PHYSICS

BOOKS - AAKASH SERIES

ELECTROSTATICS

LECTURE SHEET (EXERCISE - I) (LEVEL - I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. A Copper atom has 29 electrons revolving around the nucleus. A copper ball contains 4×10^{23} atoms. What fraction of the electrons be removed to give the ball a charge of $+9.6\mu C$?

A. -1.8×10^{-13}

B. -1.3×10^{12}

C. 6×10^{10}

D. -5.2×10^{-12}

Answer: D

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2. A pith ball of mass $9 \times 10^{-5} kg$ carries a charge of $5 \mu C$. What must be charge in another pith ball placed directly 2cm above the given pith ball such that they are held in equilibrium?

A. $3.2 \times 10^{-11} C$

B. $7.84 \times 10^{-12} C$

C. $1.2 \times 10^{-13} C$

D. $1.6 \times 10^{-19} C$

Answer: B

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3. N fundamental charges each of charge .q. are to be distributed as two point charges separated by a fixed distance, then the maximum to minimum force bears a ratio (N is even and greater than 2)

A. $\frac{(N-)^2}{4N^2}$

B. $\frac{4N^2}{(N-1)}$

C. $\frac{N^2}{4(N-1)}$

D. $\frac{2N^2}{(N-1)}$

Answer: C

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4. Two point charges placed at a certain distance r in air exert a force F on each other. Then, the distance r' at which these charges will exert the same force in a medium of dielectric constant K is given by

A. Kr

B. $\frac{r}{K}$

C. $\frac{r}{\sqrt{K}}$

D. $r\sqrt{K}$

Answer: C

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5. Two charges 2 C and 6 C are separated by a finite distance. If a charge of-4 C is added to each of them,the initial force of 12×10^3 N will change to

A. $4 \times 10^3 N$ repulsion

B. $4 \times 10^2 N$ repulssion

C. $6 \times 10^3 N$ attraction

D. $4 \times 10^3 N$ attraction

Answer: D

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6. A charge of 1μC is divided into parts such that their charges are in the ratio of 2: 3. These two charges are kept at a distance 1 m apart in vacuum. Then, the electric force between them (in N) is

A. 0.216

B. 0.00216

C. 0.0216

D. 2.16

Answer: B

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LECTURE SHEET (EXERCISE - I) (LEVEL - II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. $-10\mu C, 40\mu C$ and q are the charges on three identical conductors P,Q and R respectively, Now P and Q attract each other with a force F when they are separated by a distance d. Now P and Q are made in contact with each other and then separated . Again Q and R are touched and they are separated by a distance 'd' . The repulsive force between Q and R is 4F . Then the charge q is:

A. $10\mu C$

B. $30\mu C$

C. $40\mu C$

D. $65\mu C$

Answer: D

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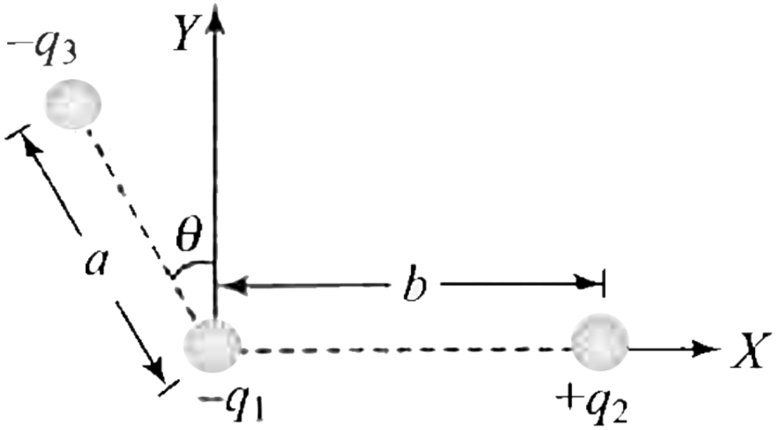
2. Three charges-q_1, $+q_2$ and $-q_3$ are placed as shown in the figure. The x-component of the force on $-q_1$ is proportional to



A. $\frac{q_2}{b^2} - \frac{q_3}{a^2}\cos\theta$

B. $\frac{q_2}{b^2} + \frac{q_3}{a^2}\sin\theta$

C. $\frac{q_2}{b^2} + \frac{q_2}{a^2}\cos\theta$

D. $\frac{q_2}{b^2} - \frac{q_2}{a^2}\sin\theta$

Answer: B

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3. Equal charges Q are placed at the four corners A, B, C, D of a square of length a. The magnitude of the force on the charge at B will be

A. $\dfrac{3q^2}{2\pi\varepsilon_o a^2}$

B. $\dfrac{4q^2}{4\pi\varepsilon_o a^2}$

C. $\left[\dfrac{1+2\sqrt{2}}{2}\right]\dfrac{q^2}{4\pi\varepsilon_o a^2}$

D. $\left[2+\dfrac{1}{\sqrt{2}}\right]\dfrac{q^2}{4\pi\varepsilon_o a^2}$

Answer: C

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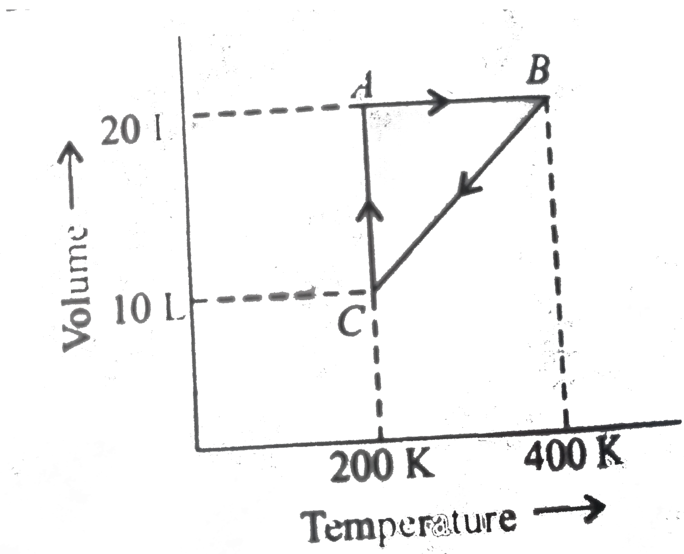
4. 

The pressures at A and B in the atmosphere are, respectively,

A. 1250 N

B. 3500 N

C. 1200 N

D. 2250 N

Answer: D

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LECTURE SHEET (EXERCISE - I) (LEVEL - II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS)

1. Five balls numbered 1,2,3,4,and 5 are suspended using separated threads. The balls (1,2),(2,4) and (4,1) show electrostatic attraction while balls (2,3) and (4,5) show repulsion. Therefore, ball 1 must be

A. positively charged

B. negatively charged

C. neutral

D. made of metal

Answer: C::D

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LECTURE SHEET (EXERCISE - I) (LEVEL - II (ADANCED) INTEGER TYPE QUESTIONS)

1. Three equal charges are placed on the three corners of a square. If the force between q_1 and q_2 is F_{12} and that between q_1 and q_3 is F_{13}, then the ratio of magnitudes (F_{12} / F_{13}) is

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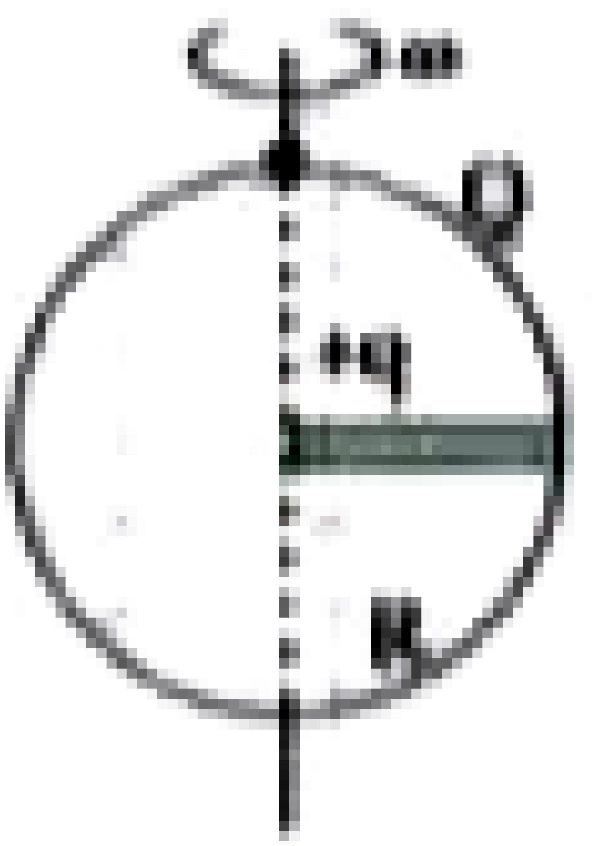
2. A small ball of mass 1 kg and charge $\frac{2}{3}\mu$ C is placed at the centre of a uniformly charged sphere of radius 1 m and charge $\frac{1}{3}mC$. A narrow smooth horizontal groove is made in the sphere from centre to suface as shown in figure. The sphere is made to rotate about its vertical diameter at a constant rate of $\frac{1}{2\pi}$ revolutions per second. Find the speed w.r.z ground (in m/s) with which the ball slides out from the groove. Neglect any magnetic force acting on ball.



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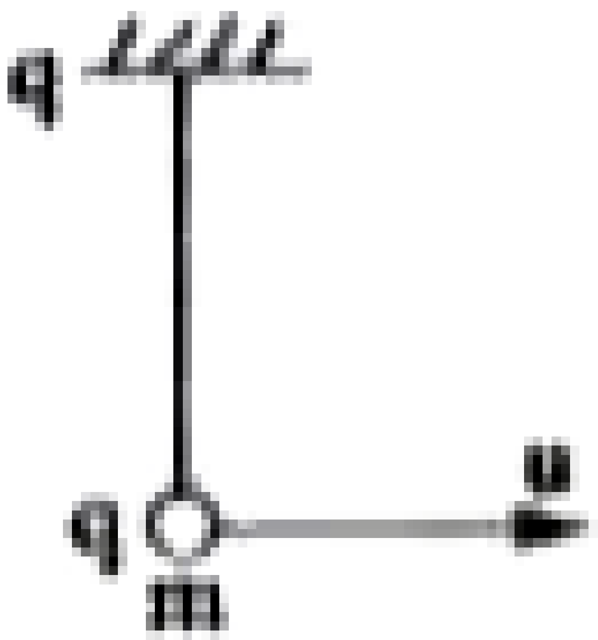
3. The both of a pendulum has mass m = 1 kg and charge $q = 40 \mu C$. Length of pendulum is = 0.9 m. The point of suspensison also has the same charge $40 \mu C$. What is the minimum speed u (in m/s) should be imparted to the bob so that it can complete vertical circle ?



