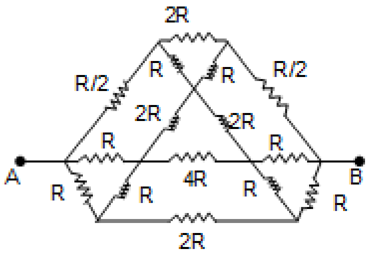
PHYSICS
PART - III
TOPIC: ELECTRICITY & MAGNETISM
EXERCISE # 01

SECTION : (A) - Single Correct Options

501. For the shown circuit the effective resistance between the points A and B will be

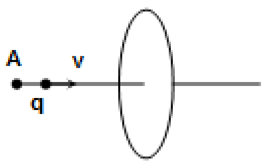


(A) 2R (B) 4R (C) R (D) R/2

502. An n sided regular polygon is inscribed in a circular region of radius R using a wire of cross sectional radius r and resistivity ρ. If the magnetic field in the circular region has a time rate of change given by $\frac{dB}{dt}$ then the current in the wire loop at any time is given by

(A) $\frac{\pi R \frac{dB}{dt} r^2 \cos(r/n)}{2\rho}$ (B) $\frac{\pi R \frac{dB}{dt} r^2 \cos(r/n)}{\sqrt{2}\rho}$ (C) $\frac{\pi R \frac{dB}{dt} r^2 \sin(r/n)}{2\rho}$ (D) $\frac{\pi R \frac{dB}{dt} r^2 \cos(r/n)}{3\rho}$

503. A charged particle carrying a charge q is moving along the axis of a conducting ring as shown in the figure. Then:



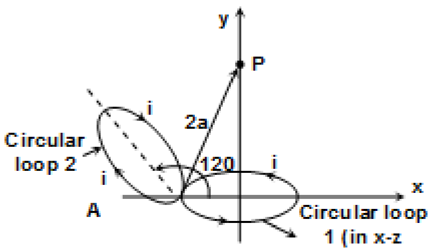
(A) No current will be induced in the loop.

(B) When viewed from A, a clockwise current will flow in the ring.

(C) Current induced will be anticlockwise when viewed from A

(D) Current induced will be initially clockwise, till the time the particle reaches the centre of the ring and then the current will be anticlockwise.

504. Planes of 2 circular loops each of radius a are inclined at an angle of 120° as shown in the figure. Each loop carries a current i as shown in the figure. The magnetic field at point P is

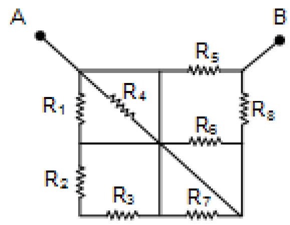


(A) $\frac{\mu_0 i}{8a}$ (B) $\frac{\mu_0 i}{16a}$ (C) $\frac{\mu_0 i}{16\pi a}$ (D) $\frac{\mu_0 i}{8\pi a}$

505. A coil has an ohmic resistance r, inductance L and reactance $X_L = 2\pi fL$. When an AC of RMS value I flows in the coil, the average power consumed in the coil will be

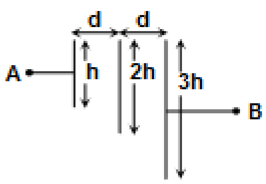
(A) I^2r (B) $I^2(r + X_L)$ (C) I^2X_L (D) $I^2\sqrt{r^2 + X_L^2}$

506. The equivalent resistance between A and B depend on the value of resistance



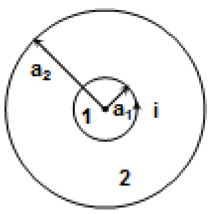
(A) R_1, R_2, R_3 and R_4 (B) R_5 and R_8 (C) R_1, R_6 and R_7 (D) R_2 and R_4

507. Three square conducting plates of side h, 2h and 3h are arranged as shown in the figure. The separation between two adjacent plates is d (see the figure). Find the equivalent capacitance between A and B if $d \ll h$



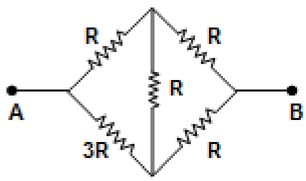
(A) $\frac{\varepsilon_0 h^2}{2d}$ (B) $\frac{36}{13}\frac{\varepsilon_0 h^2}{d}$ (C) $\frac{4}{5}\frac{\varepsilon_0 h^2}{d}$ (D) $\frac{\varepsilon_0 h^2}{d}$

508. Two circular loops 1 and 2 whose centre coincide lie in a plane. The radii of the loops are a_1 and a_2 ($a_1 \ll a_2$). A current i flows in loop 1. Find the magnetic flux ϕ_2 embraced by loop 2.



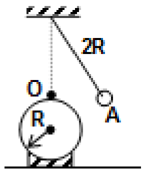
(A) $\frac{\mu_0 i}{2a_2}\pi a_1^2$ (B) $\frac{\mu_0 i}{2a_1}\pi a_2^2$ (C) $\frac{\mu_0 i}{2\pi a_1}a_2^2$ (D) None of these

509. The equivalent resistance between points A and B will be



(A) $\frac{6R}{5}$ (B) $\frac{9R}{7}$ (C) R (D) $\frac{101R}{67}$

510. A uniformly charged non conducting sphere of radius R and total charge Q is fixed on a non-conducting plane. A very small bob having negative charge –q and mass m is hung from a fixed point through a non-conducing and inextensible string of length 2R as shown in the figure. The whole system is placed in a gravity free space. The bob is displaced by a very small angle from the vertical, then find the time required to reach from point A to O. (angular displacement of the bob is so small that it can be assumed, the distance between the bob and the sphere is always nearly equal to R

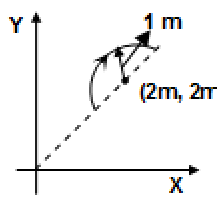


(A) $2\pi\sqrt{\frac{4\pi\varepsilon_0 R^3 m}{3Qq}}$ (B) $\frac{\pi}{2}\sqrt{\frac{4\pi\varepsilon_0 R^3 m}{3Qq}}$ (C) $2\pi\sqrt{\frac{8\pi\varepsilon_0 R^3 m}{3Qq}}$ (D) $\frac{\pi}{2}\sqrt{\frac{8\pi\varepsilon_0 R^3 m}{3Qq}}$

511. An infinite collection of current carrying infinite conductors each carrying a current I outwards perpendicular to papers are placed at x = α_0, $-2\alpha_0$, $3\alpha_0$, $-4\alpha_0$ … ad infinite on the x-axis. Another infinite collection of current carrying conductors each carrying a current I inwards perpendicular to the papers are placed at x = $-\alpha_0$, $2\alpha_0$, $-3\alpha_0$, $4\alpha_0$ … ad infinite here α_0 is a positive constant. Then the magnetic field at the origin due to the above collection of current carrying conductor is

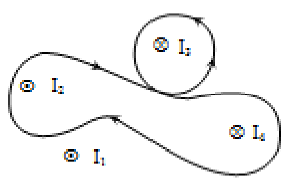
(A) zero (B) $\frac{\mu_0 I}{\pi\alpha_0 \ell n2}$ (C) $\frac{\mu_0 I \ell n2}{\pi\alpha_0}$ (D) infinite

512. A uniform magnetic field $\vec{B} = (3\hat{i} + 4\hat{j} + \hat{k})$ Tesla exists in a region of space. A semicircular wire of radius 1 m carrying current 1 A having its centre at (2, 2, 0) m is placed on the x-y plane as shown in the figure. The force on the semi-circular wire will be



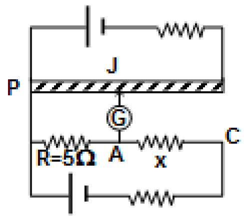
(A) $\sqrt{2}(\hat{i} + \hat{j} + \hat{k})$ N (B) $\sqrt{2}(\hat{i} - \hat{j} + \hat{k})$ N (C) $\sqrt{2}(\hat{i} + \hat{j} - \hat{k})$ N (D) $\sqrt{2}(-\hat{i} + \hat{j} + \hat{k})$ N

513. Four wires of current I_1 = 2A, I_2 = 4A, I_3 = 6A and I_4 = 8A cut the page perpendicularly at the points a, b, c and d respectively. The value of $\int \vec{B}.d\vec{\ell}$ for the shown loop would be



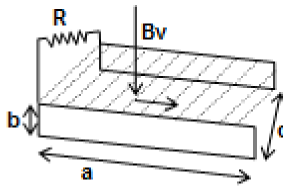
(A) + 2 μ_0-wb/m (B) – 2 μ_0-wb/m (C) + 10 μ_0-wb/m (D) – 10 μ_0-wb/m

514. Circuit for the measurement of resistance by potentiometer is shown. The galvanometer is first connected at point A and zero deflection is observed at length PJ = 10 cm. In second case it is connected at point C and zero deflection is observed at a length 25 cm from point P. Then find the value of the unknown resistance x.



(A) 5Ω (B) 7.5Ω (C) 12.5Ω (D) none of the above

515. The figure shows an apparatus suggested by Faraday to generate electric current from a flowing river. Two identical conducting planes of length a and width b are placed parallel facing one another on opposite sides of the river at a distance d apart. The river is flowing with a velocity v, vertical component of the magnetic field produced by earth is B_v and the resistivity of river water is ρ. Now both the plates are connected by a load resistance R. Find the current through the load R.

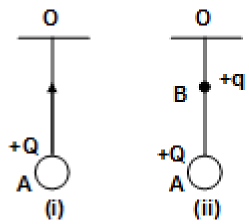


(A) $\frac{B_v vb}{R}$ (B) $\frac{B_v vb}{R+\frac{\rho d}{ab}}$ (C) $\frac{B_v vd}{R+\frac{\rho d}{ab}}$ (D) none of the above

516. A parallel plate capacitor C is equally filled with parallel layers of materials of dielectric constants K_1 and K_2. Then the ratio of new capacitance to the previous capacitance is:

(A) $\frac{2K_1K_2}{K_1+K_2}$ (B) K_1+K_2 (C) $\frac{K_1K_2}{K_1+K_2}$ (D) none of the above

517. The time period of simple pendulum of charged bob is T as shown in the figure. Now a massless charge q is placed at point B, and time period of oscillation is T′, then

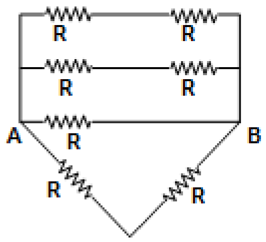


(A) T′ > T (B) T′<T (C) T′ = T (D) can't say

518. A long string with a charge of λ per unit length passes through an imaginary cube of edge a. The maximum flux of the electric field through the cube will be

(A) $\frac{\lambda a}{\varepsilon_0}$ (B) $\frac{\sqrt{2}\lambda a}{\varepsilon_0}$ (C) $\frac{6\lambda a^2}{\varepsilon_0}$ (D) $\frac{\sqrt{3}\lambda a}{\varepsilon_0}$

