of di-electric constant K=2.The slab is pulled out of capacitor C_3 by an external agent

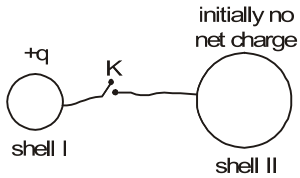


List-I		**List-II**	
A.	work consumed by the battery	p.	50 SI units
B.	work done by an external agent to pull the slab from C_3	q.	100 SI units
C.	heat generated in the circuit	r.	zero
D.	change in electrostatic potential energy of capacitors C_1 & C_2	s.	non-zero

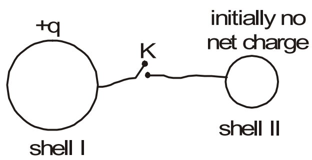
753. In each situation of column-I, some charge distributions are given with all details explained. In column -II The electrostatic potential energy and its nature is given situation in column -II. Then match situation in column-I with the corresponding results in column-II.

	Column-I			Column-II
(A)	A thin shell of radius a and having a charge – Q uniformly distributed over its surface as shown		(p)	$\frac{1}{8\pi \in_0}\frac{Q^2}{a}$ in magnitude
(B)	A thin shell of radius $\frac{5a}{2}$ and having a charge – Q uniformly distributed over its surface and a point charge – Q placed at its centre as shown.		(q)	$\frac{3}{20\pi \in_0}\frac{Q^2}{a}$ in magnitude
(C)	A solid sphere of radius a and having a charge – Q uniformly distributed throughout its volume as shown.		(r)	$\frac{2}{5\pi \in_0}\frac{Q^2}{a}$ in magnitude
(D)	A solid sphere of radius a and having a charge – Q uniformly distributed throughout its volume. The solid sphere is surrounded by a concentric thin uniformly charged spherical shell of radius 2a and carrying charge –Q as shown		(s)	Positive in sign

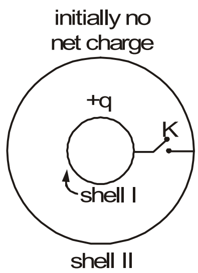
754. Column I gives certain situations involving two thin conducting shells connected by a conducting wire via a key K. In all situations one sphere has net charge +q and other sphere has no net charge. After the key K is pressed, column II gives some resulting effect. Match the figures in Column I with statements in Column II.

(A) 

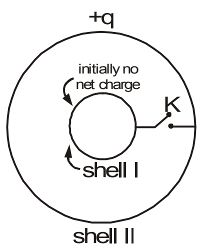
(p) charge flows through connecting wire

(B) 

(q) Potential energy of system of spheres decreases.

(C) 

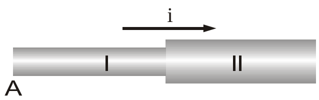
(r) No heat is produced.

(D) 

(s) The sphere I has no charge after equilibrium is reached.

(t) charge does not flows through connecting wire

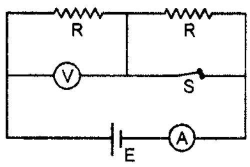
755. Column I gives physical quantities of a situation in which a current i passes through two rods I and II of equal legth that are joined in series. The ratio of free electron density (n, resistivity (p) and cross- section area (A) of both are in ratio $n_1 : n_2 = 2 : 1$, $p_1 : p_2 : = 2 : 1$ and $A_1 : A_2 = 1 : 2$ respectively. Column II gives corresponding results. Match the rations in column I with the values in Column II.



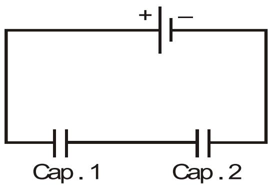
Columnn I		**Column II**	
(A)	$\dfrac{\text{Drift velocity of free electron in rod I}}{\text{Drift velocity of free electron in rod II}}$	(p)	0.5
(B)	$\dfrac{\text{Electric field in rod I}}{\text{Electric field in rod II}}$	(q)	1
(C)	$\dfrac{\text{Potential difference across rod I}}{\text{Potential difference across rod II}}$	(r)	2
(D)	$\dfrac{\text{Average time taken by free electron to move from A to B}}{\text{Average time taken by free electron to move from B to C}}$	(s)	4

756 In the circuit shown, batery, ammeter and voltmeter are ideal and the switch S is initially closed as shown. When switch S is opened, match the parmeter of column I with the effects in column II.