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LECTURE SHEET (EXERCISE - II) (LEVEL - I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. An infinite number of charges, each of magnitude q, are placed along x-axis at x = 1m, 2m, 4m, 8m, 16m and so on but the consecutive charges are of opposite sign starting with +q at x = 1m. A point charge q_0 , kept at the origin, experiences a force of magnitude :

A. $\frac{1}{10\pi\varepsilon_o}$ along + ve x-axis

B. $\frac{1}{10\pi\varepsilon_o}$ along - ve x-axis

C. $\frac{1}{\pi\varepsilon_o}$ along + ve x-axis

D. $\frac{1}{\pi\varepsilon_o}$ along - ve x-axis

Answer: A

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2. An electric field is acting vertically upwards . A particle of mass 1 mg and charge $-1\mu C$ is projected with a velocity $20m/s$ at an angle 45°

with the horizontal . Its horizontal range is 10 m, then the intensity of electric field is $\left(g = 10m / s^2\right)$

A. 20, 000 N/C

B. 10,000 N/C

C. 40,000 N/C

D. 90,000N/C

Answer: C

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3. A bob of a simple pendulum of mass 40 mg with a positive charge 4×10^{-6}C is oscilliating with time period T_1. An electric field of intensity 3.6×10^4 N/c is applied vertically upwards now time period is T_2. The value of $\frac{T_2}{T_1}$ is $\left(g = 10\frac{m}{s^2}\right)$

A. 0.16

B. 0.64

C. 1.23

D. 0.8

Answer: C

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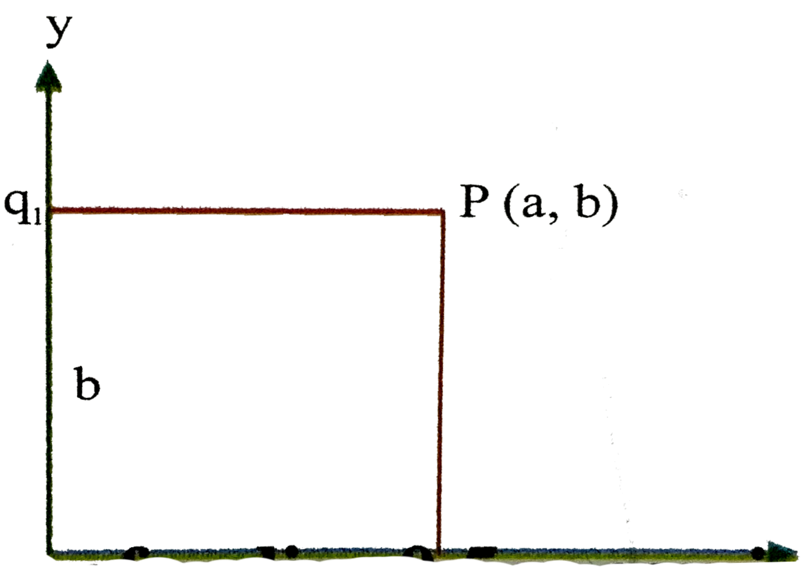
4. Two point charge $q_1 = 2\mu C$ and $q_2 = 1\mu C$ are placed at distance $b = 1$ and $a = 2cm$ from the origin on the y and x axes as shown in figure .The electric field vector at point (a, b) will subtend on angle θ with the "x-axis" given by



A. $\tan\theta = 1$

B. $\tan\theta = 2$

C. $\tan\theta = 3$

D. $\tan\theta = 4$

Answer: B

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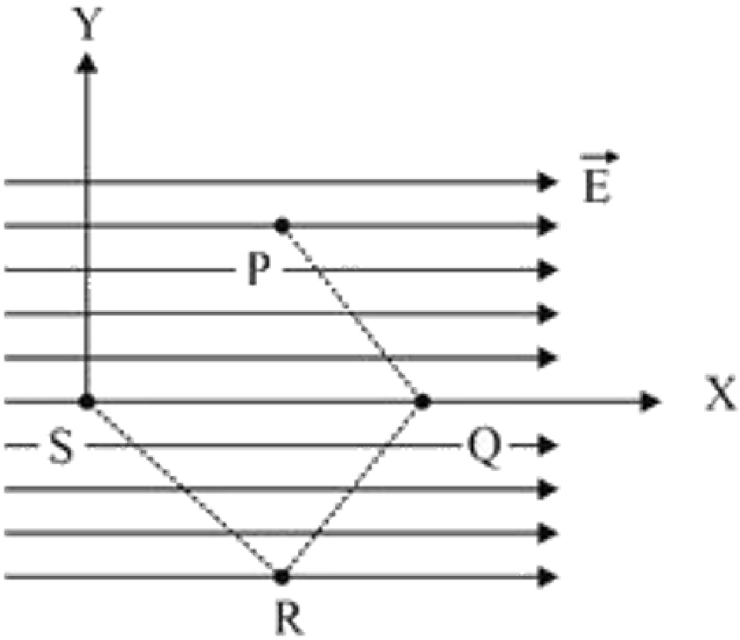
5. Point charge q moves from point P to point S along the path PQRS (figure shown) in a uniform electric field E pointing co-parallel to the positive direction of the x-axis. The coordinates of the points P, Q, R and S are $(a, b, 0)$, $(2a, 0, 0)$, $(a, -b, 0)$ and $(0, 0, 0)$ respectively. The work done by the field in the above process is given by the expression.



A. qEa

B. $-qEa$

C. $qEa\sqrt{2}$

D. $qE\sqrt{(2a)^2 + b^2}$

Answer: B

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6. There is a uniform electric field of strength $10^3 V/m$ along y-axis. A body of mass 1 g and charge $10^6 C$ is projected into the field from origin along the positive x-axis with a velocity 10 m/s. Its speed in m/s after 10 s is (neglect gravitation)

A. 10

B. $\sqrt{2}$

C. $10\sqrt{2}$

D. 20

Answer: C

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7. A partaicle of mass 1 kg and carrying 0.01 C is at rest on an inclined plane of angle of 30° with horizontal when an electric field of $\frac{490}{\sqrt{3}} NC^{-1}$ applied parallel to horizontal, the coefficient of friction is

A. 0.5

B. $\frac{1}{\sqrt{3}}$

C. $\sqrt{3}/2$

D. $\sqrt{3}/7$

Answer: D

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8. Four charges equal to-Q are placed at the four corners of a square and a charge q is at its centre. If the system is in equilibrium the value of q is

A. $-\frac{Q}{4}(1+2\sqrt{2})$

B. $\frac{Q}{2}(1+2\sqrt{2})$

C. $-\frac{Q}{2}(1+\sqrt{2})$

D. $\frac{Q}{2}(1+2\sqrt{2})$

Answer: B

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9. If Two charges $+q$ and $+4q$ are separated by a distance d and a point charge Q is placed on the line joining the above two charges and in between them such that all charges are in equilibrium. Then the charge Q and it's position are

A. A) $-\frac{4q}{9}\text{at a distance}\frac{d}{3}\text{from4q}$

B. B) $-\frac{2Q}{3}\text{at a distance}\frac{d}{3}\text{from q}$

C. C) $-\frac{4q}{9}\text{at a distance}\frac{d}{3}\text{from q}$

D. D) $\frac{-2Q}{3}\text{at a distance}\frac{d}{3}\text{from 4q}$

Answer: C

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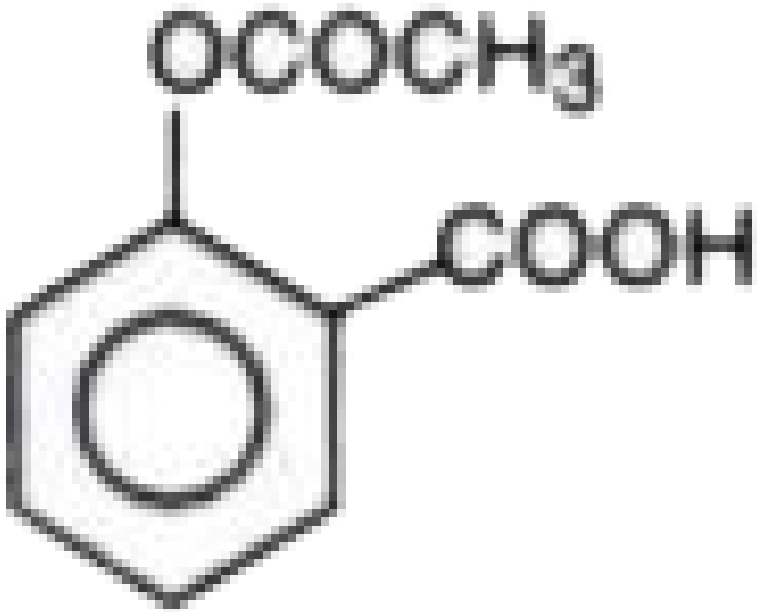
10. The compound



is used as

A. $\left[\frac{Q^2.2L}{4\pi\varepsilon.\,mg}\right]^{\frac{1}{3}}$

B. QLmg

C. $\frac{QL}{mg}$

D. $\frac{Q^2L}{2\pi mg}$

Answer: A

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LECTURE SHEET (EXERCISE - II) (LEVEL - II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS)

1. Two fixed charges 4Q (positive) and Q (negative) are located at A and B. the distance AB being 3 m.

A. A) The point P where the resultant field due to both is zero is on AB.

B. B) The point P where the resultant field due to both is zero is on AB inside AB.

C. C) If a positive charge is placed at P and displaced slightly along AB it will execute oscillations.

D. D) If a negative charge is placed at P and displaced slightly along AB it will execute oscillations.

Answer: A::D

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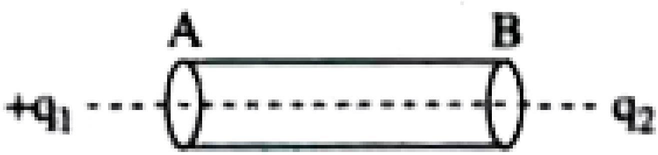
2. A thin conductinrod AB is introduced in between the two point charges $+q_1$ and q_2 as shown in figure.For this situtation mark the correct statement (s).



A. The total experienced by q_1 is vector sum of electric force experienced by $1q_1$ due to q_2 and due to induced charges on rod.

B. The end A will become negatively charged

C. The total force acting on $+q_1$, will be greater than as compared to the case without rod

D. The total force acting on $-q_2$ will be greater than as compared to the case without rod

Answer: A

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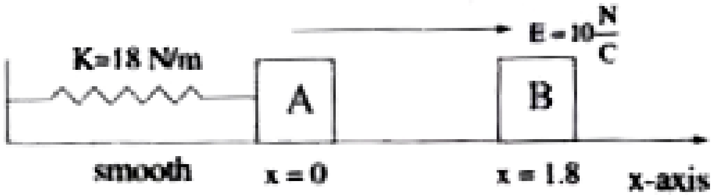
LECTURE SHEET (EXERCISE - II) (LEVEL - II (ADVANCED)LINKED COMP[REHENSION TYPE QUESTIONS)

1. Electrostatic force on a charged parricle is given by $\dot{F} = q\overrightarrow{E}$. If q is positive $\overrightarrow{F} \uparrow \Rightarrow \overrightarrow{E} \uparrow$ and if q negative $\overrightarrow{F} \uparrow \Rightarrow \overrightarrow{E} \downarrow$

Question : In the figure $m_A = m_B = 1kg$. Block A is neutral while $q_B = -1C$. Sizes of A and B are negligible. B is relased from rest at a distance 1.8 m from A. Initially spring is neither compressed nor elongated



The amplitude of oscillation of the combined mass will be :

A. 6 m/s

B. 3 m/s

C. 9 m/s

D. 12 m/s

Answer: B

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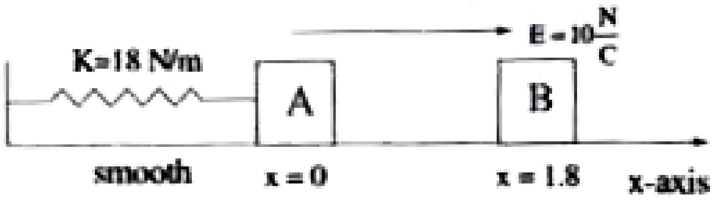
2. Electrostatic force on a charged parricle is given by $\dot{F} = q\overrightarrow{E}$. If q is positive $\overrightarrow{F} \uparrow \Rightarrow \overrightarrow{E} \uparrow$ and if q negative $\overrightarrow{F} \uparrow \Rightarrow \overrightarrow{E} \downarrow$

Question : In the figure $m_A = m_B = 1kg$. Block A is neutral while $q_B = -1C$. Sizes of A and B are negligible. B is relased from rest at a distance 1.8 m from A. Initially spring is neither compressed nor elongated



The amplitude of oscillation of the combined mass will be :

A. $-\frac{2}{3}$

B. $-\frac{1}{3}$

C. $-\frac{5}{9}$

D. $-\frac{7}{9}$

Answer: C

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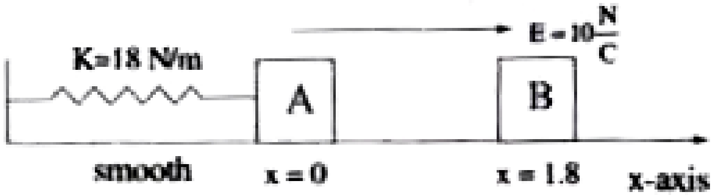
3. Electrostatic force on a charged parricle is given by $\dot{F} = q\vec{E}$. If q is positive $\vec{F} \uparrow \Rightarrow \vec{E} \uparrow$ and if q negative $\vec{F} \uparrow \Rightarrow \vec{E} \downarrow$

Question : In the figure $m_A = m_B = 1kg$. Block A is neutral while $q_B = -1C$. Sizes of A and B are negligible. B is relased from rest at a distance 1.8 m from A. Initially spring is neither compressed nor elongated