519. In the network shown below, the equivalent resistance between A and B is



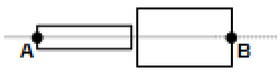
(A) R/2 (B) (2/5)R (C) 2R (D) (5/2)R

520. A charged particle begins to move from the origin in a region which has a uniform magnetic field in the x-direction and a uniform electric field in the y-direction. Its speed is V when it reaches the point (x, y, z). V will depend

(A) only on x (B) only on y

(C) on both x and y but not z (D) on x, y and z

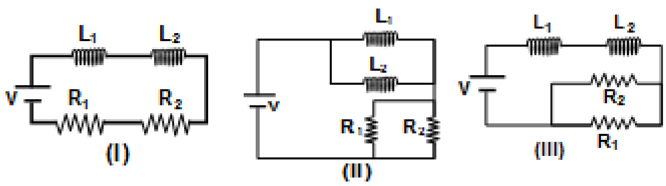
521. A cylindrical element of resistivity ρ, radius r and length ℓ is connected in series with another cylindrical element of conductivity σ, radius 2r and length ℓ, such that axis of both the cylinders is along the same line as shown. The net resistance across A and B is



(A) $\left(\rho+\frac{1}{4\sigma}\right)\frac{\ell}{\pi r^2}$ (B) $\left(\rho+\frac{4}{\sigma}\right)\frac{\ell}{\pi r^2}$ (C) $\left(\frac{1}{\rho}+4\sigma\right)\frac{\pi r^2}{\ell}$ (D) $\left(4\rho+\frac{1}{\sigma}\right)\frac{2\ell}{\pi r^2}$

522. Given L_1 = 1 mH R_1 = 1Ω L_2 = 2 mH R_2 = 2Ω

(Neglect mutual inductance) The time constants (in ms) for the circuits I, II and III are



(A) 1, 1, $\frac{9}{2}$ (B) $\frac{9}{4}$, 1, 1 (C) 1, 1, 1 (D) 1, $\frac{9}{4}$, 1

523. A horizontal ring of radius $r=\frac{1}{2}$m is kept in a vertical constant magnetic field 1T. The ring is collapsed from maximum area to zero area in 1 sec. Then the emf induced in the ring is:

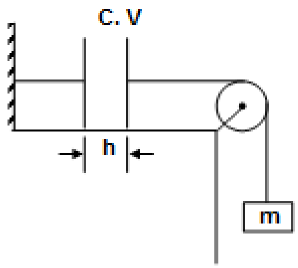
(A) 1 Volt (B) (π/4) Volt (C) (π/2) Volt (D) π Volt

524. A conducting shell of radius a and charge Q is concentric with a solid sphere of charge Q and radius b (b < a). then the electric potential at distance r (b < r < a) from the centre is

(A) $KQ\left(\frac{1}{a}+\frac{1}{b}\right)$ (B) $KQ\left(\frac{1}{a}-\frac{1}{r}\right)$ (C) $KQ\left(\frac{1}{a}+\frac{1}{r}\right)$ (D) $\frac{KQ}{a}$

where, $k=\frac{1}{4\pi\in_0}$

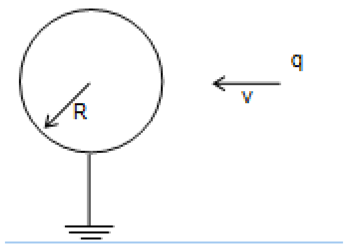
525. A parallel plate capacitor of capacity C tied by non-conducting ropes is charged to a potential difference as shown in the figure. Given $mgh = \frac{1}{2}CV^2$. When released, m will



(A) move up (B) move down C) remain at rest (D) execute SHM

SECTION : (B) - More Than One Correct Options

526. A charged particle having a positive charge q approaches a grounded metallic sphere of radius R with a constant small speed v as shown in the figure. In this situation:



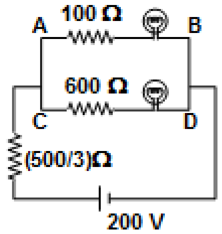
(A) As the charge draws nearer to the surface of the sphere, a current flows in to the ground .

(B) As the charge draws nearer to the surface of the sphere, a current flows out of the ground in to the sphere.

(C) As the charged particle draws nearer, the magnitude of current flowing in the connector joining the shell to the ground increases.

(D) As the charged particle draws nearer, the magnitude of current flowing in the connector joining the sphere to the ground decreases.

527. Two bulbs 25 watt-100 volt and 100 watt-200 volt are connected in the circuit as shown in figure choose the correct answer(s).



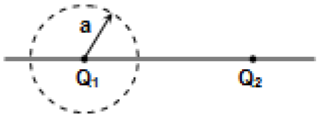
(A) Heat lost per second in the circuit will be 80 J.

(B) Ratio of heat produced per second in bulb will be 1 : 1.

(C) Ratio of heat produced in branch AB to Branch CD will be 2 : 1

(D) current drawn from the cell is 0.4 amp

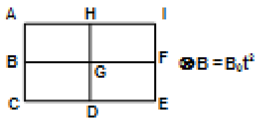
528. In the figure shown, there are two charges Q_1 and Q_2 with Q_1 fixed and Q_2 is moving along the line joining the two charges. Considering a spherical surface of radius a centred at Q_1. The electric flux passing through the left half of the surface at the position shown



(A) will increase (B) will decrease

(C) depends on nature of Q_2 and Q_1 (D) depends on velocity of Q_2

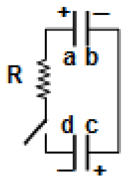
529. The loop shown in the figure is kept in varying magnetic field as shown. The loop is in the plane of the page and the magnetic field is into the plane of the page. The loop is made of wire with uniform resistance per unit length.



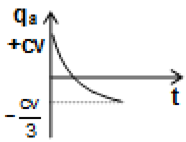
(A) current in branch GH = 0 (B) Current in branch GF = 0

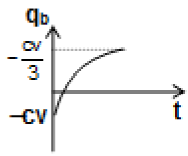
(C) current in branch FI = 0 (D) Current in branch HI = 0

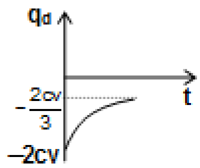
530. A parallel plate capacitor of capacitance C is charged to a potential difference V, such that plate a is positively charged and plate b is negatively charged. Another capacitor of capacitance 2C is charged to a same potential difference V, such that plate c is positively charged and plate d is negatively charged. Now both the capacitors are connected to each other as shown in the figure, such that plate a is connected to plate d and plate b is connected to plate c with the help of a conductor having resistance R.

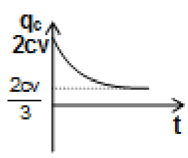


Then choose the correct curve(s) if q_a, q_b, q_c and q_d represents the charge on the plates a, b, c and d respectively

(A) 

(B) 

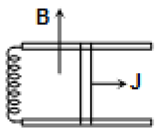
(C) 

(D) 

531. A uniform disc of radius R lies on the x-y plane with its centre at origin. Its moment of inertia about z-axis is equal to its moment of inertia about an axis along the line $y = K_1x + K_2$ where K_1 and K_2 are constants. Then choose the option(s) having possible values of K_1 and K_2.

(A) $K_1 = 1, K_2 = +\frac{R}{\sqrt{2}}$ (B) $K_1 = 1, K_2 = -\frac{R}{2}$ (C) $K_1 = -1, K_2 = +\frac{R}{2}$ (D) $K_1 = -1, K_2 = -\frac{R}{\sqrt{2}}$

532. Two parallel resistance less rails are connected by an inductor of inductance L at one end as shown in the figure. A magnetic field B exists in the space which is perpendicular to the plane of the rails. Now a conductor of length ℓ and mass m is placed transverse on the rails and given an impulse J towards the rightward direction. Then choose the correct option(s)



(A) Velocity of the conductor is half of the initial velocity after a displacement of the conductor $d = \sqrt{\frac{3J^2L}{4B^2\ell^2m}}$.

(B) Current flowing through the inductor at the instant when velocity of the conductor is half of the initial velocity is $i = \sqrt{\frac{3J^2}{4Lm}}$

(C) Velocity of the conductor is half of the initial velocity after a displacement of the conductor $d = \sqrt{\frac{3J^2L}{B^2\ell^2m}}$

(D) Current flowing through the inductor at the instant when velocity of the conductor is half of the initial velocity is $i = \sqrt{\frac{3J^2}{mL}}$

533. The plates of a parallel plate capacitor are charged with surface densities σ_1 and σ_2 respectively. The electric field at points.

(A) Inside the region between the plates will be zero.

(B) Inside the metallic plate of the capacitor is zero.

(C) Everywhere in the space will be zero.

(D) Inside the region between the plates will be uniform and nonzero

534. When a charged particle enters a magnetic field then the magnetic field:

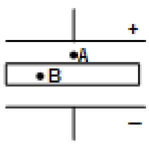
(A) may change the direction of motion of the particle

(B) may not change the direction of motion of the particle

(C) may change the kinetic energy of the particle

(D) will not change the kinetic energy of the particle.

535. A slab S is placed between the plates of a parallel plate charged isolated capacitor as shown. Let E_A and E_B be electric field intensities at A and B respectively. Then,



(A) E_A is opposite to E_B in direction if S is dielectric.

(B) E_A will always be same in direction as E_B.

(C) E_A will be same in direction as E_B only if S is conducting

(D) E_B will be zero if S is a metal

536. Four charges, all of the same magnitude are placed at the four corners of a square. At the centre of the square, the field is E. By suitable choices of the signs of the four charges which of the following can be obtained

(A) v = 0, E = 0 (B) V = 0, E $\neq$ 0 (C) v $\neq$ 0, E = 0 (D) v $\neq$ 0, E $\neq$ 0

537. The electric potential in a region along the x-axis varies with x according to the relation

$V(x) = 4 + 5x^2$ then

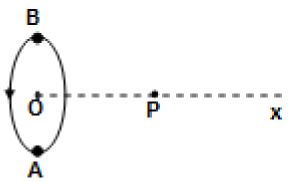
(A) potential difference between the points x = 1 and x = –2 is 15 volt.

(B) Force experienced by a one coulomb charge at x = –1 m will be 10 N.

(C) The force experienced by the above charge will be toward +x-axis

(D) A uniform electric field exists in this region along the x-axis

538. A is a circular loop carrying a current i. P is a point on axis OX, $d\ell$ is an element of length dl on the loop at a point B on it. The magnetic field at P,



(A) due to loop is directed along OX (B) due to dl is directed along OX

(C) due to dl is perpendicular to OX (D) due to dl is perpendicular to BP

539. When a positively charged particle is placed in a constant magnetic field then the

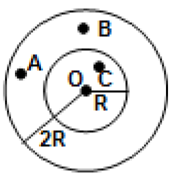
(A) intensity of the magnetic field change

(B) intensity of the magnetic field does not change

(C) direction of the magnetic lines of force changes

(D) direction of the magnetic lines of force does not change

540. A hollow conducting sphere of inner radius R and outer radius 2R is given a charge Q as shown in the figure, then the



(A) potential at A and B is same (B) potential at O and B is same

(C) potential at O and C is same (D) potential at A, B, C and O is same

541. An infinite current carrying conductor is placed along the z-axis and a wire loop is kept in the x-y plane. The current in the conductor is increasing with time. Then the

(A) emf induced in the wire loop is zero

(B) magnetic flux passing through the wire loop is zero

(C) emf induced is zero but magnetic flux is not zero

(D) emf induced is not zero but magnetic flux is zero

542. A positively charged thin metal ring of radius R is fixed in x-y plane with its centre at the origin o. A negatively charged particle P is released from rest at the point (O, O, Zo). Then the motion of P is

(A) periodic for all values of Zo

(B) SHM for all values of Zo satisfying O < Zo < R

(C) approximately SHM, provided z >> R

(D) approximately SHM, provided Z << R.