Columnn I		**Column II**	
(A)	Equivalent resistance across the battery,	(p)	Remains same
(B)	Power dissipated by left resistance R	(q)	Increases
(C)	Voltmeter reading	(r)	decreases
(D)	Ammeter reading	(s)	Becomes zero.



757. Two identical capacitors are connected in series, and the combination is connected with a battery, as shown. Some chages in the capacitor 1 are now made independintly after the steady state is achieved, listed in column-I. Some effects which may occur in new steady state due to these changes on the capacitor 2 are listed in column-II. Match the changes one capacitor 1 in column-I with corresponding effect on capacitor 2 in column-II.

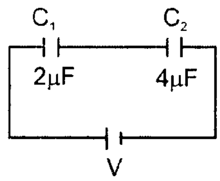


Column I		**Column II**	
(A)	A dielectric slab is inserted.	(p)	Charge on the capacitor increases.
(B)	Separation between plates jincreased	(q)	Charge on the capacitor decreases.
(C)	A metal plate is inserted connecting both plates	(r)	Energy stored in the capacitor increases.
(D)	The left plate is grounded.	(s)	Energy stored is capactor is decreased
		(t)	No change is occured

758. In each situation of column-some changes are made to a charged capacitor under conditions of constant potential difference or constant charge. Condition of constant potential difference means that the a cell is connected across the capacitor and condition of constant charge means that the capacitor is isolated. Match the conditions in conditions in column-I with coresponding results in column-II.

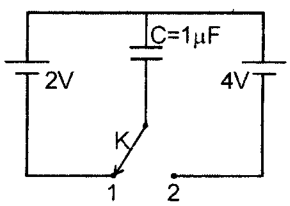
	Column I		Column II
(A)	For a capacitor maintained at constant potential difference, the separation between plates is increased.	(p)	Then electric field inside the capacitor decreases in compatison to what it was before the change.
(B)	For a capacitor maintained at constant charge, the separation between the plates is increased	(q)	Then electric field inside the capacitor remains same.
(C)	For a capacitor maintained at constant potential difference, area of the both the plates is doubled.	(r)	Then potential energy stored in the capacitor decreases in comparison to what it was before the change.
(D)	For a capacitor maintained at constant charge, area of both plates is doubled	(s)	The potential energy stored in the capacitor decreases in comparison to what it was before the change.
		(t)	Capacitance of capacitor decreases

759. In the given figure, the separation between the plates of C_1 is slowly increased to double of its inital value then.



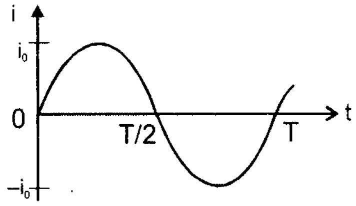
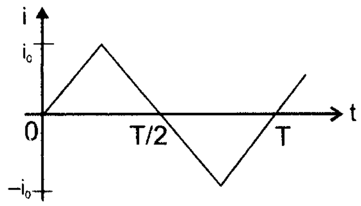
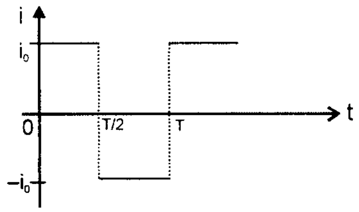
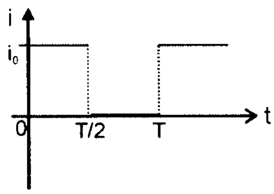
	Column-I		Column-II
(A)	the potential difference across C_1	(p)	increases
(B)	the potential difference across C_2	(q)	decreases
(C)	the energy stored in C_1	(r)	increases by a factor of 6/5
(D)	the energy stored in C_2	(s)	decreases by a factor of 18/25
		(t)	decreases by a factor of 9/35

760. The circuit involves two ideal cells connected to a 1 μF capacitor via a key K. Initially the key K is in position 1 and the capacitor is charged fully by 2V cell. The key is pushed to position 2. Column I gives physical quantities involving the circuit after the key k is pushed from position 1. Column II gives corresponding results. Match the statements in Column I whith the corresponding values in Column II.