The amplitude of oscillation of the combined mass will be :

A. $\frac{2}{3}$

B. $\frac{\sqrt{124}}{3}m$

C. $\frac{\sqrt{72}}{9}m$

D. $\frac{\sqrt{106}}{9}m$

Answer: D

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LECTURE SHEET (EXERCISE - II) (LEVEL - II (ADVANCED) INTEGER TYPE QUESTIONS)

1. A 0.50 gm ball carries a charge of magnitude $10\mu C$. It is suspended by a string in a downward electric field of intensity 300N/C. If the charge on the ball is positive, then the tension in the string is $(g = 10ms^{-2})$

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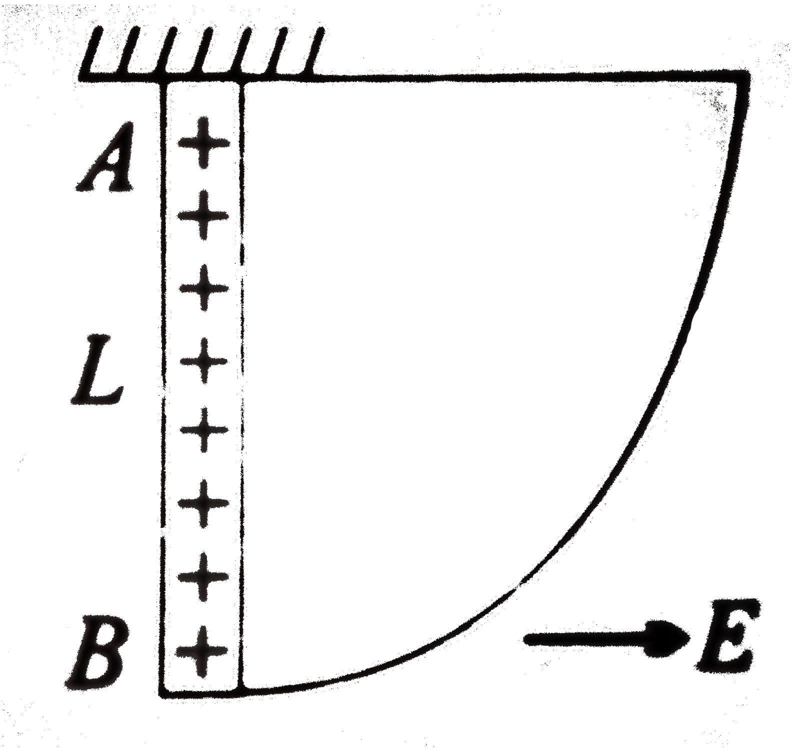
2. A rod AB of length L and mass m is uniformly charged with a charge Q, and it is suspended from end A as shown in fig. The rod can freely rotate about A in the plane of the figure. An electric field E is suddenly switched on in the horizontal direction due to which the rod gets turned by a maximum angle of 90°. The magnitude of E is equal of nMg/Q. Find the value of n.



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LECTURE SHEET (EXERCISE - III) (LEVEL - I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. A cylinder of radius R and length l is placed in a uniform electric field E parallel to the axis of the cylinder. The total flux over the curved surface of the cylinder is

A. $2\pi R^2 E$

B. $\pi R^2 / E$

C. $\frac{(\pi R^2 - \pi R)}{E}$

D. zero

Answer: D

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2. A cube is arranged such that its length, breadth and height are along X, Y and Z directions, One of its corners is situated a the origin. Length of each side of the cube is 25cm. The components of electric field are $E_x = 400\sqrt{2}N/C, E_y = 0$ and $E_z = 0$ respectively. Find the flux coming out of the cube at one end.

A. $25\sqrt{2}Nm^2/C$

B. $5\sqrt{2}Nm^2/C$

C. $250\sqrt{2}Nm^2/C$

D. $25Nm^2/C$

Answer: A

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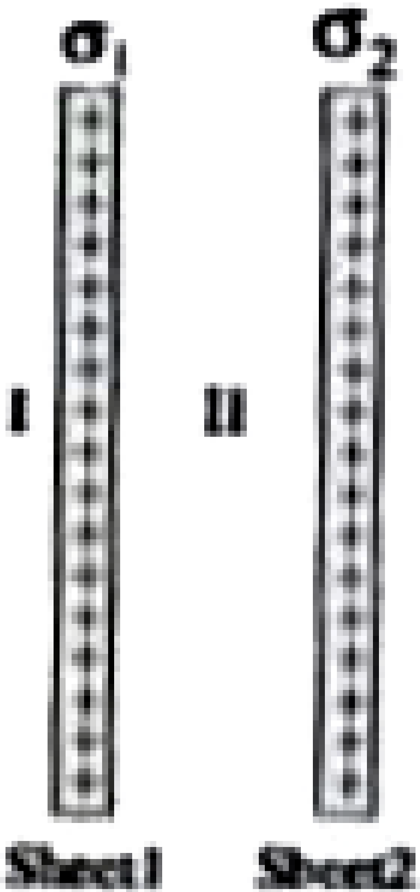
3. Two paralle plane sheets 1 and 2 carry uniform charge densites σ_1 and σ_2 (see fig. The electric field in the region marked I is $(\sigma_1 > \sigma_2)$:



A. $-\frac{\sigma_1}{2\varepsilon_0}$

B. $-\frac{\sigma_2}{2\varepsilon_0}$

C. $\frac{(\sigma_1-\sigma_2)}{2\varepsilon_0}$

D. $\frac{(\sigma_1+\sigma_2)}{2\varepsilon_0}$

Answer: D

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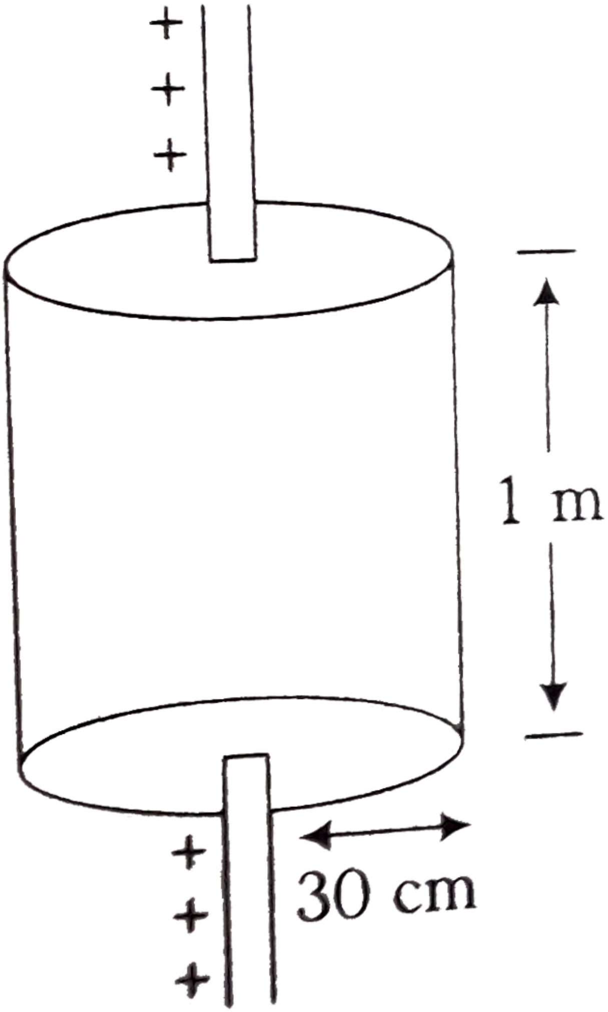
4. Electric charge is uniformly distributed along a long straight wire of radius 1 mm. The charge per centimetre length of the wire is Q coulomb. Another cylindrical surface of radius 50 cm and length 1 m symmetrically enclosed the wire as shown in the figure. The total electric flux passing through the cylindrical surface is



A. $\frac{Q}{\varepsilon_0}$

B. $\frac{100Q}{\varepsilon_0}$

C. $\frac{10Q}{(\pi\varepsilon_0)}$

D. $\frac{100Q}{\pi\varepsilon_0}$

Answer: B

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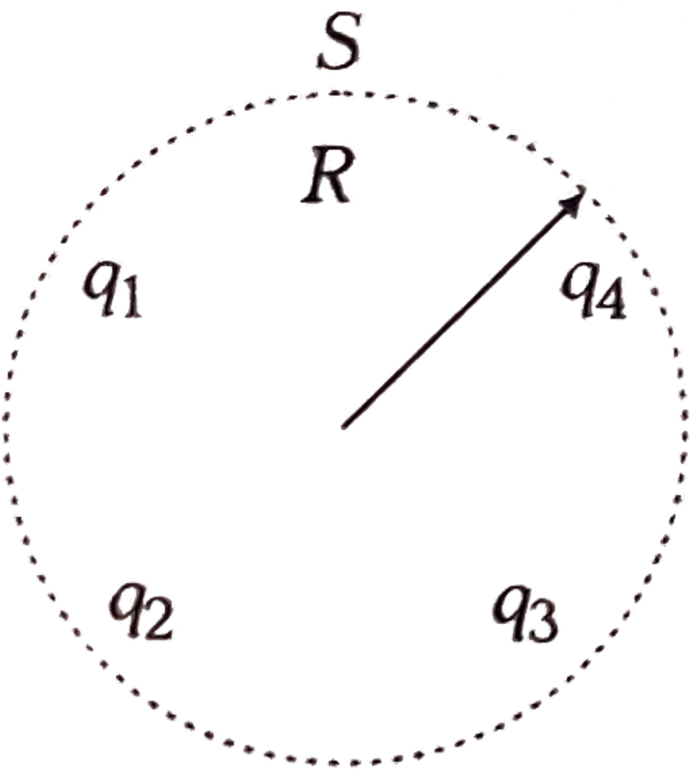
5. q_1, q_2, q_3 and q_4 are point charges located at points as shown in the figure and S is a spherical Gaussian surface of radius R. Which of the following is true according to the Gauss's law ?



A. $\oint\left(\overrightarrow{E_1}+\overrightarrow{E_2}+\overrightarrow{E_3}\right).\,d\overrightarrow{A}=\frac{q_1+q_2+q_3}{\varepsilon_0}$

B. $\oint\left(\overrightarrow{E_1}+\overrightarrow{E_2}+\overrightarrow{E_3}+\overrightarrow{E_4}\right)d\overrightarrow{A}=\frac{q_1+q_2+q_3}{\varepsilon_0}$

C. $\oint\left(\overrightarrow{E_1}+\overrightarrow{E_2}+\overrightarrow{E_3}\right).\,d\overrightarrow{A}=\frac{(q_1+q_2+q_3+q_4)}{\varepsilon_0}$

D. $\oint\left(\overrightarrow{E_1}+\overrightarrow{E_2}+\overrightarrow{E_3}+\overrightarrow{E_4}\right).\,d\overrightarrow{A}=\frac{(q_1+q_2+q_3+q_4)}{\varepsilon_0}$

Answer: B

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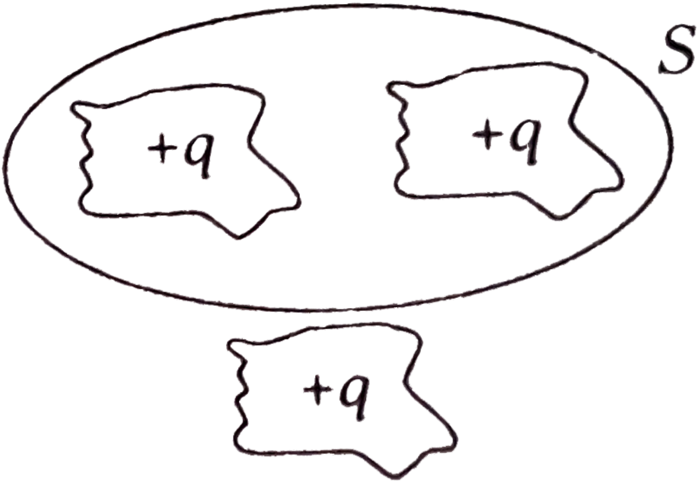
6. Figure shown below is a distribution of charges. The flux of electric field due to these charges through the surface S is



A. $3q / \varepsilon_0 1$

B. Zero

C. $q / \varepsilon_0)$

D. $2q / \varepsilon_0$

Answer: B

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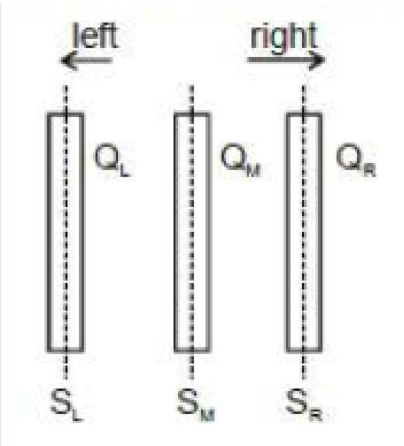
LECTURE SHEET (EXERCISE - III) (LEVEL - II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. Three large identical conducting plates of area A are closely placed parallel to each other as shown (the area A is perpendicular to plane of diagram). The net charge on left, middle and right plates are Q_L, Q_M and Q_R respectively. Three infinitely large parallel surface S_L, S_M and S_R are drawn passing through middle of each plate such that surface are perpendicular to plane of diagram as shown. Then pick up the correct option(s).