543. A capacitor of capacitance 'C' is connected with a battery of emf ε. After full charging a dielectric of same size of capacitor & dielectric constant k is inserted then choose correct statements.

Capacitor is always connected to battery.

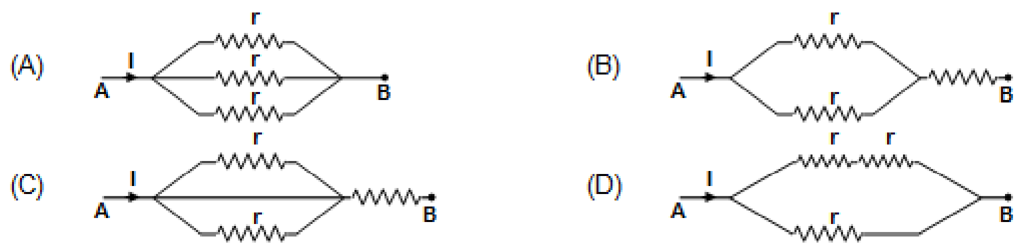
(A) electric field between plates of capacitor remain same

(B) charge on capacitor increased to KC ε

(C) energy on capacitor increased

(D) electric field between plates of capacitor increased

544. If the same current passes through following circuits P and R represents power dissipated and equivalent resistance across A, B points then



(A) $P_1 > P_2 > P_3 > P_4$ (B) $R_1 > R_2 > R_3 > R_4$ (C) $P_2 > P_3 > P_4 > P_1$ (D) $R_2 > R_3 > R_4 > R_1$

545. For induced electric field

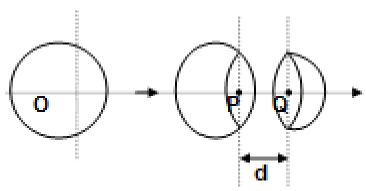
(A) the field lines may not be closed

(B) the field lines are always closed

(C) "potential" is not defined

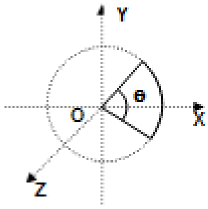
(D) magnetic flux must change

546. An insulating spherical shell of uniform surface charge density is cut into two parts as shown in the figure. $\vec{E}_p$ and $\vec{E}_Q$ denote the electric fields at P and Q respectively. As d (i.e., PQ) ∞



(A) $|\vec{E}_p| > |\vec{E}_Q|$ (B) $|\vec{E}_p| = |\vec{E}_Q|$ (C) $|\vec{E}_p| < |\vec{E}_Q|$ (D) $\vec{E}_p + \vec{E}_Q = 0$

547. A current carrying loop lies in the x–y plane. The magnetic field in the region is given by $\vec{B} = B_0\hat{k} + x\hat{j}$. Then



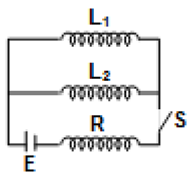
(A) net force acting on the loop is zero for all real x.

(B) initial angular acceleration is minimum then x = 0.

(C) for x = 0, the loop won't rotate.

(D) for x = 0, the loop rotates.

548. In the circuit, a battery of emf E, a resistance R and inductance coil L_1 and L_2 and switch S are connected as shown. Initially the switch is open



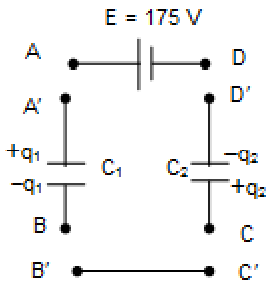
(A) The time constant of the circuit is $\frac{1}{R}\left(\frac{L_1L_2}{L_1+L_2}\right)$

(B) Steady state current in the inductor L_1 is $\frac{EL_2}{R(L_1+L_2)}$

(C) Steady state current in the inductor L_2 is $\frac{EL_1}{R(L_1+L_2)}$

(D) In steady state the total energy stored in the inductor coils is

549. In the figure shown capacitor C_1 =4μF is charged to a value q_1 = 200 μC and capacitor C_2 = 2μF is charged to a value q_2 = 400μC. The polarities are as shown. Now a source of EMF E = 175 Volt is connected in the circuit by joining terminals A to A′, B to B′, C to C′ and D to D.



(A) After a long time the charges on capacitor C_1 and C_2 are 100 μC and 300 μC respectively.

(B) Internal energy of the capacitor system decreases.

(C) Work done by the battery in the process is -1.75×10^{-2} J.

(D) all of them are incorrect

550. Three concentric spherical metallic shells, A, B and C of radii a, b and c (a<b<c) have surface charge densities σ, -σ and σ respectively.

(A) Potential of shell A is $\frac{\sigma}{\varepsilon_0}(a-b+c)$

(B) Potential of shell C is $\frac{\sigma}{\varepsilon_0 C}(a^2-b^2+c^2)$

(C) Potential of C is $\frac{\sigma}{2\varepsilon_0 c}(a^2+b^2-c^2)$

(D) If the shell A and C is same then relation between radii a, b and c is c = a + b.

551. A solenoid is connected to a source of constant emf for a long time. A soft iron piece is increased into it, then

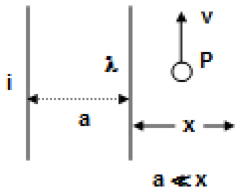
(A) self inductance of solenoid gets increased

(B) flux linked with solenoid increases, hence steady state current gets decreased.

(C) energy stored in the solenoid gets increased

(D) magnetic field due to solenoid get increased.

552. Two long, thin parallel conductors are kept very close to each other, without touching one carries a current I, and the other has charge λ per unit length. A proton moving parallel conductors with velocity v is un deflected. Assume 'C' is the velocity of light. Then



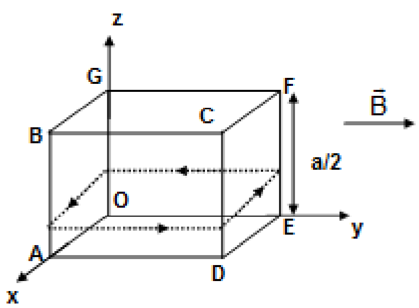
(A) $V = \frac{\lambda C^2}{i}$

(B) $v = \frac{i}{\lambda}$

(C) $c = \frac{i}{\lambda}$

(D) The proton may be at any distance from the conductor

553. A wooden cubical block ABCDEFG of mass m and side a is wrapped by a square wire loop of perimeter 4a, carrying current I. The whole system is placed at frictionless horizontal surface in a uniform magnetic field $\vec{B} = B_0\hat{j}$ as shown in the figure. In this situation, normal given by horizontal surface by a distance x from centre. Choose correct statement(S)



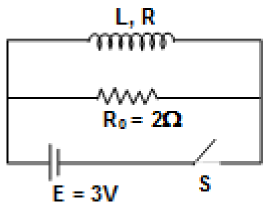
(A) Block must not topple if $I < \frac{mg}{aB_0}$

(B) Block must not topple if $I < \frac{mg}{2aB_0}$

(C) $x = \frac{a}{4}$ if $I = \frac{mg}{2aB_0}$

(D) $x = \frac{a}{4}$ if

554. In inductor if inductance L = 1H and resistance R = 3/2 is connected a circuit as shown in the figure. Initial switch was closed for a long time and switch is opened at t = 0 sec. Now choose correct statement(s)



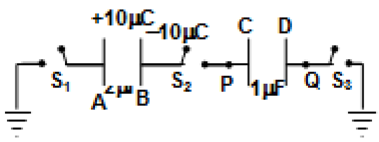
(A) $I = e^{-5t}$, where I is current following through R_0 at t = t sec

(B) Net heat generated in the circuit after switch is opened is 0.3 joule

(C) $I = 3e^{-5t}$ where I is current following through R_0 at t = t sec

(D) Total heat generated in the resistance R after switch is opened is 0.18 joule

555. A system of two capacitor is shown in the figure. If $V_p - V_Q = +20V$, then



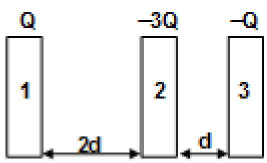
(A) If switch S_2 is closed potential difference between plate A and plate B is 15 volt.

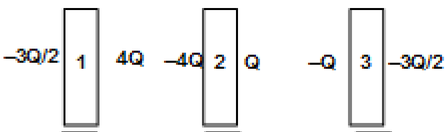
(B) If all switches are closed, $Q_A = -\frac{20}{3}\mu C$ and $Q_C = \frac{10}{3}\mu C$

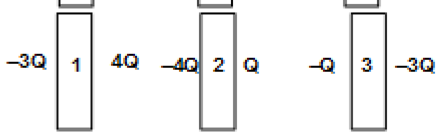
(C) If all switches are closed $V_P - V_Q = \frac{10}{3}$ volt

(D) If all switches are closed, energy loss in the circuit is 75 μj

556. Three identical metal plates with large surface area [A] are kept are given charges $Q, -3Q$ and Q respectively. If plate B is earthed and potential of plate 2 is V then choose the correct statement(s) if $\frac{A\varepsilon_0 V}{d} = Q$ $d \ll A$



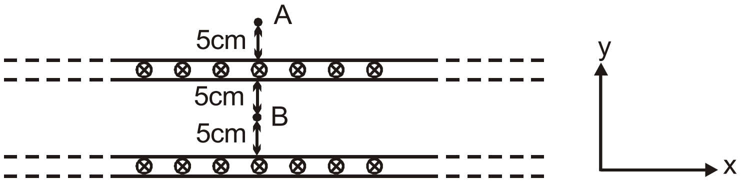
(A) 

(B) 

(C) Potential difference between plates 1 and 2 is 8 V

(D) Magnitude of charge supplied by earth is 5 Q

557. Figure shows cross section of two large parallel metal sheets carrying electric currents along their surfaces. The current in each sheet is $\frac{10}{\pi}$ A/m along the width. Consider two points A and B, as shown in the figure with their positions.



(A) Magnetic field at A is 4μT along x-direction.

(B) Magnetic field at A is 4μT along negative x-direction.

(C) Magnetic field at B is zero.

(D) Magnetic field at B is 2μT along x-direction

558. Two capacitors of capacitance 1 μF and 2 μF are separately charged by a common battery. The two capacitors start discharging through equal resistances separately at $t = 0$.