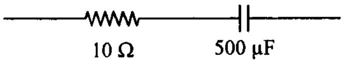
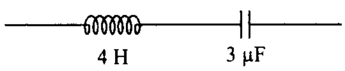
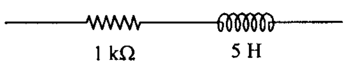


	Column I		Column II
(A)	The net charge crossing the 4volt cell in μC is	(p)	2
(B)	The magnitude of work done by 4Volt cell in μJ is	(q)	6
(C)	The gain in potential energy of capacitor in μJ is	(r)	8
(D)	The net heat produced in circuit in μJ is	(s)	16

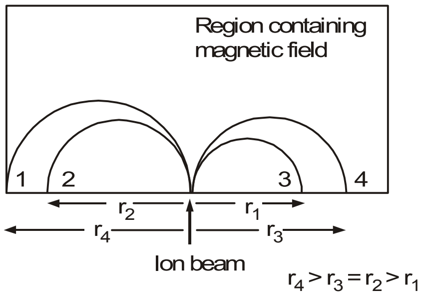
761. In Column I, variation of current i with time t is given in figures. In column II root mean square current i average current is given. Match the column I with corresponding quantities given in Column II

Column I	Column II
(A) 	(p) $i_{ms} = \frac{i_0}{\sqrt{3}}$
(B) 	(q) Average current for positive half cycle is i_0
(C) 	(r) Average current for positive half cycle is $\frac{i_0}{2}$
(D) 	(s) Full cycle average current is zero.
	(t) Root mean square value of current for positive half cycle is i_0

762. Four fifferent circuit components are given in each situation of column-I and all the components are connected across an ac source of same angular frequency ω = 200rad/sec. The information of phase difference between the current and source voltage in each situation of column-I is given in column-II. Match the circuit components in column-I with corresponding results in column-II.

Column - I	Column - II
(A) 	(p) the magnitude of required phase difference is $\frac{\pi}{2}$.
(B) 	(q) the magnitude of required phase difference is $\frac{\pi}{4}$.
(C) 	(r) the current leads in phase to sourcevoltage.
(D) 	(s) the magnitude of required phase difference is zero
	(t) the current lags in phase to source voltage.

763. A beam consiting of four types of ions A, B, C and D enters a region that contains a uniform magnetic field as shown. The field is perpendicular to the plane of the paper, but its precise direction is not given. All ions in the beam travel with the same speed. The table below gives the masses and charges of the ions.

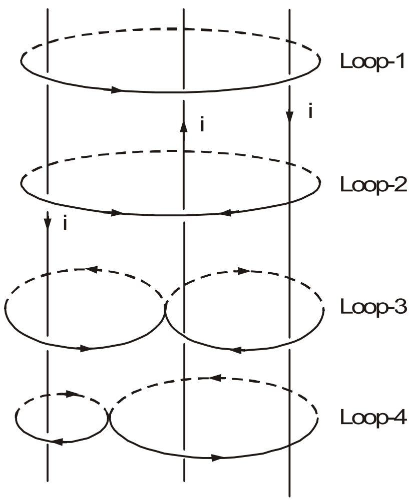


ION	MASS	CHARGE
A	2m	+e
B	4m	−e
C	2m	−e
D	m	+e

The ions fall at different positions 1, 2, 3 and 4 as shown. Correctly match the ions with respective falling positions.