A. The net charge on the left side of surface S_L is equal to net charge on right side of surface S_R.

B. The net charge on left side of surface S_L is equal to net charge on right side of surface S_M

C. The net charge on the left side of surface S_L is equal to net charge on right side of surface S_L.

D. The net charge on right side of surface S_L is equal to net charge on left side of surfaces S_R.

Answer: A

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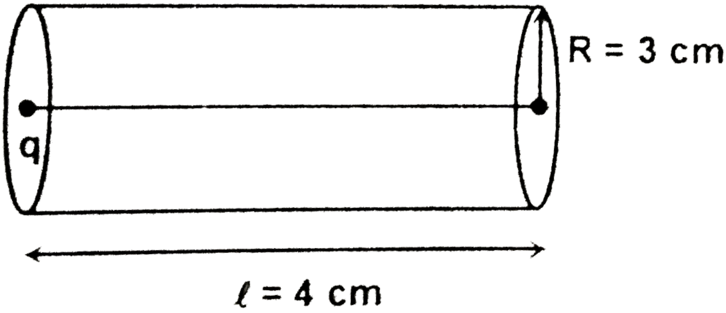

2.

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

A. $\frac{q}{2\varepsilon_0} - \frac{q}{2\varepsilon_0}\left[1 - \frac{1}{\sqrt{2}}\right]$

B. $\frac{q}{2\varepsilon_0}\left[1 - \frac{1}{\sqrt{2}}\right]$

C. $\frac{q}{2\varepsilon_0} - \frac{q}{\varepsilon_0}\left[\frac{1}{\sqrt{2}}\right]$

D. `(q)/(epsilon_(0))

Answer: A

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3. Electric flux through a surface of area $100m^2$ lying in the plane in the xy plane is (in V-m) if $E = \hat{i}\sqrt{2}\hat{j} + \sqrt{3}\hat{k}$:

A. 100

B. 141.4

C. 173.2

D. 200

Answer: C

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4. A cylinder of length 2a and radius .a. has the x-axis. It two ends (plane surfaces) are at x = a and x = 3a respectively. Point chargas +q are located at x = 2a and x = 0 respectively on the axis of cylinder. The electric flux through the curved surface of cylinder is (nearly)

A. $0.6\frac{q}{\varepsilon_0}$

B. $1.8\frac{q}{\varepsilon_0}$

C. $0.9\frac{q}{\varepsilon_0}$

D. $\frac{q}{\varepsilon_0}$

Answer: A

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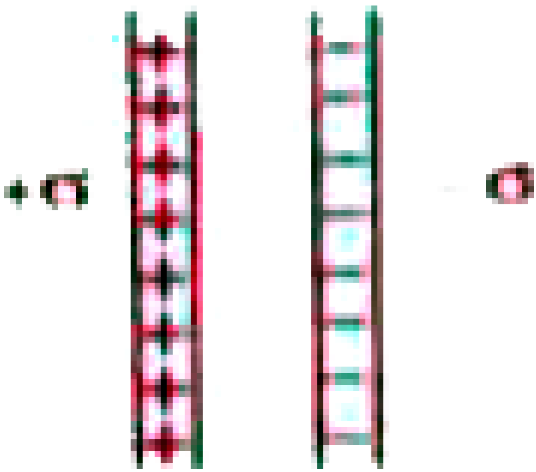
5. Two infinite sheets of unifrom charge density $+\sigma$ and $-\sigma$ are parallel to each other as shown in the figure. Electric field at the



A. points to the left or to thte right of the sheets is zero.

B. midpoint between the seets is zero

C. midpoint of the sheets is σ / ε_0 and is directed towards right.

D. midpoint of the sheet is $2\sigma / \varepsilon_0$ and is directed towards right.

Answer: A::C

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LECTURE SHEET (EXERCISE - III) (LEVEL - II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS)

1. An electric field converges at the origin whose magnitude is given by the expression $E = 100r N / C$, where r is the distance measured from the origin.

A. total charge contained in any spherical volume with its centre at origin is negative.

B. total charge contained at any spherical volume, irrespective of the location of its centre,is negative.

C. total charge contaied in a spherical volume of radius 3 cm with its centre at origin has magniture $3 \times 10^{-13} C$.

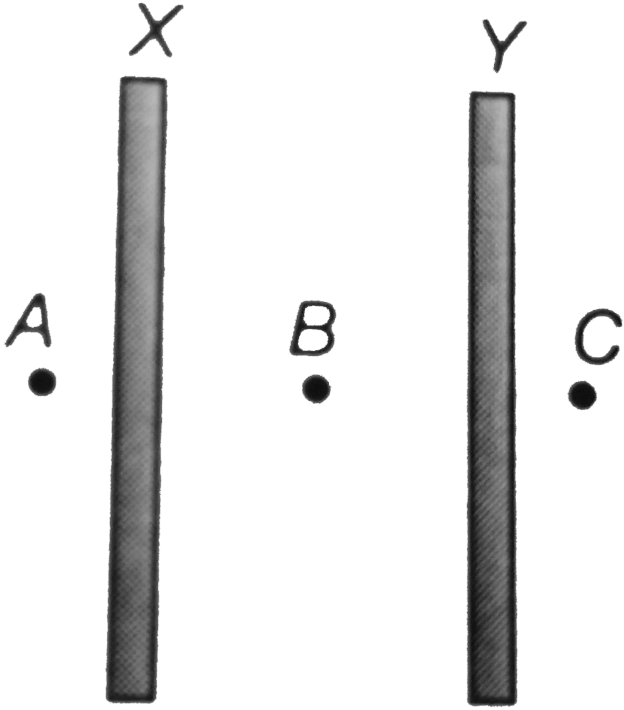
D. total charge contained in a spherical volume of radius 3 cm with its centre at origin has magnitude 3×10^{-9} Coul.

Answer: A::B::C

Watch Video Solution

2. X and Y are large, parallel conducting plates close to each other. Each face has an area A. X is given a charge Q. Y is without any charge. Points

A, B and C are as shown in the figure.



A. The field at B is $\frac{Q}{2\varepsilon_0 A}$

B. The field at B is $\frac{Q}{\varepsilon_0 A}$

C. The fields at A, B and C are of the same magnitude.

D. The field at A and C are of the same magnitud, but in opposite directions.

Answer: A::C::D

Watch Video Solution

3. Mark the correct options.

A. Gauss.s law is valid only for uniform charge distributions.

B. Gauss.s law is valid only for charges placed in vacuum.

C. The electric field calculated by Gauss.s law is the field due to the charges.

D. The electric field of the electric field through a closed surface due to all the charges is equa t the flux due to the charges enclosed by the surface.

Answer: C::D

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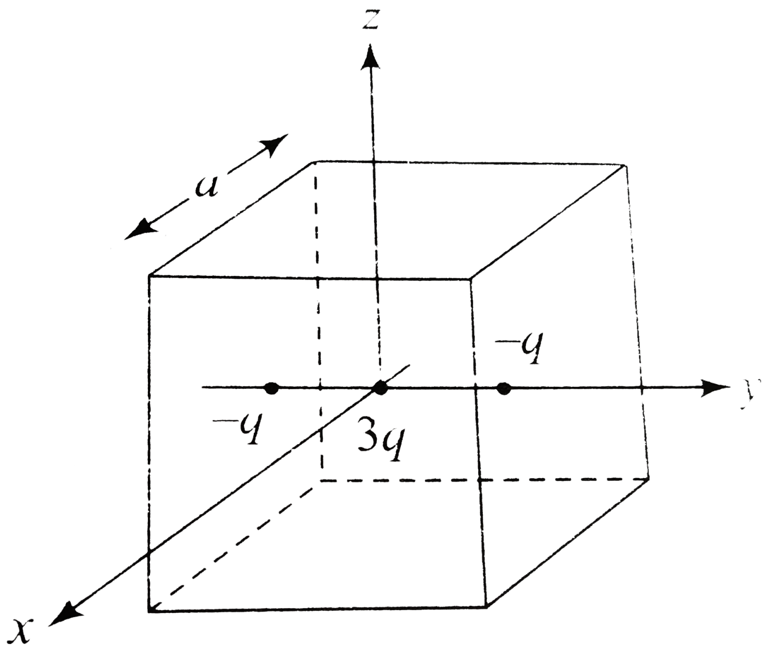
4. A cubical region of side a has its center at the origin. It encloses three fixed point charges, $-q at (0, -a/4, 0), +3q at (0, 0, 0)$, and $-q at (0, +a/4, 0)$. Choose the correct option (s)



A. The net electric flux crossing the plane x = + a/2 is equal to

B. The net electric flux crossing the plane y = + a/2 is more tha the net electric flux crossing the plane y = - a/2

C. The net electric flux passing through the given cube is $\frac{q}{\varepsilon_0}$

D. The net electric flux crossing the plane z = + a/2 is equal to the net electric flux crossing the plane x = + a/2

Answer: A::C::D

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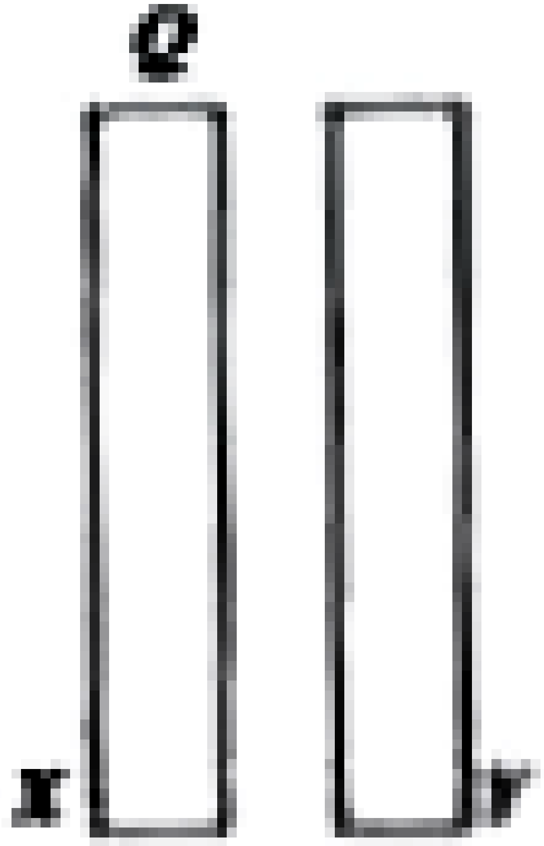
LECTURE SHEET (EXERCISE - III) (LEVEL - II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. Two conducting plates X and Y, each having large surface aera A (on one side), are placed parallel to each other as show in figure.



Find the surface charge density at the inner surface of the plate X.

A. $\frac{Q}{3A}$

B. $-\frac{Q}{A}$

C. $+\frac{Q}{A}$

D. $\frac{Q}{2A}$

Answer: D

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2. What is the amount of work done in bringing a mass from the surface of Earth on one side to a point diametrically opposite on the other side?

A. $\frac{Q}{2A\varepsilon_0}$ towards left

B. $\frac{Q}{A\varepsilon_0}$ away from the plates

C. $\frac{QA}{\varepsilon_0}$ towards left

D. $\frac{Q}{\varepsilon_A}$ towards the plates

Answer: A

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LECTURE SHEET (EXERCISE - III) (LEVEL - II (ADVANCED) MATRIX MATCHING TYPE QUESTIONS)

1.