(A) The current in each of the two discharging circuit is zero at $t = 0$

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

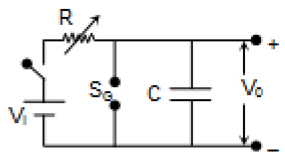
(C) The currents in two discharging circuits are equal at all times

(D) Capacitor of 1 μF capacity loses 50% of its charge earlier than capacitor of capacity 2 μF

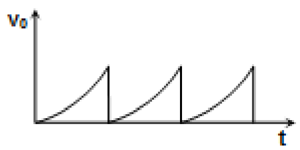
SECTION : (C) -Passage Type Questions

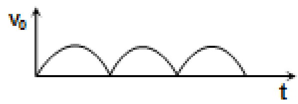
PASSAGE 01:

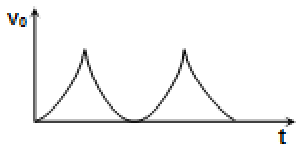
A semi tooth voltage waveform V_0 can be obtained across the capacitor C in figure. R is a variable resistor, V_i is an ideal battery, and SG is a spark plug consisting of two electrodes with an adjustable distance between them, when the voltage across the electrodes exceeds the firing voltage V_s, the air between the electrodes breaks down. Hence the gap becomes a short circuit and remains so until the voltage across the gap becomes very small

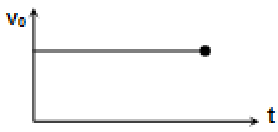


559. The plot of output voltage waveform V_0 versus time t will be

(A)


(B)


(C)


(D)


560. What condition must be satisfactory order to have a almost linearly varying semi tooth

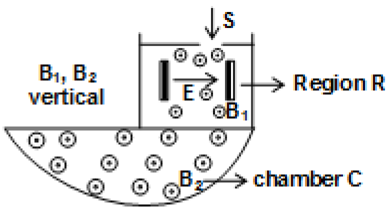
(A) C is very large (B) C is very small (C) R is very small (D) None of these.

561. If condition in previous question is satisfied, a simplified expression for the time period T of the waveform will be

(A) $V_f RC$ (B) $\frac{V_f}{V_{battery}} \times RC$ (C) $\frac{V_{battery}}{V_f RL}$ (D) $\frac{V_{battery}}{V_f} RC$

PASSAGE 02:

Figure shows the plan of a mass spectrometer in which positive ions are produced and accelerated by a suitable voltage towards a plate with a slit S. The ions then pass into an evacuated region R where there is a horizontal electric field E and a vertical magnetic field B_1. Region R acts as velocity selector, such that the ions passes the region un-deflected. Finally, they pass into an evacuated chamber C where there is a vertical magnetic field B_2. In a particular experiment singly charged ions of two isotopes (A) and (B) of neon of masses 20 u and 22 u are respectively accelerated from rest and passed through region R where the electric field is 3×10^4 V/m. The values of the magnetic fields B_1 and B_2 are both equal to 0.4 T



Answer the following questions based on the above passage

562. What is the speed of both type of ions before entering the chamber C.

(A) 7.5×10^4 m/s for both type of ions (B) 7.5×10^4 m/s for A and 6.82×10^4 m/s for B

(C) 6.82×10^4 m/s for A and 7.5×10^4 m/s for B (D) can't be calculated.

563. Find the radius of curvature of the path of the ion A in chamber C

(A) 42.80 mm (B) 38.91 mm (C) 25.70 mm (D) 23.36 mm

564. Calculate the separation of the isotopes after one half revolution inside the chamber C.

(A) 7.8 mm (B) 3.9 mm (C) 42.80 mm (D) 38.91 mm

PASSAGE 03:

Two point charges, of equal charge +q, are kept distance d apart. Another, similar charge is brought from infinity to a point such that the three charges form an equilateral triangle of side d.

565. The electrostatic force between the two charges kept at distance d apart, during the time in which the third charge is brought from infinity, is:

(A) $\frac{1}{4\pi\epsilon_0}\frac{q^2}{d^2}$ (B) $\frac{1}{4\pi\epsilon_0}\frac{2q^2}{d^2}$

(C) $\frac{1}{4\pi\epsilon_0}\frac{q}{d}$ (D) it changes with time and connot be defined.

566. Another charge is to be placed at the centre of the triangle so that the system is in equilibrium, the value of the charge is:

(A) $\frac{q}{\sqrt{3}}$ (B) $\frac{q}{3}$ (C) $\frac{-q}{3}$ (D) $\frac{-q}{\sqrt{3}}$

567. Due to the presence of this charge at the centre, the electrostatic force between the charges kept at the corners:

(A) increases in magnitude

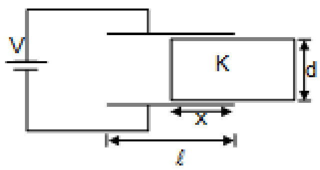
(B) decreases in magnitude

(C) does not change in magnitude and direction.

(D) only changes in direction but remains same in magnitude.

PASSAGE 04:

In the situation shown in figure the area of the square plates is A. The dielectric slab is released from rest and mass of the slab is m



568. What is the charge on the capacitor when dielectric slab is released

(A) $\frac{\varepsilon_0 \ell V}{2d}[\ell + x(k-1)]$ (B) $\frac{\varepsilon_0 \ell V}{d}[\ell + x(k-1)]$ (C) $\frac{\varepsilon_0 \ell V}{d}[2\ell + x(k-1)]$ (D) None of these

569. Motion of the dielectric slab after releases is

(A) SHM (B) Oscillatory (C) Uniform (D) Cannot be predicted

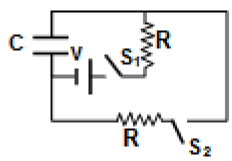
570. The time period of the slab is

(A) $8\sqrt{\frac{(\ell - x)m\ell d}{\varepsilon_0 AV^2(k-1)}}$ (B) $8\sqrt{\frac{2(\ell - x)m\ell d}{\varepsilon_0 AV^2(k-1)}}$ (C) $4\sqrt{\frac{(\ell - x)m\ell d}{\varepsilon_0 AV^2(k-1)}}$ (D) $3\sqrt{\frac{(\ell - x)m\ell d}{\varepsilon_0 AV^2(k-1)}}$

PASSAGE 05:

A capacitor of capacitance C can be charged (with the help of a resistance R) by a voltage source of emf V, by closing switch S_1 while keeping switch S_2 open. Initially the capacitor is uncharged.

571. At time t = 0 switch S_1 is closed and S_2 is left open and if τ is the time constant for this circuit then:



(A) τ = 2RC and charge on the capacitor at t = τ is CV $(1-e^{-1})$

(B) τ = RC and charge on the capacitor at t = 2τ is CV $(1-e^{-1})$

(C) τ = RC and charge on the capacitor at t = 2τ is CV $(1-e^{-2})$

(D) $\tau = \frac{RC}{2}$ and charge on the capacitor at t = τ/2 is CV

572. The rate of increase of charge on the capacitor is

(A) $\frac{V}{R}e^{-tRC}$ (B) $2\frac{V}{R}e^{-t/RC}$ (C) $\frac{V}{R}e^{-t/RC}$ (D) none of the above

573. When the capacitor has reached steady state then switch S_1 is opened and S_2 is closed. The ratio of RC to the charge on the capacitor after the first RC seconds is:

(A) R/v (B) Re/v (C) Rv/e (D) R/ve

PASSAGE 06:

A student constructs a series RLC circuit. While operating the circuit at a frequency *f* she uses an AC voltmeter and measures the potential difference across each device as $(\Delta V_R)_{max}$ = 8.8 V, $(\Delta V_L)_{max}$ =2.6V, , and $(\Delta V_c)_{max}$=7.4V.

574. The circuit is constructed so that the inductor is next to the capacitor. What result should the student expect for a measurement of the combined potential difference $(\Delta V_L + \Delta_C)_{max}$ across the inductor and capacitor ?

(A) 10.0V (B) 7.8V (C) 7.4V (D) 4.8V

575. What result should the student expect for a measurement of the amplitude E_m of the potential difference across the power supply?

(A) 18.8V (B) 13.6V (C) 10.0V (D) 4.0V

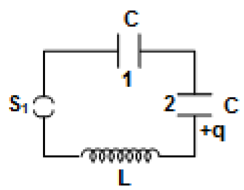
576. How should the frequency of this circuit be changed to increase the current i_m through the circuit?

(A) Increase *f*. (B) Decrease *f*.

(C) The current is already at a maximum. (D) There is not enough information to answer the question.

PASSAGE 07:

In the figure shown, capacitor 1 has a charge Q and 2 has no charge. At t = 0, the switch S_1 is closed. L is the inductance of the inductor.



577. At what time the charges will be equally divided between the two capacitors for the first time?

(A) $\frac{\pi\sqrt{LC}}{2\sqrt{2}}$ (B) $\frac{\pi\sqrt{LC}}{\sqrt{2}}$ (C) $\frac{\pi\sqrt{LC}}{2}$ (D) $\frac{\pi\sqrt{LC}}{4}$

578. What will be the current in the circuit at the time mentioned above?

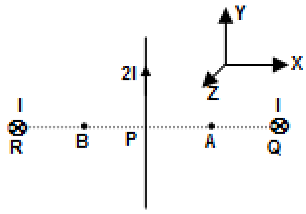
(A) $\frac{Q}{\sqrt{LC}}$ (B) $\frac{Q}{\sqrt{2LC}}$ (C) $\frac{Q\sqrt{2}}{\sqrt{LC}}$ (D) $\frac{2Q}{\sqrt{LC}}$

579. When the capacitor 2 will be fully charged for the first time? Here ω is the angular frequency of LC oscillation.

(A) $\frac{2\pi}{\omega}$ (B) $\frac{\pi}{\omega}$ (C) $\frac{\pi}{2\omega}$ (D) $\frac{4\pi}{\omega}$

PASSAGE 08:

Three infinitely long straight conductors are at P, Q and R arranged as shown in the figure. Here RB = BP = PA = AQ = d



580. The direction of magnetic field at A due to wire at R is

(A) $\hat{j}$ (B) $+\hat{k}$ (C) $-\hat{j}$ (D) $-\hat{k}$

581. The net magnetic field at A due to all wires is

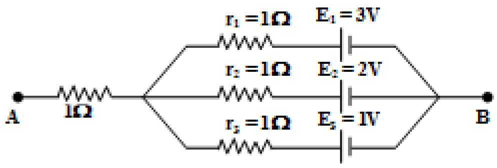
(A) $\frac{\mu_0 I}{2\pi d}\left[\frac{2}{3}\hat{j}-2\hat{k}\right]$ (B) $\frac{\mu_0 I}{2\pi d}\left[\frac{2}{3}\hat{j}+2\hat{k}\right]$ (C) $\frac{\mu_0 I}{2\pi d}\left[-\frac{2}{3}\hat{j}+2\hat{k}\right]$ (D) none of these

582. The net magnetic field at B due to all wires is

(A) $\frac{\mu_0 I}{2\pi d}\left[\frac{2}{3}\hat{j}-2\hat{k}\right]$ (B) $\frac{\mu_0 I}{2\pi d}\left[\frac{2}{3}\hat{j}+2\hat{k}\right]$ (C) $\frac{\mu_0 I}{2\pi d}\left[-\frac{2}{3}\hat{j}+2\hat{k}\right]$ (D) none of these

PASSAGE 09:

In the circuit shown in the figure E_1 = 3V, E_2 = 2V, E_3 = 1 V, R = r_1 = r_2 = r_3 = 1 Ω.