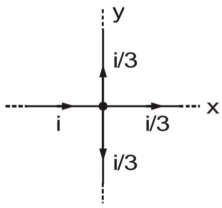
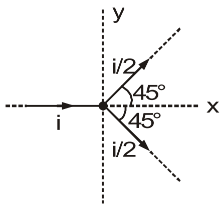
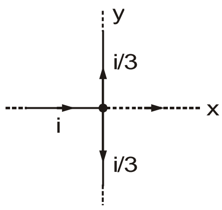
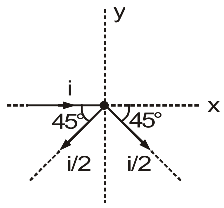
Column - I		**Column - II**	
(A)	a	(p)	1
(B)	b	(q)	2
(C)	c	(r)	3
(D)	d	(s)	4

764. Three wires are carrying same constant current i in different directions. Four loops enclosing the wires in different manners are shown. The direction of $d\vec{\ell}$ is shown in the figure:

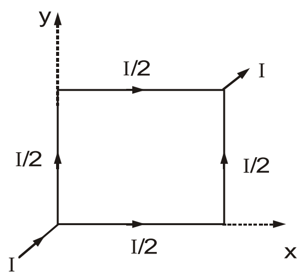


	Column - I		**Column - II**
(A)	Along closed Loop - 1	(b)	$\oint \vec{B}.d\vec{\ell} = \mu_0 i$
(B)	Along closed Loop - 2	(q)	$\oint \vec{B}.d\vec{\ell} = -\mu_0 i$
(C)	Along closed Loop - 3	(r)	$\oint \vec{B}.d\vec{\ell} = 0$
(D)	Along closed Loop - 4	(s)	net work done by the magnetic force to move a unit charge along the loop is zero.

765. Column-II gives four situations in which three or four semi infinite current carrying wires are placed in xy-plane as shown. The magnitude and direction of current is shown each figure. Column-I gives statements regarding the x and y components of magnetic field at a point P whose coordinates are P (0, 0, d). Match the statements in column-I with the corresponding figures in column-II

Column-I	Column-II
(A) The x component of magnetic field at point P is zero in	(p) 
(B) The z component of magnetic field at point P is zero in	(q) 
(C) The magnitude of magnetic field at point P is $\frac{\mu_0 i}{4\pi d}$ in	(r) 
(D) The magnitude of magnetic field at point P is less than $\frac{\mu_0 i}{2\pi d}$ in	(s) 

766. A square loop of uniform conducting wire is as shown in figure. A current I (in amperes) enters the loop from one end exits the loop from opposite end as shown in figure. The length of one side of square loop is ℓ metre. The wire has uniform cross section area and uniform linear mass density. In four situations of column I, the loop is subjected to four different magnetic field. Under the conditions of column I, match the column I with corresponding results of column II (B_0 in column I is a positive nonzero constant)

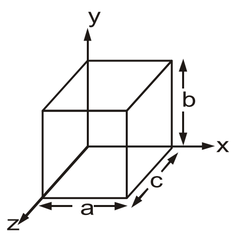


Column I	Column II
(A) $\vec{B} = B_o\hat{i}$ in tesla	(p) magnitude of net force on loop is $\sqrt{2}B_oI\ell$ newton
(B) $\vec{B} = B_o\hat{j}$ in tesla	(q) magnitude of net force on loop is zero
(C) $\vec{B} = B_o(\hat{i}+\hat{j})$ in tesla	(r) magnitude of net torque on loop about its centre is zero
(D) $\vec{B} = B_o\hat{k}$ in tesla	(s) magnitude of net force on loop is $B_oI\ell$ newton

767. A particle enters a space where exists uniform magnetic field $\vec{B} = B_x\vec{i} + B_y\vec{j} + B_z\vec{k}$ & uniform electric field $\vec{E} = E_x\vec{i} + E_y\vec{j} + E_z\vec{k}$ with initial velocity $\vec{u} = u_x\vec{i} + u_y\vec{j} + u_z\vec{k}$. Depending on the values of various components the particle selects a path. Match the entries of column A with the entries of column B. The components ohter than specified in column A in each entry are non-zero. Neglect gravity.

	Column-I		**Column-II**
(A)	$B_y = B_z = E_x = E_z = 0;\ u = 0$	(p)	circle
(B)	$E = 0,\ u_xB_x + u_yB_y \neq -u_zB_z$	(q)	helix with uniform pitch and constant radius
(C)	$\vec{u} \times \vec{B}=0, \vec{u}\times\vec{E}=0$	(r)	cycloid
(D)	$\vec{u} \perp \vec{B}, \vec{B} \parallel \vec{E}$	(s)	helix with variable pitch and constant radius
		(t)	straight line

768. The figure shows a metallic solid block, placed in a way so that its faces are parallel to the coordinate axes. Edge lengths along axis x, y and z are a, band c respectively. The block is in a region of uniform magnetic field of magnitude 30mT. One of the edge length of the block is 25 cm. The block is moved at 4 m/s parallel to each axis and in turn, the resulting potential difference V that appears across the block is measured. When the motion is parallel to the y axis, V = 24 mY; with the motion parallel to the z axis, V = 36 mV; with the motion parallel to the x axis, V = 0. Using the givein information, correctly match the dimensions of the block with the values given.