COLUMN - I	COLU
A) Infinite plane sheet of charge	p)0
B) Infinite plane sheet of uniform thickness	q) $\frac{p}{2\varepsilon_0}$
C)Non - conducting charged solid sphere of radius R at its surface	r) $\frac{Rp}{3\varepsilon_0}$
D) Non - conducting charge solid sphere of radius R at its centre	s) $\frac{p}{\varepsilon_0}$

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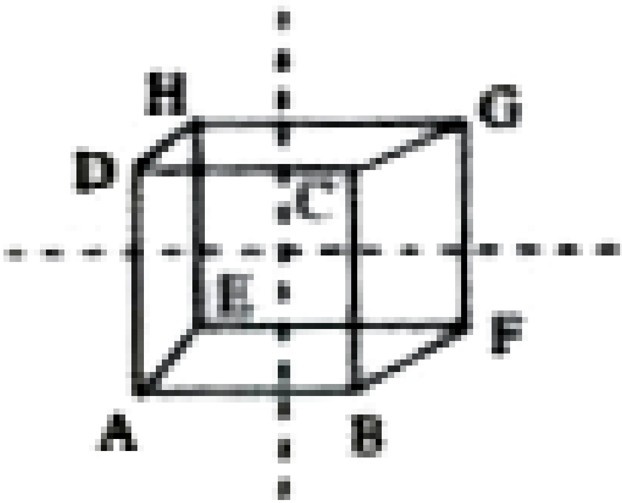
LECTURE SHEET (EXERCISE - III) (LEVEL - II (ADVANCED) INTEGER TYPE QUESTIONS)

1. Two infinite line charges, each having a uniform density λ. Pass through the midpoints of two pairs of opposite faces of a cube of edge L as shown in figure. The modulus of the total electric flux due to both the line charges through the face is ABCD is $\lambda L/(k\varepsilon_0)$ find the value of k ?



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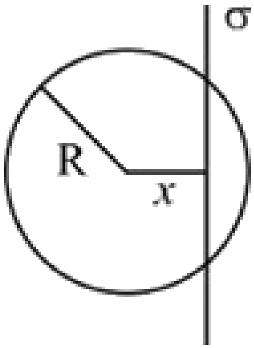
2. An infinite, uniformly charged sheet with surface charge density cuts through a spherical Gaussian surface of radius R at a distance x from its center, as shown in the figure. The electric flux through the Gaussian surface is :



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LECTURE SHEET (EXERCISE - IV) (LEVEL - I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. If the electric potential of the inner metal shell is 10 V and that of the outer shell is 5 V, then the potential at the centre will be

A. 10 volt

B. 5 volt

C. 15 volt

D. 0

Answer: A

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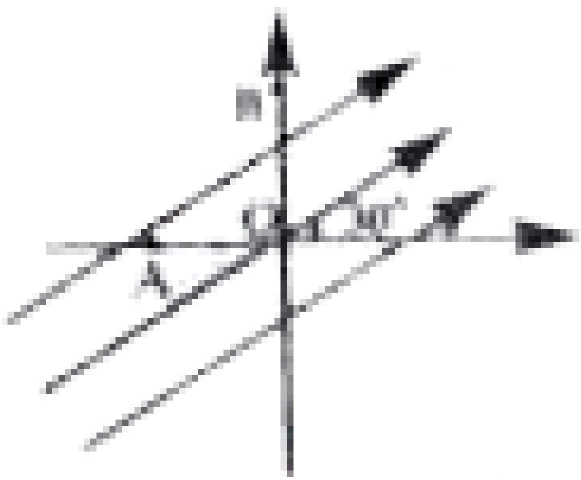
2. A uniform electric field of 100 V/m is directed at 30° with the positive x-axis as shown in figure Find the potential difference $V_a - V_A$ if OA = 2 m and OB = 4m.



A. $100(2-\sqrt{3})$ volt

B. $100(3-\sqrt{2})$ volt

C. $-100(3+\sqrt{2})$ volt

D. $-100(2+\sqrt{3})$ volt

Answer: D

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3. Find the potential V of an electrostatic field $\overrightarrow{E}=a\left(y\hat{i}+x\hat{j}\right)$, where a is a constant.

A. $v_0+ax^2y-\frac{ay^3}{3}$

B. $V_0-axy^2-\frac{ay^2}{3}$

C. $V_0+axy^2+\frac{ay^3}{3}$

D. $V_0-ax^2y+\frac{ay^3}{3}$

Answer: D

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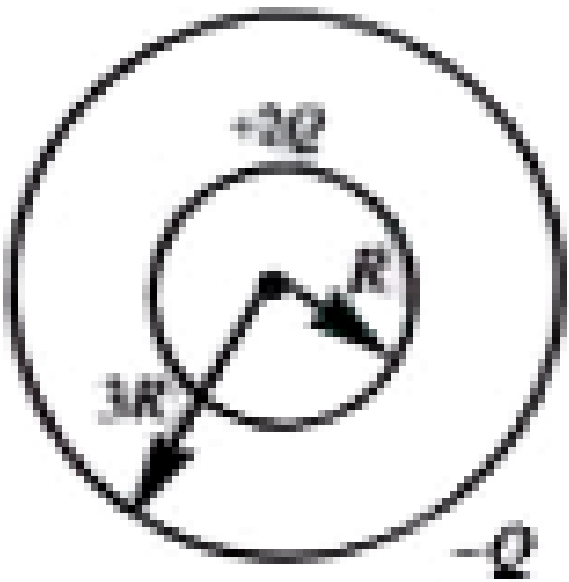
4. A solid metal sphere of radius R has a charg +2Q. A hollow spherical shell of radius 3R placed concentric with the frist sphere has net charge -Q.



What would be the final distribution of charges if the sphres are joined by a conducting wire

A. $\dfrac{Q}{\pi\varepsilon_0 R}$

B. $\dfrac{Q}{3\pi\varepsilon_0 R}$

C. $\dfrac{Q}{2\pi\varepsilon_0 R}$

D. $\frac{Q}{7\pi\varepsilon_0 R}$

Answer: B

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5. Two equal positive charges are kept at points A and B. The electric potential at the points between A and B (excluding these points) is studied while moving from A to B. The potential will

A. contiuously increases

B. continuously decreases

C. increases then decreases

D. decreases then increases

Answer: D

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6. Find V_{ab} in an electric field $\overrightarrow{E}=\left(2\hat{i}+3\hat{j}+4\hat{k}\right)N/C$ where $\overrightarrow{r}_a=\left(\hat{i}-2\hat{j}+\hat{k}\right)m$ and $\overrightarrow{r_b}=\left(2\hat{i}+\hat{j}-2\hat{k}\right)m$

A. 2 volt

B. -1 volt

C. 1 volt

D. 3 volt

Answer: B

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7. For a spherical shell

A. If potential inside it is zero then it necessarily electrically neutral

B. Electric field in a charged conducting spherical shell can be zero only when the charge is uniformly distributed.

C. Electric potential due to induced charges at a point inside it will always by zero

D. None of these

Answer: D

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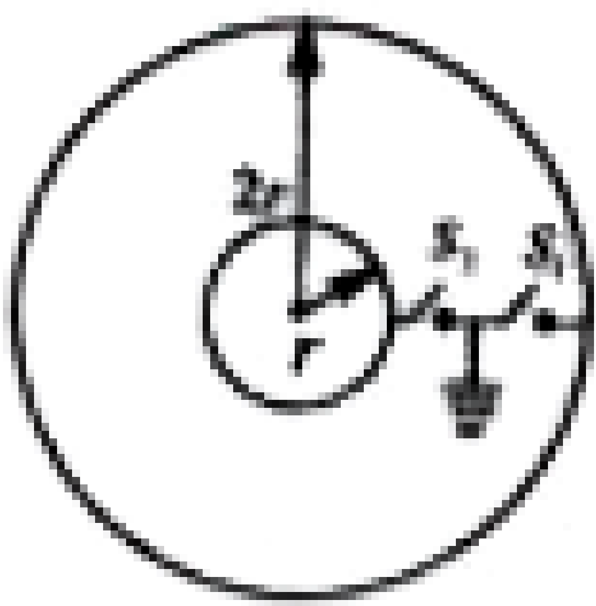
8. There are two concentric spherical shells of ratii r and 2r. Intially a charge Q is given to the inner shell. Now switch $S_1$is closed and S_2 is opned and the process is repeated n times for both the keys altermatively. Find the final potential between the shells.



A. $\frac{1}{4^{n+1}}\left[\frac{Q}{2\pi\varepsilon_0 r}\right]$

B. $\frac{1}{2^{n+1}}\left[\frac{Q}{4\pi\varepsilon_0 r}\right]$

C. $\frac{1}{2^{n+1}}\left[\frac{Q}{2\pi\varepsilon}\right]$

D. $\frac{1}{2^{n+1}}\left[\frac{Q}{\pi\varepsilon_0 r}\right]$

Answer: B

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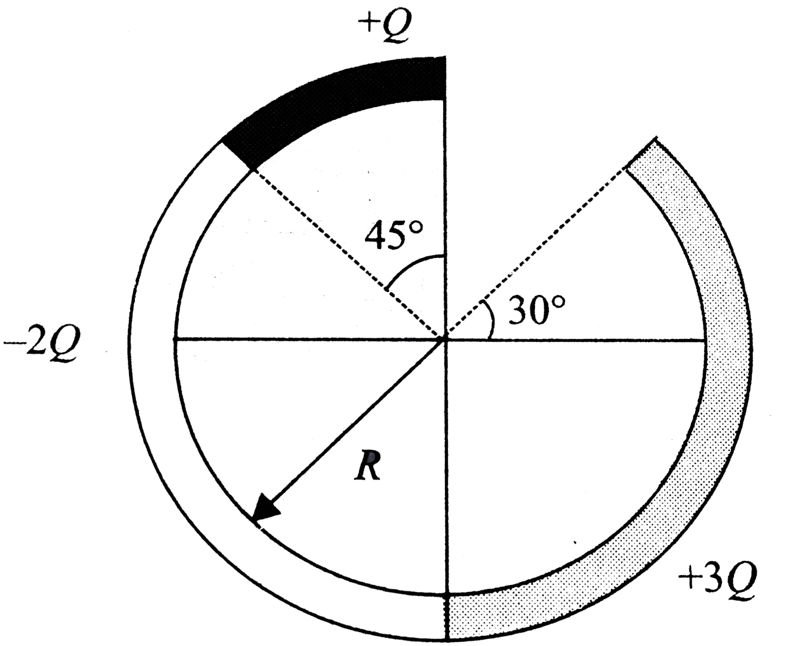
9. (Figure 3.139) shows three circular arcs, each of radius R and total charge as indicated. The net electric potential at the center of curvature.



A. $\dfrac{Q}{2\pi\varepsilon_0 R}$

B. $\dfrac{Q}{4\pi\varepsilon_0 R}$

C. $\dfrac{2Q}{\pi\varepsilon_0 R}$

D. $\dfrac{Q}{\pi\varepsilon_0 R}$

Answer: A

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10. An infinite nonconducting sheet of charge has a surface charge density of $10^7 C/m^2$. The separation between two equipotential surfaces near the whose potential differ by 5V is

A. 0.88 cm

B. 0.88 mm

C. 0.88 m

D. $5 \times 10^{-7} m$

Answer: B

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LECTURE SHEET (EXERCISE - IV) (LEVEL - II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. Two isolated metallic solid spheres of radii R and 2R are charged such that both of these have same charge density σ. The spheres are located far away from each other and connected by a thin conducting wire. Find the new charge density on the bigger sphere.