583. Potential difference between the points A and B is

(A) 3 V (B) 2 V (C) 1.5 V (D) 2.5 V

584. Current in the branch containing E_2

(A) 1 A (B) 1.5 A (C) 0 A (D) 2 A

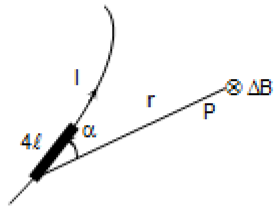
585. If r_2 is short circuited and point A is connected to point B. Then current through resistance R is

(A) 1 A (B) 1.5 A (C) 0 A (D) 2 A

PASSAGE 10:

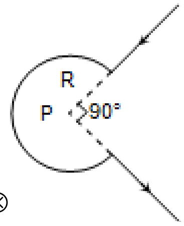
To calculate B for any shape of conductor, Boit and Savart gave a law which can now stated as follows. The flux density B at a point P due to a small element $\Delta\ell$ of a conductor carrying current is given by

$$\Delta B = \frac{\mu_0}{4\pi}\frac{I\Delta\ell \sin\alpha}{r^2}$$



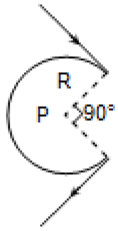
where r is the distance from the point to a element and α is the angle between the element and line joining it to point P

586. Calculate magnetic field at point P.



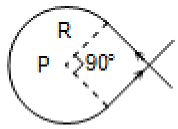
(A) $\frac{\mu_0}{4\pi}\frac{I}{R^2}\left(\frac{\pi}{2}\right)\odot$ (B) $\frac{\mu_0 3I}{8R}\odot$ (C) $\frac{\mu_0 3I}{8R}\otimes$ (D) $\frac{\mu_0 3I}{8R^2}\otimes$

587. Calculate magnetic field at point P.



(A) $\frac{\mu_0}{4\pi}\frac{I}{R}\left(\frac{3\pi}{2}-2\right)\odot$ (B) $\frac{\mu_0}{4\pi}\frac{I}{R}\left(\frac{3\pi}{2}+2\right)\otimes$ (C) $\frac{\mu_0}{4\pi}\frac{I}{R}\left(\frac{\pi}{2}-2\right)\odot$ (D) $\frac{\mu_0}{4\pi}\frac{I}{R}\left(\frac{\pi}{2}+2\right)\otimes$

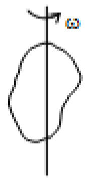
588. Calculate magnetic field at point P.



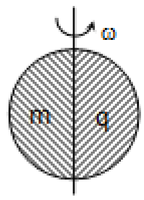
(A) $\frac{\mu_0}{4\pi}\frac{I}{R}\left(\frac{3\pi}{2}+2\right)\odot$ (B) $\frac{\mu_0}{4\pi}\frac{I}{R}\times\frac{3\pi}{2}\otimes$ (C) $\frac{\mu_0}{2\pi}\frac{I}{R}\odot$ (D) $\frac{\mu_0 I}{2R}\otimes$

PASSAGE 11:

Consider a non-conducting homogeneous rigid body of mass m which has a total charge q distributed similar to mass distribution. The mass is rotated about an axis passing through the body with angular speed ω. The magnetic moment of the body M and the angular momentum L of the body about the same axis is given by

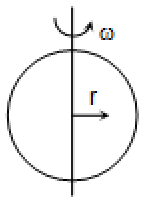


589. Consider a hypothetic spherical body. The body is cut into two parts about the diameter. One of hemispherical portion has mass distribution m while the other portion has identical charge distribution q. The body is rotated about the axis with constant speed ω. Then the ratio of M to L is



(A) $\frac{q}{2m}$ (B) $>\frac{q}{2m}$ (C) $<\frac{q}{2m}$ (D) Cannot be calculated.

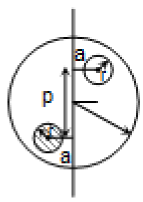
590. Consider a solid sphere whose mass and charge distribution is proportional to r^2, where r is the radial distance from the axis of rotation. The solid sphere is rotated about the diameter of the sphere. Then the ratio of M to L is



(A) $\frac{q}{2m}$ (B) $>\frac{q}{2m}$

(C) $<\frac{q}{2m}$ (D) Cannot be calculated

591. Consider a solid non-conducting sphere of radius r and mass m. Initially the mass and the charge q is uniformly distributed over the entire volume. A small sphere of charge is picked from a distance a from the axis of rotation, keeping the mass distribution unchanged and embedded at the opposite side by same distance from the axis as shown in the figure. Again the system is rotated about the given axis by constant angular speed ω. Then ratio of M to L is



(A) $\frac{q}{2m}$ (B) $>\frac{q}{2m}$ (C) $<\frac{q}{2m}$ (D) Cannot be calculated.

SECTION : (D) - Matrix Match

592. A charged particle having charge q and mass m is to be subjected to a combination of constant uniform magnetic field ($\vec{B}$) and a constant uniform gravitational field ($\vec{E}$). Apart from these field forces there exists no other force. Now match the column.

Column I		Column II	
(A)	The charged particle moves without change in its direction.	(1)	It is possible that both $\vec{B}$ and $\vec{E}$ are zero.
(B)	The charged particle moves without change in its velocity.	(2)	It is possible that both $\vec{B}$ and $\vec{E}$ are non zero
(C)	The charged particle takes a circular path	(3)	It is possible that $\vec{B}$ is zero and $\vec{E}$ is not zero
(D)	The charged particle take a parabolic path	(4)	It is possible that $\vec{B}$ is non zero and $\vec{E}$ is zero

593. Match the physical quantities with their appropriate dimensions

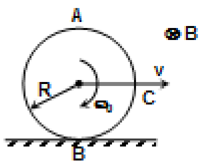
Column I		Column II	
(A)	Inductance	(1)	$MLT^{-2}A^{-2}$
(B)	Capacitance	(2)	$ML^{2}T^{-2}A^{-1}$
(C)	Magnetic flux	(3)	$M^{-1}L^{-2}T^{4}A^{2}$
(D)	Permeability of free space	(4)	$ML^{2}T^{-2}A^{-2}$

594.

Column – I		Column – II	
(A)	Inside a conducting charged sphere.	(i)	constant field
(B)	Inside a uniformly charged sphere.	(ii)	constant potential
(C)	For a cavity in a conductor.	(iii)	Linearly varying field
(D)	Spherical cavity inside a uniformly charged sphere.	(iv)	Linear variation of potential.

595. **Column – I** **Column – II**

(A) A ring or radius R is rolling on a horizontal surface with angular velocity ω_0 as shown. emf induced across AB is

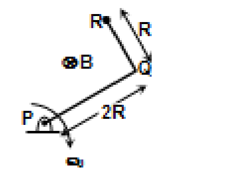


(i) $B\omega_0 R^2$

(B) Consider the situation in part (a).
The emf induced across AC will be

(ii) $2\ B\omega_0 R^2$

(C) Consider an L shaped rod shown in the figure.
The rod rotates about P with an angular velocity ω_0.
The emf induced across PR is



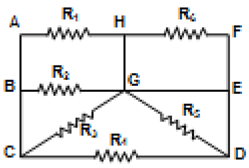
(iii) $2.5\ B\omega_0 R^2$

(D) Consider the situation shown in part C. The emf induced across QR will be

(iv) $0.5\ B\omega_0 R^2$

(v) $1.5\ B\omega_0 R^2$

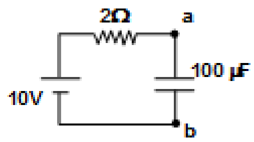
596. For the circuit shown in the figure

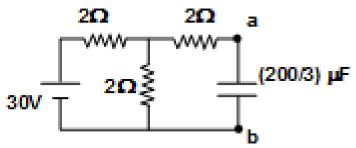


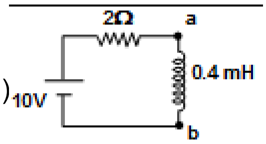
Column – I		Column – II	
(A)	Equivalent resistance between G and C is	(i)	dependent on R_1
(B)	Equivalent resistance between BG is	(ii)	dependent on R_2
(C)	Equivalent resistance between EA is	(iii)	dependent on R_3
(D)	Equivalent resistance between DG is	(iv)	Independent of R_1, R_2, R_3, R_4, R_5, R_6

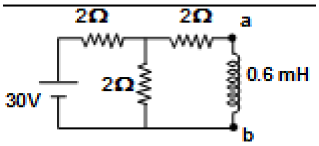
597. Choose the correct equation of current in the List II as a function of t through the circuit element 'ab' of the circuits in the List – I

List – I

(A) 

(B) 

(C) 

(D) 

List – II

(i) $i = (5A)\left[1 - e^{-\frac{t}{(2\times10^{-4}\ \text{sec})}}\right]$

(ii) $i = (5A)\left[1 - e^{-\frac{t}{(4\times10^{-4}\ \text{sec})}}\right]$

(iii) $i = (5A)\, e^{-\frac{t}{(2\times10^{-4}\ \text{sec})}}$

(iv) $i = (5A)\, e^{-\frac{t}{(4\times10^{-4}\ \text{sec})}}$

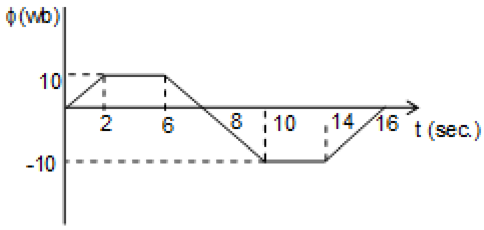
598. Four bulbs of 25W, 40W, 60W and 100W are connected in series and their combination is connected across a main power supply. Match the following list I with the potential difference across each bulb in list II

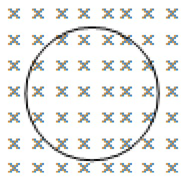
List I		List II	
(A)	25 W	(i)	Highest potential differences
(B)	100 W	(ii)	Second highest potential difference
(C)	60 W	(iii)	Third highest potential difference
(D)	40 W	(iv)	Lowest potential difference

599. For information given in list I, match it with that of list II

	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

600. Magnetic flux in a circular coil of resistance 10 Ω changes with time as shown in the figure. Direction indicates a direction perpendicular to paper inwords. Match the following





	List – I		**List – II**
(A)	At 1 sec induced current is	(i)	Clock wise
(B)	At 5 sec induced current is	(ii)	Anticlockwise
(C)	At 9 sec induced current is	(iii)	Zero
(D)	At 15 sec induced current is	(iv)	2A
		(v)	None

601. Match the type of field lines of the fields given in list I with the possible geometrical shapes, they can acquire, in list II