Column I		**Column II**	
(A)	a	(p)	20 cm
(B)	b	(q)	24 cm
(C)	c	(r)	25 cm
(D)	$\frac{bc}{a}$	(s)	30 cm
		(t)	26 cm

769. Column-I gives situations involving a charged particle which **may be** realised under the condition given in column-II. Match the situations in column-I with the condition in column-II.

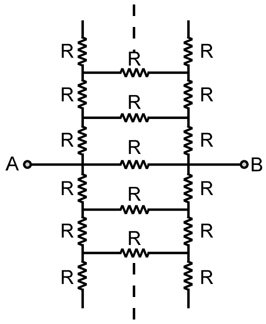
	Column I		Column II
(A)	Increase in speed of a charged particle	(p)	Electric field uniform in space and constant with time
(B)	Exert a force on an electron initially at rest	(q)	Magnetic field uniform in space and constant with time.
(C)	Move a charged particle in a circle with uniform speed	(r)	Magnetic field uniform in space but varying with time.
		(s)	Magnetic field non-uniform in space but constant with time
(D)	Accelerate a moving charged particle	(t)	Electric field non-uniform in space but constant with time

770. A square loop of conducting wire is placed near a long straight current carrying wire as shown. Match the statements in column-I with the corresponding results in column-II.

	Column-I		Column-II
(A)	If the magnitude of current I is increased	(p)	Induced current in the loop will be clockwise
(B)	If the magnitude of current I is decreased	(q)	Induced current in the loop will be anticlockwise
(C)	If the loop is moved away from the wire	(r)	wire will attract the loop
(D)	If the loop is moved towards the wire	(s)	wire will repel the loop
		(t)	Torque about centre of mass of loop is zero due to magnetie force

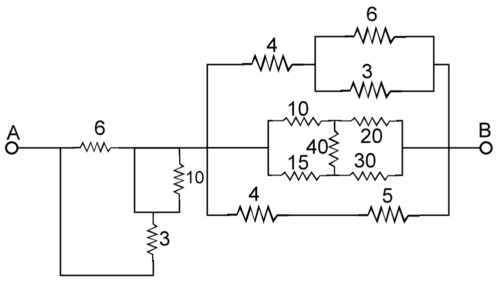
SECTION : (E) - Integer Type

771. Find equivalent resistance (in ohm) between A and B



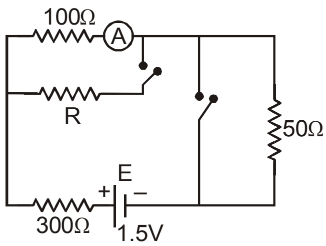
R = $100\sqrt{3}\ \Omega$

772. Find equivalent resistance (in ohm) between A and B

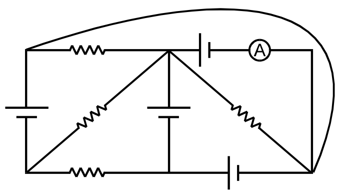


All resistances are in Ω.

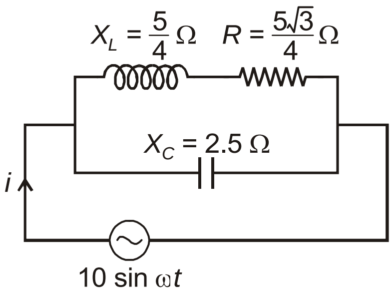
773. In the circuit shown, the reading of the (an ideal) ammeter is the same with both switches open as with both closed. Find the value of resistance R in ohm.