A. 5σ

B. 6σ

C. $\frac{5}{6}\sigma$

D. 2σ

Answer: C

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2. Two charges 2 nano coulombs and -6 nano coulombs are separated by 16 cm in air. The resultant electric intensity at the zero potential point which lies in between them and on the line joining them is

A. $15000 NC^{-1}$

B. $7500 NC^{-1}$

C. $450 NC^{-1}$

D. $1.5 NC^{-1}$

Answer: A

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3. A hollow charged metal sphere has radius r. If the potential difference between its surface and a point at a distance $3r$ from the centre is V, then electric field intensity at a distance $3r$ is

A. $\frac{V}{2R}$

B. $\frac{V}{3R}$

C. $\frac{V}{4R}$

D. $\frac{V}{6R}$

Answer: D

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4. A solid conducting sphere having a charge Q is surrounded by an uncharged concentric conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be V. If the shell is now given a charge of $-3Q$, then the new potential difference between the same two surface is

A. V

B. 2V

C. 4V

D. $-2V$

Answer: A

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5. Two concentric spherical conducting shells of radii R and 2R are carrying charges q and 2q, respectively. Both are now connected by a conducting wire. Find the change in electric potential (inV) on the outer shell.

A. zero

B. $\frac{3KQ}{2R}$

C. $\frac{KQ}{R}$

D. $\frac{2kQ}{R}$

Answer: A

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6. If V_o be the potential at origin in an electric field $\overrightarrow{E} = E_x\hat{i} + E_y\hat{j}$, then the potential at point $P(x, y)$ is

A. $V_0 - xE_x - yE_y$

B. $V_0 + xE_x + yE_y$

C. $xE_x + yE_y - V_0$

D. $\sqrt{x^2 + y^2}\sqrt{E_x^2 + E_y^2 - V_o}$

Answer: A

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LECTURE SHEET (EXERCISE - IV) (LEVEL - II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS)

1. Four charges of $6\mu C, 2\mu C, -12\mu C$ and $4\mu C$ are placed at the corners of a square of side 1m. The square is in x-y plane and its centre is at origin. Electric potential due to these charges is zero everywhere or the line

A. The electric potential is zero at the origin.

B. The electric potential is zero everywhere along the x-axis only on the sides of the square which are parallel to y axis.

C. The electric potential is zero everywhere along the z-axis for any orientation of the square in the x-y plane.

D. The electric potential is not zero along z-axis except at the origin.

Answer: A::C::D

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2. Three point charges Q, 4Q and 16Q are placed on a straight line 9 cm long. Charges are placed in such a way that the system has minimum potential energy. Then:

A. 4Q and 16Q must be at the ends and Q at a distance of 3 cm from the 16Q.

B. 4Q and 16Q must be the ends and Q at a distance of 6 cm from the 16Q

C. Electric field at the position of Q is zero.

D. Electric field at the position of Q is $\frac{Q}{4\pi\varepsilon_0}$.

Answer: B::C

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3. Potential at a point A is 3 volt and at a point B is 7 volt, an electron is moving towards A from B. Then:

A. It must have some K.E at B to reach A

B. It need not have any K.E at B to reach A

C. to reach A it must have more than or equal to 4 eV K.E at B.

D. when it will reach A, it will have K.E. more than or at least equal to 4 eV if it was relased from rest at B.

Answer: A::C

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4. At a distance of$5cm$ and $10cm$ from surface of a uniformly charge solid sphere, te potentials are $100V$ and $75V$ respectivley. Then

A. potential at its surface is 150 V.

B. the charge on the sphere is $(5/3) \times 10^{-10}C$.

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

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

Answer: A::B::C::D

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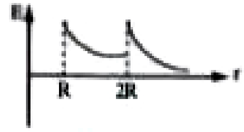
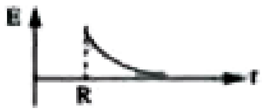
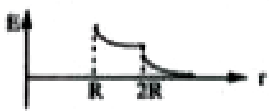
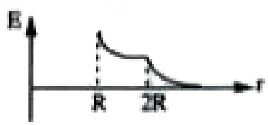
LECTURE SHEET (EXERCISE - IV) (LEVEL - II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. Potential (V) at a point in space is given by $v = x^2 + y^2 + z^2$. Gravitational field at a point (x,y,z) is

A. 

B. 

C. 

D. 

Answer: A

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2. A current I is flowing in a straight conductor of length L. The magnetic induction at a point distant $\frac{L}{4}$ from its centre will be

A. At a distance r $(R < r < 2R)$ from the centre electric potential is $\frac{KQ}{r^2}$

B. At the same distance electric field is $\frac{KQ}{r^2}$

C. Both (a) and (b) are correct

D. Both (a) and (b) are wrong

Answer: B

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LECTURE SHEET (EXERCISE - IV) (LEVEL - II (ADVANCED) INTEGER TYPE QUESTIONS)

1. Resistors of 1, 2, 3 ohm are connected in the form of a triangle. If a $1.5V$ cell of negligible internal resistance is connected across 3 ohm resistor, the current flowing through this resistance will be

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2. Uniform electric field of magnitude $100Vm^{-1}$ in space is directed along the line $y = 3 + x$. Find the potential difference between points $A(3, 1)$ and $B(1, 3)$.

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LECTURE SHEET (EXERCISE - V) (LEVEL - I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. Electric charges q,q and -2q are placed at the corners of an equilateral triangle of side l. The magnitude of electric dipole moment of the system is

A. ql

B. 2ql

C. $\sqrt{3}ql$

D. $4ql$

Answer: C

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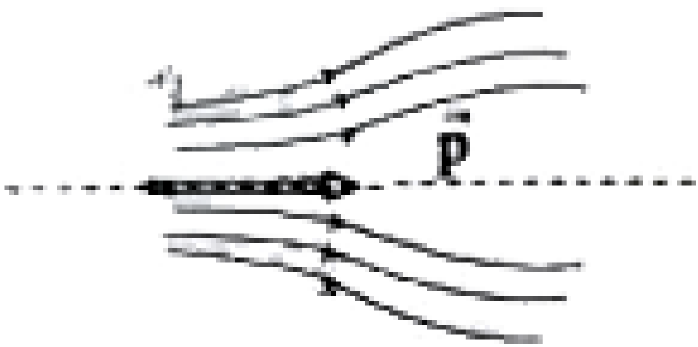
2. Conisder the dipole $\vec{p}$ kept in a space of electric field a shown. The dipole will move



A. upwards

B. downwards

C. towards right

D. towards left

Answer: D

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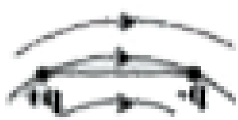
3. In which of the following cases,force acting on the dipole could be zero

A. 

B. 

C. 

D. None

Answer: C

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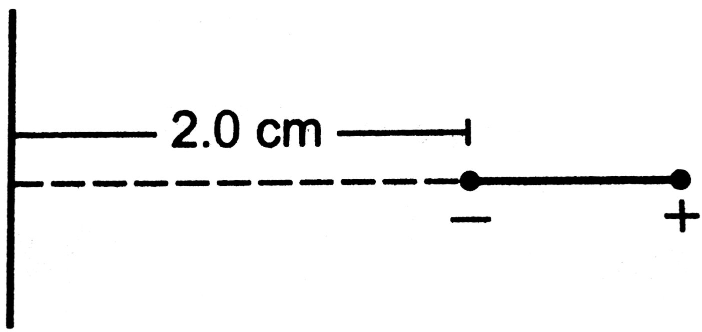
4. An electric dipole consists of charges $\pm 2.0 \times 10^{-8} C$ separated by a distance of 2.0×10^{-3} m. It is placed near a long line charge of linear charge density $4.0 \times 10^{-4} Cm^{-1}$ as shown in figure (30-W4), Such that the negative charge is at a distance of `2.0 cm from the line charge. Find the force acting on the dipole.



A. 0.6 N towards the line charge

B. 0.1 N away from the line charge

C. 0.9 N towards the line charge

D. 1.5 N away away from the line charge

Answer: A

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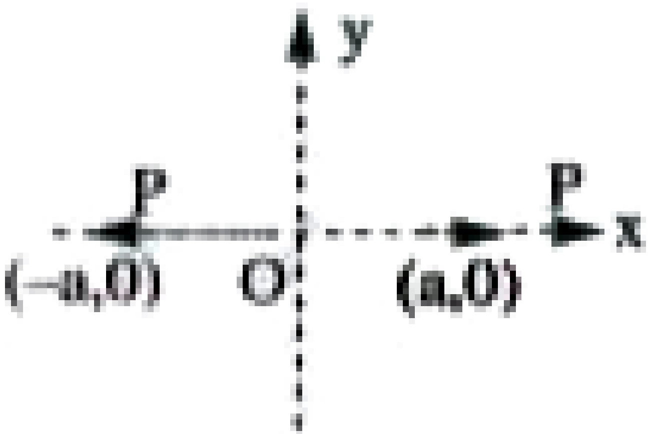
5. A system of two electric dipoles, each of dipole moment having magnitude P are arranged in the configuration shown in figure The electrostatic interaction energy of this systm of two dipoles is :



A. A) $\frac{5kp^2}{4a^2}$

B. B) $\frac{7kp^2}{a^3}$

C. C) $\frac{kp^2}{4a^2}$

D. D) None of these

Answer: C

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6. An electric point dipole is placed at the origin O with its dipolemoment along the X-axis . A point A is at a distance r from the origin such that OA makes an angle $\pi/3$ with the X -axis if the electric field $\overrightarrow{E}$ due to the dipole at A makes an angle θ with the positive X-axis, the value of θ is

A. $\pi/3$

B. $(\pi/3)+\tan^{-1}(\sqrt{3}/2)$

C. $(\pi/3)-\tan^{-1}(\sqrt{3}/2)$

D. $\tan^{-1}(\sqrt{3}/2)$

Answer: B

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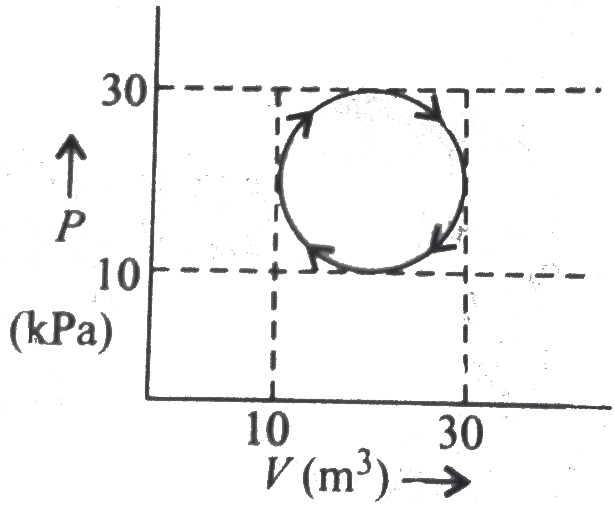
7. Which one is not correct for a cyclic process as shown in the figure ?



A. 1

B. 2

C. 3

D. 8

Answer: D

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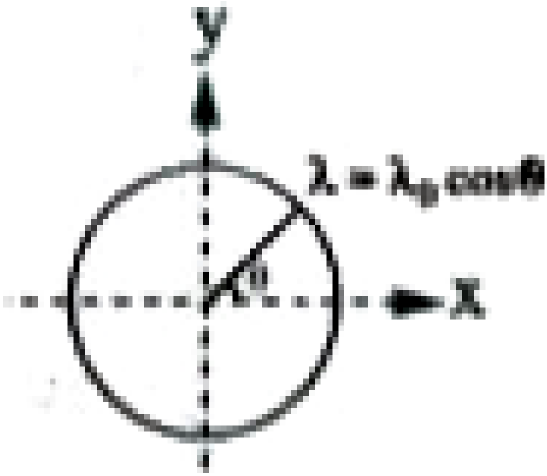
8. A ring of radius R carries a non - uniform charge of linear density $\lambda = \lambda_0 \cos \theta$ sec in the figure) Magnitude of the net dipolement of the ring is :



A. $\pi R^2 \lambda_0$

B. $2\pi R^2 \lambda_0$

C. $\frac{\pi R^2}{2} \lambda_0$

D. $4\pi R^2 \lambda_0$

Answer: A

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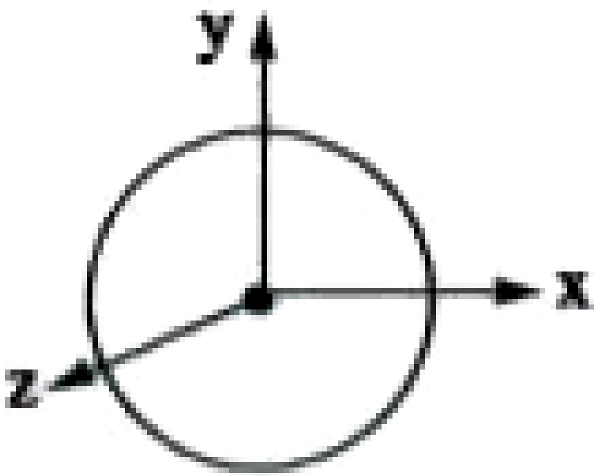
9. Consider uniform charged shell of surface charge density s $\left(=3e^{o}SI\text{units}\right)$ and a dipole of dipole moment P $\left(=2pe_{n}SI\text{units}\right)$. Centre of the shell and the dipole lies at the origin, and dipole moment vector is along +x axis. If the field at a point on x-axis just over the shell is $\overrightarrow{E_1}$ and that at a point on y-axis just over the shell is $\overrightarrow{E_2}$. Find $\left|\overrightarrow{E_1}\right|=\left|\overrightarrow{E_2}\right|$ in N/C. Radius of shell = 50 cm.