	List – I		**List – II**
(A)	Gravitational field	(i)	Circle
(B)	Electrostatic field	(ii)	Parallel straight lines
(C)	Magnetic field	(iii)	Straight lines diverging from a point
(D)	non-conservative electric field	(iv)	Straight lines converging on to a point

602. $\mu_0 \rightarrow$ R Permeability, $\tau_0 \rightarrow$ permittivity

L $\rightarrow$ Inductance, R $\rightarrow$ Resistance, C $\rightarrow$ Capacitance

$\eta \rightarrow$ coefficient of viscosity

	List – I(Terms)		**List – II(Dimension Formula)**
A.	$\frac{1}{\mu_0 \varepsilon_0}$	i.	L^2T^{-2}
B.	L	ii.	$[ML^{-1}T^{-1}]$
C.	$\frac{R}{LC}$	iii.	$[ML^2T^{-2}A^{-2}]$
D.	η	iv.	$[ML^2T^{-4}A^{-2}]$

603. There is a small dipole of dipole moment $\vec{p}$ is placed parallel to an internal electric field $\vec{E}_0$ at origin along x-axis

	List – I		**List – II**
(A)	Radius of equipotential sphere centre at dipole	(i)	$y = \pm\sqrt{2}x$
(B)	Electric field at a point $(x_0, 0)$ on x-axis line in which dipole lies	(ii)	$\left(\dfrac{k\lvert\vec{P}\rvert}{\lvert\vec{E}_0\rvert}\right)^{1/3}$
(C)	Electric field due to dipole is along y-axis on the line.	(iii)	$\left(\vec{E}_0 + \dfrac{2k\vec{P}}{x_0^3}\right)$
(D)	Work done to move a unit charge from origin to $(x_0, 0)$	(iv)	$-\left(E_0 x_0 + \dfrac{kP}{x_0^2}\right)$

604.

	List – I		**List – II**
(A)	Pair production when high energy photons enter a thin walled box in vacuum.	(i)	Charge is invariant.
(B)	Charge of a body is independent of its speed	(ii)	Conservation of mass and energy
(C)	Spherical charged conductor for an internal point	(iii)	Equipotential surface
(D)	Uniformly charged disc	(iv)	Electric field component in the plane is in radially outward direction

605.

	List – I		**List - II**
(A)	Electrostatic field	(i)	non-conservative
(B)	Induced electric field	(ii)	conservative
(C)	Gravitational field	(iii)	lines always closed
(D)	Induced Magnetic field	(iv)	lines are open

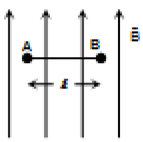
606. Figure A shows a straight current carrying conductor AB of length 'ℓ' placed in the plane of paper. Considering the plane of paper to be in the XY-plane a uniform magnetic field exists along the positive Y-direction as shown. The conductor experience a force is 10 N.

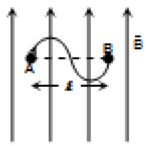
Figure B shows a curved current carrying conductor AB straight line distance between A and B is ℓ'. The conductor is in the plane of paper and in same magnetic field as in figure A.

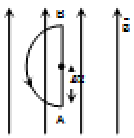
Figure C shows a semicircular closed conductor that carries current and is placed in the plane of paper and in same magnetic field as in figure A. Radius of the given semi-circle is $\ell/2$.

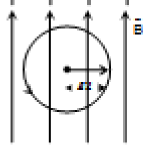
The system shown in figure D is a circular current carrying conductor placed in the plane of paper and in the same magnetic field as in figure A. Radius of conductor is $\ell/2$.

Assuming current in each conductor has same value

(A) 

(B) 

(C) 

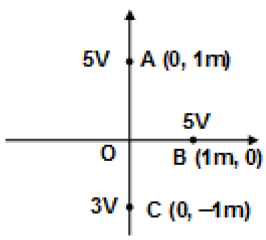
(D) 

	List – I		List – II
(A)	Force experienced by the conductor in figure B	(i)	zero
(B)	Force experienced by the conductor in figure C.	(ii)	10 N
(C)	Force experienced by the curved part of the conductor in figure C.	(iii)	slightly less than 10 N
(D)	Force experienced by the conductor in figure D.	(iv)	slightly more than 10 N

607.

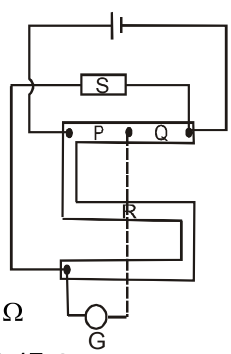
	List – I		List - II
(A)	Magnetic flux density due to a current carrying circular coil	(i)	zero
(B)	Magnetic flux density at a point on a current carrying thin wire	(ii)	Maximum at the centre
(C)	Electric field strength due to an uniform charged ring	(iii)	Continuously decreases as we move away from the centre along the axis.
(D)	Electric potential due to an uniform charged ring	(iv)	Continuously increases as we move away from the centre upto a definite distance along the axis.

608. An uniform electric field exists in straight line in the X–Y plane. The potential at different point in region are shown in the figure. Now match the following list if charge particles P (mass = 10^{-6} kg, charge $\sqrt{2}$ μC) and θ (mass = 10^{-6} kg. Charge = $-2\sqrt{2}$ μC are released from origin)



	List I		List II
(A)	Co-ordinate of position of particle P at time t = $2\sqrt{2}$ sec	(i)	($4\sqrt{2}$ m, $4\sqrt{2}$ m)
(B)	Co-ordinate of position of particle at time t = 2 sec	(ii)	($-4\sqrt{2}$ m, $-4\sqrt{2}$m)
(C)	Distance travelled by particle Q in 2 sec is	(iii)	8 m
(D)	Distance travelled by particle P in 2 sec is	(iv)	4 m

609. Connections made in a post office box are shown in figure.R(↗) =10W denotes that when R= 10W the pointer in the galvanometer is as (↗).



(a) P=100Ω, Q=10Ω , R(↗) = 400 Ω, R(↖) = 500 Ω

(b)P=100Ω, Q=1 Ω , R(↗) = 460 Ω, R(↖) = 470 Ω

(c)P=100Ω, Q=10Ω , R(↗) = 460 Ω, R(↖) = 470 Ω

(d) P=1000Ω, Q=1 Ω , R(↗) = 460 Ω, R(↖) = 470 Ω

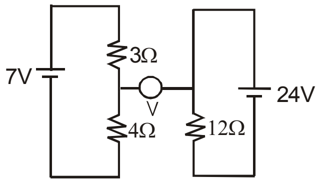
(P) 46 Ω < S < 47 Ω

(Q) 0.46 Ω < S < 0.47 Ω

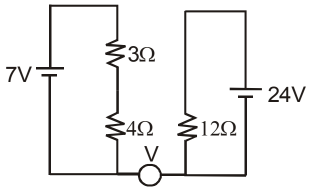
(R) 40 Ω < S < 50 Ω

(S) 4.6 Ω < S < 4.7 Ω

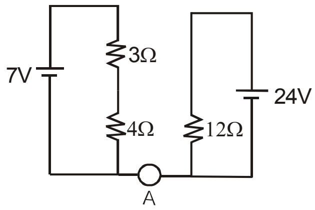
610. Match the readings of the voltmeter and ammeter respectively shown in the figures.

(a) 

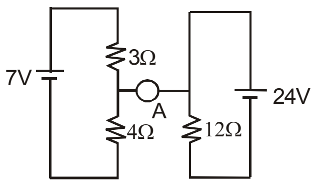
(P) 0V

(b) 

(Q) 20A

(c) 

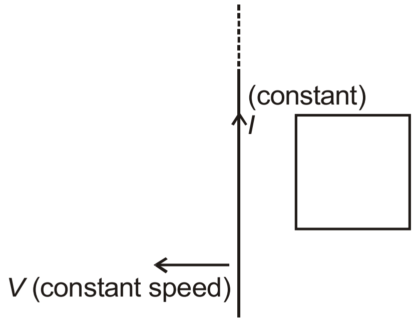
(R) 0A

(d) 

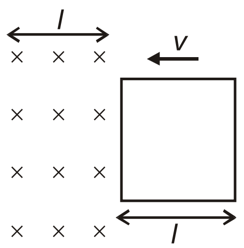
(S) 20 V

611. **Column I** **Column II**

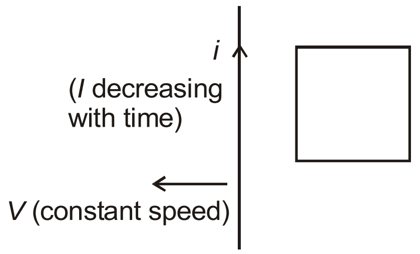
(A) In the figure shown the wire starts moving towards left with constant speed



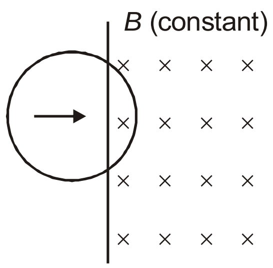
(B) Loop is having with constant speed towards the region of magnetic field for $t < \frac{l}{v}$



(C) In the figure shown the wire starts moving towards left with constant speed



(D) Loop is moving out of magnetic field region with constant speed



(p) Induced emf is clockwise

(q) Induced emf is anti-clockwise

(r) Induced emf can be clockwise and anti-clockwise

(s) emf is increasing in magnitude

(t) emf is decreasing in magnitude

612. **Column I** / **Column II**

(a) Consider an infinitely long line charge with a constant positive linear charge density. The electric field at a point which is at a distance 'r' from the line charge is

(b) Consider a uniformly charged non-conducting ring of radius 'R'. The electric field at a point 'P' located on the axis of the ring at a distance 'r' from its centre is

(c) Consider a spherical charged conductor of a radius 'R' with a concentric spherical cavity of radiusR/2. The electric field at a point 'P' at a distance 'r' from the centre is

(d) Consider a spherical uncharged conductor of radius 'R' with a is placed at the centre of the cavity. The electric field at a point 'P' at a distance 'r' from the centre of the sphere is

(p) Inversely proportional to r^2 when r<R/2.

(q) Radially outward and in versely proportional to r.

(r) Inversely proportional to r^2 when r > R.

(s) Increases with r, reaches a maximum and then de creases.

613. A 1C charge of mass 1kg is projected in a magnetic field of 2T with velocity $2\sqrt{2}$ at angle 45^0, Match the following:

	Table -1		Table -2
(a)	Radius of helical path	(P)	π SI units
(b)	Pitch of helical path	(Q)	1 SI units
(c)	Time period	(R)	2π SI units
(d)	Numbe of rotations in 10 seconds	(s)	$\frac{10}{\pi}$ SI units

614. In L-C oscillations, match the following:

	Table-1		Table -2
(a)	Maximum charge	(P)	Maximum rate of change of current
(b)	Zero charge	(Q)	Maximum electrostatic energy
(c)	Maximum current	(R)	Maximum magnetic energy
(d)	zero current	(S)	zero rate of change of current

615. . **Column A** / **Column B**

A) Consider an infinitely long line charge with a constant positive linear charge density. The electric field at a point which is at a distance 'r' from the line charge is

B) Consider a uniformly charged non-conducting ring of radius 'R'. The electric field at a point 'P' located on the axis of the ring at a distance 'r' from its centre is

C) Consider a spherical charged conductor of a radius 'R' with a concentric spherical cavity of radius $\frac{R}{2}$. The electric field at a point 'P' at a distance 'r' from the centre is

D) Consider a spherical uncharged conductor of radius 'R' with a concentric spherical cavity of radius $\frac{R}{2}$. A point charge q(q > 0) is placed at the centre of the cavity. The electric field at a point 'P' at a distance 'r' from the centre of the sphere is

(P) Inversely proportional to r^2 when $r < \frac{R}{2}$.