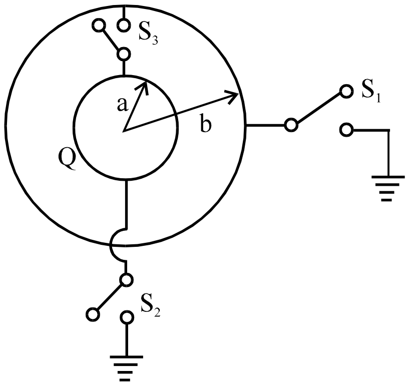
774. In the circuit diagram shown , each battery is ideal having an e.m.f. of 1 volt . Each resistor has a resistance of 1 Ω . Ammeter (A) has a resistance of 1 Ω. Find the total thermal power (in Watt) produced in the circuit.



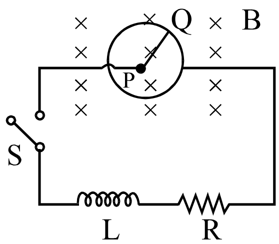
775. Find the peak value of *i* (in ampere) in the following circuit



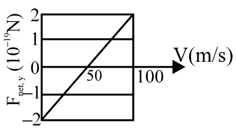
776. The figure shows a conducting sphere 'A' of radius 'a' which is surrounded by a neutral conducting spherical shell B of radius 'b' (> a). Initially switches S_1, S_2 and S_3 are open and sphere 'A' carries a charge Q. First the switch 'S_1' is closed to connect the shell B with the ground and then opened. Now the switch 'S_2' is closed so that the sphere 'A' is grounded and then S_2 is opened. Finally, the switch 'S_3' is closed to connect the spheres together. The heat (in Joule) which is produced after closing the switch S_3 is X. Find 10X [Consider b = 4 cm, a = 2 cm & Q = 8 μC]



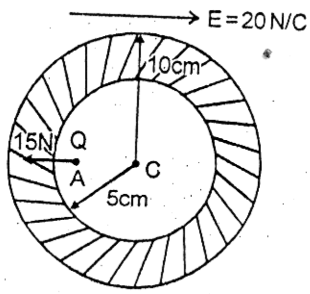
777. The diagram shows a circuit having a coil of resistance R = 10 Ω and inductance L connected to a conducting rod PQ which can slide on a perfectly conducting circular ring of radius 10 cm with its centre at P. Assume that friction and gravity are absent and a constant uniform magnetic field of 5 T exists as shown in figure. At t = 0, the circuit is switched on and simultaneously a time varying external torque is applied on the rod so that it rotates about P with a constant angular velocity 40 rad/s. The magnitude of this torque (in milli Nm) when current reaches half of its maximum value is X/Y. Find X+Y Neglect the self inductance of the loop formed by the circuit.



778. At time t_1, an electron is sent along the positive direction of an x-axis, through both an electric field **E** and a magnetic field **B** , with **E** directed parallel to the y-axis. Graph gives the y-component $F_{net,\,y}$ of the net force on the electron due to the two fields, as a function of the electron's speed V at time t_1. Assuming B_x = 0, find magnitude of electric field **E** in mN/C. (Use e = 1.6 × 10^{-19} C)

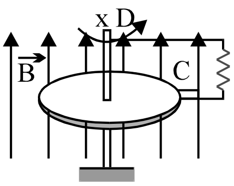


779. In a conducting hollow sphere of inner and outer radii 5 cm and 10 cm respectively, a point change 1μC is placed at point A, that is 3 cm from the centre C of the hollow sphere. An external uniform electric field of magnitude 20 N/C is also applied. Net electric force on the this charge is 15N, away from the centre of the sphere as shown. Find magnitude of force exerted by the induced charge on the charge placed at point A in newtons.



780. In a spark plug which is connected to the secondary coil of transformer an emf 40000 V is induced when in primary coil current changes from 4A to 0 in 10 μs. The self inductance of secondary coil is 1000H, find the minimum value of self inductance of primary coil in μH.

781. A metal disc of radius r = 0.1 m is placed perpendicular to a uniform magnetic field of induction B = 0.50 T. It is capable of rotation about an axis XY parallel to the inducation B, the axis is passing through its centre. Using sliding contacts C and D the disc is connected to a resistance R = 2.5Ω. Determine the mechanical power consumed in mW in rotating the disc if a current of 0.10 A flows through R. Friction can be neglected.