A. 6

B. 3

C. 2

D. 1

Answer: A

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10. Two charges $-q$ each are separated by distance $2d$. A third charge $+q$ is kept at mid-point O. Find potential energy of $+q$ as a function of small distance x from O due to $-q$ charges. Prove that the charge at O is in an unstable equilibrium.

A. α

B. $2\sin^{-1}\left(\frac{1}{\sqrt{2}}\sin\frac{\alpha}{2}\right)$

C. $\sin^{-1}\left(\frac{1}{\sqrt{2}}\sin\frac{\alpha}{2}\right)$

D. $\sin^{-1}\left(\frac{1}{2\sqrt{2}}\sin\frac{\alpha}{2}\right)$

Answer: B

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LECTURE SHEET (EXERCISE - V) (LEVEL - II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS)

1. An electric dipole of dipole moment p is placed in a uniform external electric field E. Then, the

A. Net force experienced by the dipole is zero

B. One of the equi-potential surface enclosing the dipole forms sphere

C. The radius of spherical euqi-potential $\left[\frac{P}{4\pi\varepsilon_0 E}\right]^{\frac{1}{3}}$

D. The radius of spherical equi-potential surface is $\sqrt{\frac{P}{4\pi\varepsilon_0 E}}$

Answer: A::B::C::D

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2. An electric dipole moment $P = \left(2.0\hat{i} + 3.0\hat{j}\right)\mu C - m$ is placed in a uniform electric field $E = \left(3.0\hat{i} + 2.0\hat{k}\right) \times 10^5 NC^{-1}$

A. The torque that $\overrightarrow{E}$ exerts on $\overrightarrow{P}$ is $\left(0.6\hat{i} - 0.4\hat{j} - 0.9\widehat{K}\right)$ Nm.

B. The potential energy of the dipole is - 0.6 j.

C. The potential energy of the dipole is 0.6 j.

D. If the dipole is rotated in the electric field, the maximum potential energy of the dipole is1.3 j.

Answer: A::B::D

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3. An electric dipole is placed at the centre of a sphere. Mark the correct options

A. the flux of the electric field through the sphere is zero

B. the electric field is zero at every point of the sphere.

C. the electric potential is zero everywhere on the sphere.

D. the electric potential is zero on a circle on the surface.

Answer: A::D

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4. As a charged particle 'q' moving with a velocity $\overrightarrow{v}$ enters a uniform magnetic field $\overrightarrow{B}$, it experience a force $\overrightarrow{F} = q\left(\overrightarrow{v} \times \overrightarrow{B}\right)$. F or $\theta = 0^\circ$ or 180°, θ being the angle between $\overrightarrow{v}$ and $\overrightarrow{B}$, 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 $\left(mv^2/r\right)$. For other values of $\theta(\theta \neq 0^\circ, 180^\circ, 90^\circ)$, 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 $\overrightarrow{B} = -0.4\hat{k}T$. At some instant, velocity of the particle is $\overrightarrow{v} = \left(8\hat{i} - 6\hat{j}4\hat{k}\right) \times 10^6 ms^{-1}$ and force acting on it has a magnitude 1.6 N

Angular frequency of rotation of particle, also called the `cyclotron frequency' is

A. Force acting on the dipole is zero

B. Force acting on the dipole is approximately $\frac{PQ}{4\pi\varepsilon r^3}$ and is acting upwards

C. Torque acting on the dipole is $\frac{PQ}{4\pi\varepsilon_0 r^2}$ in clockwise direction

D. Torque acting on the dipole is $\frac{PQ}{4\pi\varepsilon_0 r^2}$ in anti- clockwise direction

Answer: B::C

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LECTURE SHEET (EXERCISE - V) (LEVEL - II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. In the figure given below, two particles of masses m and 2m are fixed in place on an axis. Where on the axis can a third particle of mass 3m be placed (other than at infinity) so that the gravitational force on it from the first two particles is zero?

A. $3q\frac{t}{2}$

B. $5q\frac{l}{2}$

C. ql

D. Zero

Answer: D

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2. When stamens are fused by their anthers and the filaments are free, the condition, is called

A. $E\alpha\frac{1}{a^2}$

B. $E\alpha\frac{1}{a^3}$

C. $E\alpha\frac{1}{a^3}$

D. $E \alpha \frac{1}{a^3}$

Answer: A

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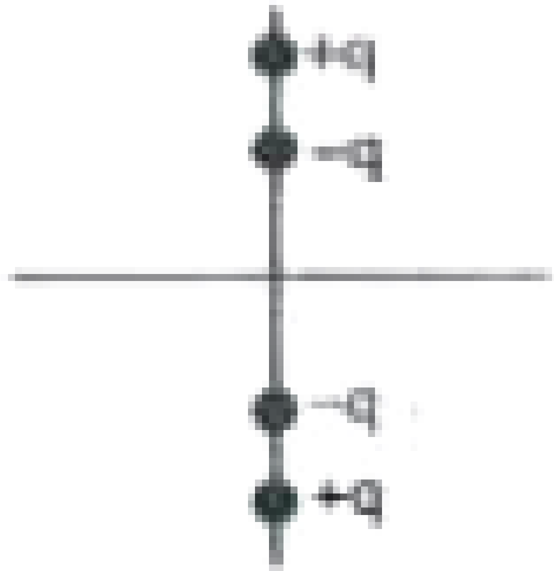
3. Type insulated light rods of length l and 2l are placed in xy plane such their mid point is origin and they are free to rotate in xy plane about z-axis. Two + q charges are fixed at two ends of bigger rod and two - q charges are fixed at two ends of smaller rod.



What is electric dipolement of system ?

A. 0

B. $\frac{kq^2}{l}$

C. $\frac{2kq^2}{l}$

D. $\frac{3kq^2}{l}$

Answer: A

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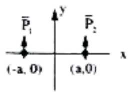
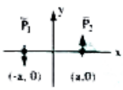
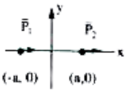
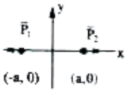
1. In each situation of Column - I, two electric dipoles having dipole moments $\overrightarrow{p_1}$ and $\overrightarrow{p_2}$ of same magnitude $(\text{that is}, p_1 = p_2)$ are placed on x-axis symmertrically about origin in different orientations as shown. In column - II certain inferences are drawn for these two dipoles. Then match the different orientations of dipoles in column - I with the corresponding results in column - II. [In column I the co-ordinates corresponding to the centres of dipoles and dipoles having the same dipole lenght]

COLUMN - I	COLUMN - II
A)  ($\vec{p}_1$ and $\vec{p}_2$ perpendicular to x-axis as shown)	p) The torque on one dipole due to other is zero.
B)  ($\vec{p}_1$ and $\vec{p}_2$ and perpendicular x-axis as shown)	q) The potential energy of one dipole in the electric field of other dipole is negative
C)  ($\vec{p}_1$ and $\vec{p}_2$ and in the same x-y direction are parallel to x-axis as shown)	r) There is one straight line in plane (not at infinity) which is equipotential
D)  ($\vec{p}_1$ and $\vec{p}_2$ and are opposite)	s) Electric field at origin is zero.

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LECTURE SHEET (EXERCISE - V) (LEVEL - II (ADVANCED) INTEGER TYPE QUESTIONS)

1. A dipole of dipole moment $\overrightarrow{P} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ is placed at point A (2, -3, 1). The electric potential due to this dipole at the point B (4, -1, 0) is equal to (All the parameters specified here are in S.L. units) ____ $\times 10^9$ volts

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2. A small electric dipole is kept on the axis of a uniformly charged ring at distance $R/\sqrt{2}$ from the centre of the ring. The direction of the dipole moment is along the axis. The dipole moment is P, charge of the ring is Q and radius of the ring is R. The force on the dipole is nearly ____

Watch Video Solution

PRACTICE SHEET (EXERCISE - I COULOMB.S INVERSE SQUARE LAQW) (LEVEL -I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTION

1. Two electrons separated by distance .r. experience a force F between them. The force between a proton and a singly ionized helium atom separated by distance 2r is

A. 4F

B. 2F

C. F/2

D. F/4

Answer: D

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2. Two charges of equal magnitudes and at a distance r exert a force F on each other. If the charges are halved and distance between them is doubled, then the new force acting on each charge is

A. F/8

B. F/4

C. 4F

D. F/16

Answer: D

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3. Two identical copper spheres are separated by 1m in vacuum. How many electrons would have to be removed from one sphere and added to the other so that they now attract each other with a force of 0.9N?

A. 6.25×10^{15}

B. 62.5×10^{15}

C. 6.25×10^{13}

D. 0.65×10^{13}

Answer: C

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4. Two positive charges separated by a distance 2m repel each other with a force of 0.36N. If the combined charge is $26\mu C$, the charges are

A. $20\mu C, 6\mu C$

B. $16\mu C, 10\mu C$

C. $18\mu C, 8\mu C$

D. $13\mu C, 13\mu C$

Answer: B

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5. Two identical blocks of charge q each are connected by a massless spring of force constant k. They are placed over a smooth horizontal surface. They are released when the separation between them is r and spring is unstretched. If maximum extension of the spring is r, the value of k is (neglect gravitational effect)

A. $\frac{q}{4r}\sqrt{\frac{1}{\pi\varepsilon_0 r}}$

B. $\frac{q}{2r}\sqrt{\frac{1}{\pi\varepsilon_0 r}}$

C. $\frac{2q}{r}\sqrt{\frac{1}{\pi\varepsilon_0 r}}$

D. $\frac{q}{r}\sqrt{\frac{1}{\pi\varepsilon_0 r}}$

Answer: B

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PRACTICE SHEET (EXERCISE - I COULOMB.S INVERSE SQUARE LAQW) (LEVEL - II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTION)

1. Identify A and B:

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2. A conducting ball is positively charged and another positive point charge is brought closer to the ball.