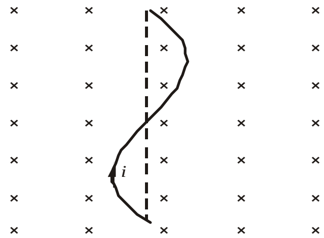
(Q) Radially outward and inversely proportional to r.

(R) Inversely proportional to r^2 when r > R.

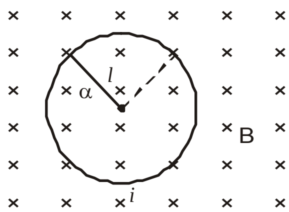
(S) Increases with r, reaches a maximum and then decreases.

616.

	Column A		Column B
(a)	Force on a wire made of two semicircular wires each of length $\frac{\pi l}{4}$ placed in an uniform magnetic field B and carrying a current i is as shown in the figure.	(p)	Zero



(b)	Tension in the wire of statement (A)	(q)	iLB
(c)	Force on a ring of radius l carrying a current i placed in a uniform magnetic field	(r)	$\frac{ilB}{2\pi}$

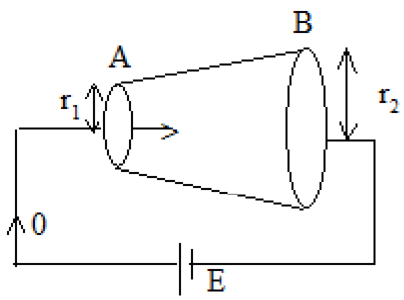


(d)	Tension in the ring of statement (C)	(s)	Can not be determined

617. An electric dipole in uniform electric field is rotated from 30^0 to 120^0. Match the following:

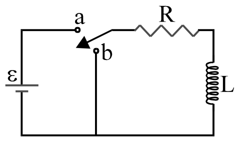
	Table -1		Table -2
(a)	Force	(P)	increases
(b)	Torque	(Q)	decreases
(c)	Potential energy	(R)	remain constant
(d)	stability	(s)	increases then decreases

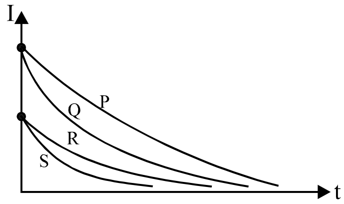
618. A battery of emf E is connected across a conductor as shown as one observe from A to B. Match the following



	Column-I		**Column-II**
(a)	Current	(p)	increases
(b)	Drift velocity of electron	(q)	decreases
(c)	Electric field	(r)	remains same
(d)	Potential drop across the length	(s)	Cannot be determine

619. Figure shows an RL circuit. The switch in the circuit has been closed on **a** for a very long time when it is then thrown to **b**. The resulting current through the inductor is indicated in figure for four sets of values for the resistance R and inductance L in Column I. Which set goes with which curve?





	Column I		*Column II*
(a)	R_0 and L_0	(P)	Curve P
(b)	$2R_0$ and L_0	(Q)	Curve Q
(c)	R_0 and $2L_0$	(R)	Curve R
(d)	$2R_0$ and $2L_0$	(S)	curve S

620.

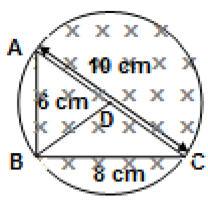
(a)	A circular conducting loop rotating about its axis in a uniform and constant magnetic field parallel to its axis	(P)	Conservation of energy.
(b)	Lenz's law explains	(Q)	Direction of magnetic field.
(c)	If a current in the loop decreases.	(R)	No emf is induced in the loop.
(d)	Flemming's rule explains	(S)	emf is induced in the loop.

621.

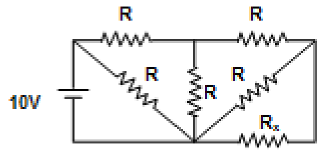
(a)	Gauss Theorem is applicable	(P)	perpendicular to the equipotential surface
(b)	Surface charge density of a conducting body	(Q)	non-conservative field
(c)	Electric lines of forces	(R)	maximum at corner of the body
(d)	Induced electric field	(S)	for any shape of charged body

SECTION : (E) - Integer Type

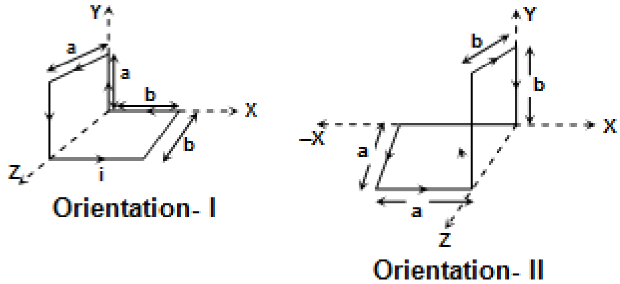
622. ABC is a triangular frame made out of a metallic wire. BD is a median of the triangular frame joining the vertex B to the side AC, (Also made of the same metallic wire). It is known that AB = 6 cm, BC = 8 cm and AC = 10 cm. The cross sectional area of the wire is 1 mm^2 and its resistivity is 24 nΩm. The triangle ABC lies in a cylindrical region of magnetic field such that the intersection of the surface of the cylinder with the plane containing the frame forms the circumcircle of triangle ABC. The magnetic field in the region varies at the rate of 0.263 T/s. What is the magnitude of the induced current in mA in the median BD of the frame?



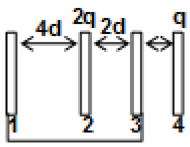
623. If R = 10 Ω, find the value of R_x (in ohm) for which the heat generated per unit time in R_x is maximum.



624. Find the work done (in joule) in slowly rotating the loop shown in the figure from orientation 1 to orientation 2. A uniform magnetic field $\vec{B} = (3\hat{i} + 4\hat{j})$ Tesla exists in the region and a current of 1A flow in the loop in the direction shown in the figure. Given a = b = 1 m.



625. Four identical metal plates of large area A are arranged as shown in the diagram. The plates 1 and 3 are connected by a conducting wire. The charge on plate 2 is 2q and an plate 4 is q. Find the potential difference (in volts) between the plate 2 and 3 if $\frac{qd}{\varepsilon_0 A} = 2$.

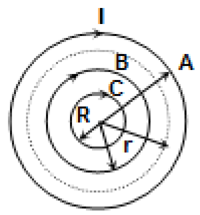


626. A long solenoid A contains another two co-axial solenoids B and C. Radii of solenoids A, B and C are 4 cm, 2 cm and 1 cm respectively. All the solenoids have same number of coils per unit length and current through the coils varies with time t as given.

I_A = 3 Kt

I_B = 2 Kt

I_C = 19 Kt,



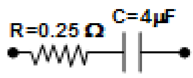
where K is a positive constants and I_A, I_B and I_C are the currents through the solenoid A, B and C respectively. Directions of all the current are same. As a result of the increasing currents a charged particle initially at rest between the solenoids A and B, starts moving along a circular trajectory as shown in the figure. Find the radius r of the circular trajectory, give your answer in C.G.S unit.

627. A battery of emf 12 V and internal resistance 0.5 Ω is charged by a battery charger which supplies a 132 V do supply using a series resistance of 11.5 Ω. What is the terminal voltage in volt of the battery during charging

628. In a car spark coil, an emf of 40,000 volts is induced in its secondary coil when the current in its primary changes from 4A to zero in 10 μs. The mutual inductance between the primary and secondary windings (in Henry) of the spark coil is X/10. Find the value of X.

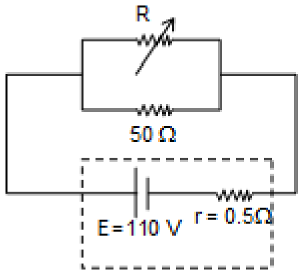
629. A square loop of each side 2 m is kept horizontally in a vertical constant magnetic field 10^{-2} T. The alignment of the loop is such that maximum flux passes through the loop. In 1 second, the loop is collapsed to have zero area, then the magnitude of the emf induced (in v) in the loop is X/100. The value of X is:

630. A 2μF capacitor is charged to 1 μC and connected in parallel to a resistance capacitor combination which has resistor of 0.25 Ω and a 4 μF capacitor (initially uncharged). The magnitude of charge on the uncharged capacitor varies with time as $q = \frac{2}{n}\left(1 - e^{-3t}\right)$

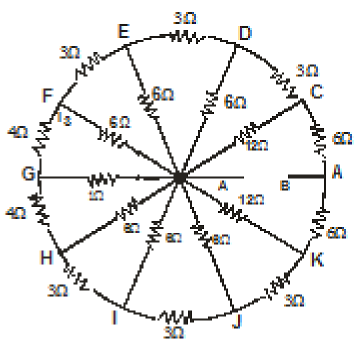


Then the value of n is:

631. An electric circuit consists of a battery emf E = 110 V, and internal resistance is 0.5 Ω and two resistors connected in parallel to the source as shown in figure. Resistance R is chosen so that power liberated in resistance R is maximum. Determine the value of R corresponding to maximum power



632. Find the equivalent resistance of shown circuit across A & B (in Ω).

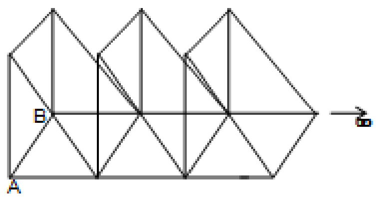


633. In an A.C. series C-R circuit, the voltage applied and the current is given as follows

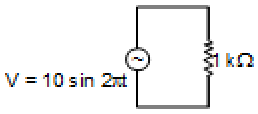
$v(t) = 170 \sin[6280t + (\pi/3)]$ volts

$i(t) = 8.5 \sin[6280t + (\pi/2)]$ volts, then RC is $\frac{\sqrt{K}}{6280}$ sec, then the value of k is ....