782. A uniform magnetic field of induction B = 1T exists in a circular region of radius $R=\sqrt{\frac{13}{2}}$ m . A loop of radius $R=\sqrt{\frac{13}{2}}$ m encloses the magnetic field at t = 0 and then pulled at a uniform speed v = 1 m/s in the plane of the paper. Find the induced EMF in volts in the loop at t = 1 s.

783. When a box 'A' is connected across an a.c. source of 200 V, 0.4 A of current flows in circuit. When a capacitor of reactance 400 Ω is connected in series with box and connected across a.c. source, the power factor of circuit becomes 1. What is power factor of box 'A'. (Express your answer in the order of 10^{-1})

784. A wire of length L and 3 identical cells of negligible internal resistance are connmected in series, when the temperature of the wire is raised by ΔT in time t due to the current. The same temperature rise is observed in the same time when N similar cells are connected in series with a wire of length 2L but of same material and cross-section. Find the value of N.

785. The distance between the plates of a parallel plate condenser is 0.05 m . A field of 3×10^4 volt/m is established btweeen the plates . It is then disconnected from the battery & an uncharged metal plates of thickness 0.01 m is inserted into the condenser parallel to its plates . Find the potential difference between the plates before the introduction of the metal plates

786. In the previous question,Find the potential difference between the plates before the introduction of the metal plates.

787. In the previous question, what would be the potential difference , if a plate of di-electric constant $\in = 2$ is introduced in place of metal plate?

788. *A coil takes a current of 2 A and 200 W power from an AC source of 220 V , 50 Hz . The resistance (in ohms) of the coil is:*

789. An AC emf $e = 200\sqrt{2}$ sin (100t) is connected to a 1 mF capacitor through an AC ammeter . The reading of the ammeter (in mA) shall be :

790. Magnetic flux through a loop of resistance R = 0.2 W is varying according to the relation $f = 6t^2 + 7t + 1$, where f is in milliwebers and t is in seconds . The magnitude of the emf (in mV) induced in the loop at t = 2s is

791. The equation of an alternating voltage is e = 220 sin (wt + p/6) and the equation of the current in the circuit is i = 10 sin (wt - p/6) . The impedance of the circuit (in ohms) is :

792. An alternating voltage is connected in series with a resistance R and an inductance L . If the potential drop across the resistance is 200V and across the inductance is 150 V , the applied voltage is

793. In a region of uniform magnetic induction $B = 10^{-2}$ T , a circular coil of radius 30 cm and resistance p^2 ohm is rotated about an axis which is perpendicular to the direction of B and which forms a diameter of the coil . If the coil rotates at 200 rpm , the amplitude of the alternating current (in mA) induced in the coil is

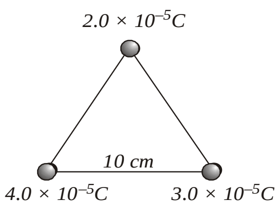
794. A coil of 50 turns & area 10^{-2} m^2 is placed with its plane normal to the field between the poles of a powerful horse shoe magnet . The coil has a resistance of 5 W & is connected to a ballistic galvanometer of resistance 35 W . When the coil is suddenly removed from the field completely , a deflection of 120 divisions is registered in the galvanometer . If the sensitivity of the galvanometer is 15 mC per division , calculate 1000X if the flux density of the field is X Tesla

795. The bob of a simple pendulum has a mass of 40 g and a positive charge of 4.0×10^{-6}C. It makes 20 oscillations in 45 s. A vertical electric field pointing upward and of magnitude 2.5×10^4N/C is switched on. How much time (in seconds) will it now take to complete 20 oscillations?

796. Two identically charged spheres are suspended by strings of equal length. The strings make an angle of 30º with each other, when suspended in a liquid of density 0.8 gm/cc, the angle remains the same. What is the dielectric constant of the liquid? The density of the material of the sphere is 1.6 gm/cc.

797. A proton is released from rest 10cm from a large sheet carrying a surface charge density of -2.21×10^{-9} cm^{-2}. It will strike the sheet after how much time (in microseconds):

798. How much work has to be done in assembling three charged particles at the vertices of an equilateral triangle as shown in figure?



799. A charge *q* is shifted from the surface of a hollow charged sphere with uniformly distributed charge *Q* to a point at a distance *R*/2 from the centre. Now if the same charge is shifted from surface to the same point in a solid uniformly charged sphere of same charge *Q*, the ratio of the two work done is

800. Two identical particles, each having a charge of 2.0×10^{-4}C and mass of 10g, are kept at a separation of 10cm and then released. What would be the speeds of the particles when the separation becomes large?

AnswerKey

Qs.	Ans.	Qs.	Ans.	Qs.	Ans.
		701	BC	751	A-(P,R,S),B-(P,R,S),C-(R),D-(Q,R)
652	B	702	AB	752	A-(Q,S),B-(P,S),C-(R),D-(R)
653	C	703	ABC	753	A-(P,S),B-(Q,S),C-(Q,S),D-(S)
654	B	704	BCD	754	A-(P,Q),B-(P,Q),C-(P,Q,S),D-
655	C	705	AC	755	A-(Q),B-(S),C-(S),D-(Q)
656	C	706	BCD	756	A-(Q),B-(R),C-(R),D-(R)
657	B	707	ABC	757	A-(P,R),B-(QS),C-(PR),D-(T)
658	D	708	AC	758	A-(P,R,T),B-(Q,S,T),C-(Q,S),D-
659	B	709	A	759	A-(P,R),B-(Q),C-(QS),D-(QT)
660	D	710	A	760	A-(P),B-(R),C-(Q),D-(P)
661	C	711	A	761	A-(S),B-(P,R,S),C-(Q,S,T),D-(Q,T)
662	B	712	B	762	A-(QR),B-(PT),C-(),D-(QT)
663	A	713	B	763	A-(S),B-(Q),C-(Q),D-(R)
664	A	714	C	764	A-(Q,S),B-(P,S),C-(Q,S),D-(P,S)
665	C	715	C	765	A-(P,Q,R),B-(P,Q,R,S),C-(R),D-
666	A	716	B	766	A-(R,S),B-(R,S),C-(Q,R),D-(P,R)
667	D	717	A	767	A-(R),B-(QT),C-(T),D-(S)
668	D	718	C	768	A-(R),B-(S),C-(P),D-(Q)
669	B	719	A	769	A-(P,R,T),B-(P,R,T),C-(Q,S),D-
670	A	720	D	770	A-(Q,S),B-(P,R),C-(P,R),D-(Q,S)
671	B	721	D	771	100
672	C	722	A	772	5
673	C	723	D	773	600
674	C	724	A	774	22
675	D	725	B	775	4
676	C	726	D	776	18
677	AD	727	C	777	9
678	ABC	728	D	778	1250
679	BD	729	C	779	15
680	ABCD	730	A	780	10
681	ABC	731	B	781	25
682	ACD	732	B	782	5
683	BC	733	C	783	6
684	AC	734	C	784	6
685	ABD	735	D	785	1500
686	ABC	736	B	786	1200
687	CD	737	C	787	1350
688	BCD	738	B	788	50
689	AC	739	A	789	40
690	ACD	740	B	790	31
691	AC	741	A-(Q,R),B-(P,R),C-(P,R),D-(Q,S)	791	22
692	AC	742	A-(S),B-(Q),C-(R),D-(Q)	792	250
693	ABC	743	A-(P,Q),B-(Q,S),C-(P,R),D-(P,R)	793	6
694	BC	744	A-(R),B-(R),C-(S),D-(Q)	794	144
695	AB	745	A-ps,B-qr,C-q,D-p	795	52
696	ABC	746	A-(P,S),B-(Q,S),C-(Q,S),D-(S)	796	2
697	AC	747	A-(P,R),B-(Q,S),C-(Q,S),D-(P,R)	797	4
698	ABC	748	A-(Q,S),B-(P,S),C-(Q,S),D-(P,S)	798	234
699	ACD	749	A-(P,Q,S),B-(P,Q,R,S),C-(P,Q,S),D-(P,Q,R,S)	799	0
700	BD	750	A-(3,1),B-(2,4),C-(2,5),D-(2,4)	800	600