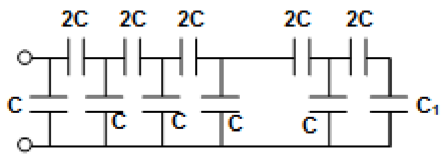
634. If the resistance of each branch is R, find the equivalent resistance between A & B if R = $\sqrt{6}\Omega$



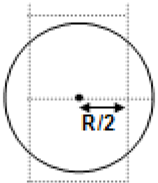
635. A voltage source v = 10 sin $2\pi t$ volt is connected to the circuit as shown in the figure. The energy dissipated through the resistor in Joule in first 0.5 sec is 1/Y. The value of Y is:



636. The figure shows a network of capacitance of several units of capacitance. Find the value of C_1 in μF so that equivalent capacitance between A and B is independent of number of units. [given C = 10μF]

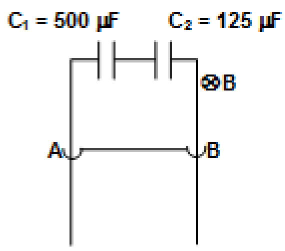


637. A charge Q is uniformly distributed over a solid spherical ball of radius R. The flux of electric field in SI unit across cuboid of dimension (R × 2R × 2R) is .... $\left[\text{if } \frac{Q}{\varepsilon} = 32 \text{ SI} - \text{unit}\right]$ [The front view is shown in the figure.]

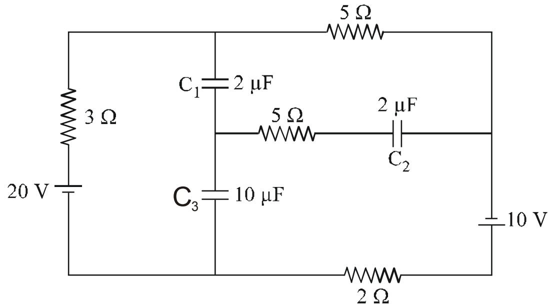


638. A wire of (AB) mass m = 5 milligram and length 1 m can slide freely on a pair of smooth, vertical rails. A magnetic field of 1T exists in the region in the direction perpendicular to the plane of the rails. The rails are connected at the top by two capacitors C_1 = 500 μF and C_2 = 125 μF of breakdown voltage 750 volts and 600 volts respectively.

The wire AB is released at t = 0, calculate the time in sec at which the circuit breaks down

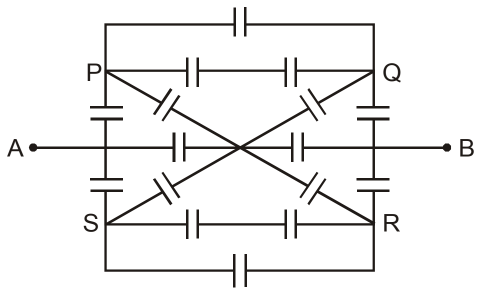


639. In the circuit shown in figure, find the charge on capacitor C_2 in steady state in μC.

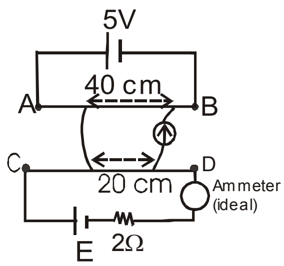


640. A dipole of dipole moment $\vec{P} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ is placed at point A (2, –3, 1). The electric potential due to this dipole at the point B (4, – 1, 0) is (ab) × 10^9volt here 'a' represents sign (for negative answer select 0 for positive answer select 1 as first digit of your answer in the OMR Sheet) and 'b' is a single digit that will appear in your answer (For Example : If your answer is – 2 × 10^9 volt then in the OMR sheet you should fill ). All the parameters specified here are in S.I. units.

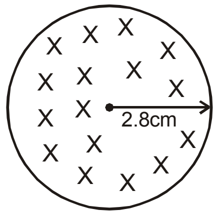
641. In the circuit shown in figure if each capacitor is of capacitance 10 μF, find the equivalent capacitance between points *A* and *B* in μF.



642. AB and CD are two uniform resistance wires of lengths 100 cm and 80 cm respectively . The connections are shown in the figure. The cell of emf 5 V is ideal while the other cell of emf E has internal resistance 2 Ω.A length of 20 cm of wire CD is balanced by 40 cm of wire AB. Find the emf E in volt, if the reading of the ideal ammeter is 2 A. The other connecting wires have negligible resistance.



643. The magnetic field of a cylindrical magnet that has a pole-face radius 2.8 cm can be varied sinusoidally between minimum value 16.8 T and maximum value 17.2 T at a frequency of $\frac{60}{\pi}$ Hz. Cross section of the magnetic field created by the magnet is shown. At a radial distance of 2cm from the axis find the amplitude of the electric field (in mN/C) induced by the magnetic field variation.



644. Given that $C_A = 1\,\mu F$, $C_B = 2\,\mu F$ and $C_C = 2\,\mu F$. Initially each capacitor was charged to potential differences of $V_A = 10$ v, $V_B = 40$ v and $V_C = 60$ v separately and are kept as shown in figure (a). Now they are connected as shown in figure (b). The + and - sign shown in figure (b) represent initial polarities. Find total amount of heat produced in μJ by the time steady state is reached.

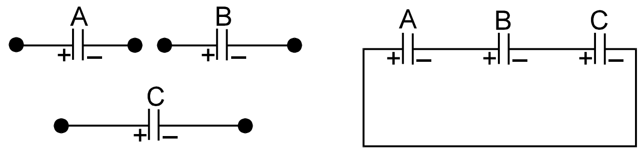


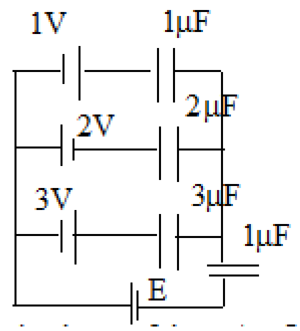
Fig. (a) Fig. (b)

645. *In an LRC series circuit at resonance current in the circuit $10\sqrt{2}$ A. If now frequency of the source is changed such that now current lags by 45° than applied voltage in the circuit. Find the new current in the circuit. Add 1 to your answer if the frequency is to be increased (from resonant frequency) and subtract 1 from your answer if the frequency is to be decreased (from resonant frequency) to get the desired result.*

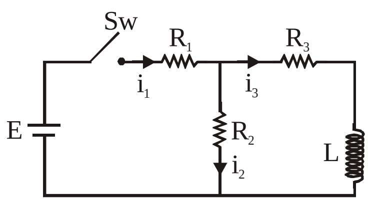
646. The bob of a simple pendulum has a mass of 40 g and a positive charge of 4.0×10^{-6} C. It makes 20 oscillations in 45 s. A vertical electric field pointing upward and of magnitude 2.5×10^4 N/C is switched on. How much time (in seconds) will it now take to complete 20 oscillations ?

647. Consider a LC series circuit.At time t=0, charge in the capacitor is 4C and it is decreasing at a rate of $\sqrt{5}$ C/ s.C=1F,L=4H.Find theMaximum charge in the capacitor can be:

648. In the figure shown, find the emf E (in volts) for which charge on 2 μF is capacitor is 4 μC



649. In the circuit shown in the figure E = 15 V, $R_1 = 1\Omega$, $R_2 = 2\Omega$, $R_3 = 2\Omega$ and L = 1.5 H. The currents flowing through R_1, R_2 and R_3 are i_1, i_2 and i_3 , respectively.find the value of i_1 just after closing the switch



650. A 200 km long telegraph wire has capacity of 0.014 $\mu F / Km$ and carries an alternating current of frequency 5 KHz. What should be the value of an inductance required to be connected in series so that impedance is minimum. [in 10^{-5}]

651. A 750 Hz, 20 V source is connected to a resistance of 100 Ω , an inductance of 0.1803 H and a capacitance of 10 μF all in series. The time in which the resistance (thermal capacity 2 J/^{0}C) will get heated by 10^0C is X/10 minutes. The value of X is:

AnswerKey

Qs.	Ans.	Qs.	Ans.	Qs.	Ans.	Qs.	Ans.
501	C	551	ACD	601	A-(ii,iii),B-(ii,iii,iv),C-(i,ii),D-(i)	651	58
502	A	552	AD	602	A-(i),B-(iii),C-(iv),D-(ii)		
503	A	553	BD	603	A-(ii),B-(iii),C-(i),D-(iv)		
504	B	554	ABD	604	A-(ii),B-(i),C-(iii),D-(iv)		
505	A	555	BCD	605	A-(ii,iv),B-(iii,i),C-(ii,iv),D-(ii,iii)		
506	B	556	BC	606	A-(ii),B-(i),C-(i),D-(i)		
507	C	557	AC	607	A-(ii,iii),B-(i),C-(iv),D-(ii,iii)		
508	A	558	BD	608	A-(ii),B-(i),C-(iii),D-(iv)		
509	B	559	A	609	A-(R),B-(S),C-(P),D-(Q)		
510	D	560	A	610	A-(P),B-(P),C-(R),D-(R)		
511	C	561	B	611	A-(p,t),B-(q),C-(p,t),D-(q,t)		
512	B	562	A	612	A-(Q),B-(S),C-(R),D-(P,R)		
513	B	563	B	613	A-(Q),B-(R),C-(P),D-(S)		
514	B	564	A	614	A-(P,Q),B-(R,S),C-(R,S),D-(P,Q)		
515	C	565	A	615	A-(Q),B-(S),C-(R),D-(PR)		
516	A	566	D	616	A-(q),B-(p),C-(p),D-(q)		
517	C	567	C	617	A-(R),B-(S),C-(P),D-(Q)		
518	D	568	B	618	A-(r),B-(q),C-(q),D-(q)		
519	B	569	B	619	A-(Q),B-(S),C-(P),D-(R)		
520	C	570	A	620	A-(S),B-(R),C-(P),D-(Q)		
521	A	571	C	621	A-(R),B-(P),C-(S),D-(Q)		
522	A	572	C	622	10mA		
523	B	573	B	623	6		
524	C	574	D	624	6		
525	C	575	C	625	4		
526	AC	576	A	626	3		
527	ACD	577	A	627	17V		
528	CD	578	B	628	1		
529	AC	579	B	629	4		
530	ABCD	580	C	630	3		
531	AD	581	A	631	55		
532	AB	582	C	632	5		
533	BD	583	B	633	3		
534	ABD	584	C	634	4		
535	BD	585	D	635	40		
536	ABCD	586	B	636	20		
537	ABC	587	A	637	11		
538	AD	588	A	638	90		
539	BD	589	A	639	10		
540	ABCD	590	A	640	2		
541	AB	591	A	641	13		
542	AD	592	A-(1,2,3),B-(1,2,4),C-(4),D-(3)	642	12		
543	ABC	593	A-(4),B-(3),C-(2),D-(1)	643	240mN/C		
544	CD	594	A-(i,ii),B-(iii),C-(I,ii),D-(i)	644	3025		
545	BCD	595	A-(ii),B-(i),C-(iii),D-(iv)	645	11		
546	BD	596	A-(i,ii,iii),B-(i,ii,iii),C-(i,ii,iii),D-(iv)	646	52		
547	ABC	597	A-(iii),B-(iii),C-(i),D-(i)	647	6		
548	ABCD	598	A-(i),B-(iv),C-(iii),D-(ii)	648	34		
549	ABC	599	A-(iii,i),B-(ii,iv),C-(ii,v),D-(ii,iv)	649	5		
550	ABD	600	A-(ii),B-(iii),C-(i),D-(ii)	650	36		