A. the all may attact the point charge

B. the ball may repel the point charge

C. the elecitic field inside the ball due to ball.s charges is non-zero.

D. the net electric field inside the ball is zero.

Answer: A::B::C::D

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3. Two free point charges $+q$ and $+4q$ are placed apart a distance x. A third charge is so placed that all the three charges are in equilibrium. Then

A. Unknown charge at $\frac{4q}{9}$

B. Unknown charge is $\frac{-9q}{4}$

C. It should be at $\frac{x}{3}$ from smaller charge b/w them

D. It should be at $\frac{2x}{3}$ from smaller charge b/w them.

Answer: A::C

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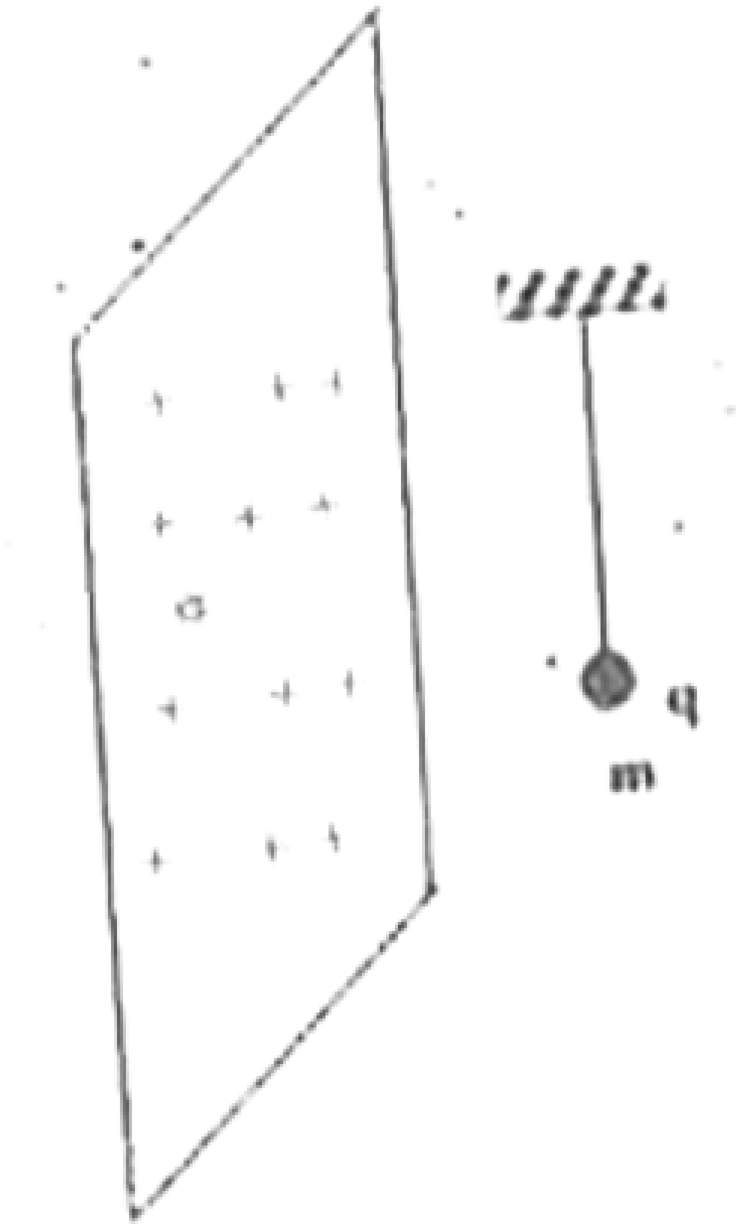
4. A small charged particle of mass m and charge q is suspended by an insulated thread in front of a very large conducting charged sheet of uniform surface density of charge σ. The angle made by the thread with the vertical in equilibrium is



A. Tension in the thread may reduce to zero if another charged sphere is placed vertically below it.

B. tension in the thread is greater than mg if another charged sphere is held in the horizontal line in which first sphere stays inequlibrium.

C. tension in the thread may increases to twice of its original value if another charged sphere is placed vertically below it

D. tension in the thread is always equal to mg.

Answer: A::B::C

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PRACTICE SHEET (EXERCISE - I COULOMB.S INVERSE SQUARE LAQW) (LEVEL - II (ADVANCED LINKED COMPREHENSION TYPE QUESTION)

1. One end of a 10 cm long silk thread is fixed to a large vertical surface of a charged non conducting plate and the other end is fastened to a small ball having a mass of 10 g and charge of 4.0×10^{C}. In equilibrium, the thread make an angle of 60^0 with the vertical. Find the surface charge density on the plate.

A. $6.5 \times 10^{-8} C/m^2$

B. $7.5 \times 10^{-7} C/cm^2$

C. $7.5 \times 10^{-9} C/m^2$

D. $9.5 \times 10^{-6} C/cm^2$

Answer: C

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2. One end of a 10 cm long silk thread is fixed to a large vertical surface of a charged non-conducting plate and the other end is fastened to a small ball of mass 10 g and charge of $4 \times 10^{-6} C$. In equilibrium, thread makes an angle of 60^o with the vertical.

(a) Find the tension in the string in equilibrium.

(b) Suppose the ball is slightly pushed aside and released. Find the time period of the small oscillations.

(Use $\sigma = 7.5 \times 10^{-7} \frac{C}{m^2}$)

A. 0.5 N

B. 0.40 N

C. 0.10 N

D. 0.20 N

Answer: D

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3. One end of a 10 cm long silk thread is fixed to a large vertical surface of a charged non-conducting plate and the other end is fastened to a small ball of mass 10 g and charge of $4 \times 10^{-6} C$. In equilibrium, thread makes an angle of 60^o with the vertical.

(a) Find the tension in the string in equilibrium.

(b) Suppose the ball is slightly pushed aside and released. Find the time period of the small oscillations.

(Use $\sigma = 7.5 \times 10^{-7} \frac{C}{m^2}$)

A. 0.45 sec

B. 0.32 sec

C. 0.1sec

D. 0.52sec

Answer: A

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PRACTICE SHEET (EXERCISE - II INTENSITY OF ELECTRIC FIELD) (LEVEL - I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTION)

1. Two point charges Q and -3Q are placed at some distance apart. If the electric field at the location of Q is $\overrightarrow{E}$, the field at the location of $-3Q$ is

A. $\overrightarrow{E}$

B. $-\overrightarrow{E}$

C. $+\frac{\overrightarrow{E}}{3}$

D. $-\frac{\overrightarrow{E}}{3}$

Answer: C

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2. The electric field at (30, 30) cm due to a charge of $-8nC$ at the origin in NC^{-1} is

A. $-400\left(\hat{i}-\hat{j}\right)$

B. $400\left(\hat{i}+\hat{j}\right)$

C. $-200\sqrt{2}\left(\hat{i}+\hat{j}\right)$

D. $200\sqrt{2}\left(\hat{i}+\hat{j}\right)$

Answer: C

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3. Two charges 4×10^{-9} and -16×10^{-9} C are separated by a distance 20 cm in air. The position of theh neutral point from the small charge is

A. 40/3 cm

B. 20/3 cm

C. 20 cm

D. 10/3 cm

Answer: C

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4. The number of electrons to be put on a spherical conductor of radius 0.1m to produce an electric field of 0.036N/C just above its surface is

A. 2.7×10^5

B. 2.6×10^5

C. 2.5×10^5

D. 2.4×10^5

Answer: C

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5. The magnitude of electric field intensity at a distance x due to charge q is E. An identical charge in placed at a distance 2x form it. Then the magnitude of force it experiences is -

A. Eq

B. 2Eq

C. $\frac{Eq}{2}$

D. $\frac{Eq}{4}$

Answer: D

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6. A sphere of mass 50 gm is suspended by a string in an electric field of intensity $5NC^{-1}$ acting vertically upward. If the tension in the string is 520 millinewton, the charge on the sphere is $\left(g = 10ms^{-2}\right)$

A. $-4 \times 10^{-3}C$

B. $4 \times 10^{3}C$

C. $8 \times 10^{3}C$

D. $-8 \times 10^{-3}C$

Answer: A

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7. A and B are two points separately by a distance 5cm. Two charges $10\mu C$ and $20\mu C$ are placed at A and B. The resultant electric intensity at a point P outside the charges at a distance 5cm from $10\mu C$ is

A. 54×10^6 N/C away from f $10\mu C$

B. 56×10^6 N/C towards $10\mu C$

C. 9×10^6 N/C away from $10\mu C$

D. zero

Answer: A

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8. At the corners A, B, C of a square ABCD, charges $10mC, -20mC$ and $10mC$ are placed. The electric intensity at the centre of the square to become zero, the charge to be placed at the corner D is

A. $-20mC$

B. $+20mC$

C. 30 mC

D. $-30mC$

Answer: A

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9. A charged oil drop is suspended in uniform field of $3 \times 10^4 Vm^{-1}$ so that it neither falls nor rises. The charge on the drop will be ...(mass of the charge $=9.9 \times 10^{-15}$ kg

A. $3.3 \times 10^{-18} C$

B. $3.2 \times 10^{-18} C$

C. $1.6 \times 10^{-18} C$

D. $4.8 \times 10^{-18} C$

Answer: A

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10. A particle of mass m and charge q is placed at rest in a uniform electric field E and then released. The kinetic energy attained by the particle after moving a distance y is :

A. qEy^2

B. qE^2y

C. qEy

D. q^2Ey

Answer: C

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11. A proton and an α-particle start from rest in a uniform electric field, then the ratio of times of flight to travel same distance in the field is

A. $\sqrt{5}:\sqrt{2}$

B. $\sqrt{3}:1$

C. $2:1$

D. $1:\sqrt{2}$

Answer: D

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12. In a regular hexagon each corner is at a distance .r. from the centre. Identical charges of magnitude .Q. are placed at 5 corners. The field at the centre is $\left(K=\frac{1}{4\pi \in_0}\right)$

A. KQ/r^2

B. $\frac{6KQ}{r^2}$

C. $\frac{5KQ}{r^2}$

D. Zero

Answer: A

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13. A positive point charge $50\mu C$ is located in the plane xy at a point with radius vector $\overrightarrow{r}_0 = 2\hat{i} + 3\hat{j}$. The electric field vector $\overrightarrow{E}$ at a point with radius vector $\overrightarrow{r} = 8\hat{i} - 5\hat{j}$, where r_0 and r are expressed in meter, is

A. 1200 V/m

B. 0.40 V/m

C. 900 V/m

D. 4500 V/m

Answer: D

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14. Four identical charges Q are fixed at the four corners of a square of side a. The electric field at a point P located symmetrically at a distance $a/\sqrt{2}$ from the center of the square is

A. $\frac{Q}{2\sqrt{2}\pi\varepsilon_0 a^2}$

B. $\frac{Q}{\sqrt{2}\pi\varepsilon_0 a^2}$

C. $\frac{2\sqrt{2Q}}{\pi\varepsilon_0 a^2}$

D. $\frac{\sqrt{2Q}}{\pi\varepsilon_0 a^2}$

Answer: B

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15. Intensity of electric field at a point at a perpendicular distance .r. from an infinite line charge, having linear charge density . λ. is given by :

A. $(\lambda\pi\varepsilon_0 r)$

B. $\frac{\lambda}{2\pi\varepsilon_0 r}$

C. $\frac{\lambda}{\varepsilon_0 r}$

D. $\lambda\varepsilon_0 r$

Answer: A

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16. Electric field at centre of quarter circular ring having charge density λ is _____

A. $\frac{\sqrt{2}\lambda}{4\pi\varepsilon_0 r}$

B. $\frac{\lambda}{2\pi\varepsilon_0 r}$

C. $\frac{\lambda}{\varepsilon_0 r}$

D. $\frac{\sqrt{2}\lambda}{2\pi\varepsilon_0 r}$

Answer: A

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17. A charged disc of radius 3 m has charge density σ. Electric field at a distance of 4 m from its centre on axis is ______

A. $\frac{3\sigma}{5\varepsilon_0}$

B. $\frac{\sigma}{10\varepsilon_0}$

C. $\frac{\sigma}{8\varepsilon_0}$

D. None

Answer: B

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18. The ratio of distance of two satellites from the centre of earth is 1 : 4. The ratio of their time periods of rotation will be :

A. A & B are false

B. A true,m B false

C. A & B are true

D. A false, B true

Answer: C

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19. A solid non conducting sphere has charge density pCm^{-3} Electric field at distance x from its centre is _____ $[x < R]$

A. $\frac{px}{3\varepsilon_0}$

B. $\frac{px}{2\varepsilon_0}$

C. $\frac{px}{R\varepsilon - (0)}$

D. None

Answer: A

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20. A hollow sphere has charge density $.\sigma.Cm^{-2}$. Identify incorrect statement

A. Electric field inside sphere is zero

B. Electric field outside sphere is inversaly

C. Electric field on its surface is $\frac{\sigma}{\varepsilon_0}$

D. Electric feld sphere is inversly proportional to square of distance of that point from its centre.

Answer: B

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PRACTICE SHEET (EXERCISE - II INTENSITY OF ELECTRIC FIELD) (LEVEL - II (MAIN) STRAIGHT OBJECTIVE TYPE QUESTION)

1. A nonconducting solid sphere of radius R is uniformly charged. The magnitude of the electric field due to the sphere at a distance r from its center

A. $\frac{px}{3\varepsilon_0}$

B. $\frac{px}{2\varepsilon_0}$

C. $\frac{px}{R\varepsilon_0}$

D. $\frac{3px}{t_0}$

Answer: B

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2. A nonconducting ring of radius R has uniformly distributed positive charge Q. A small part of the ring.of length d, is removed $(d < < R)$. The electric field at the centre of the ring will now be

A. directed towards the gap, inversely proportional to R^3

B. directed towards the gap, inverselt proportional to R^2

C. directed away from the gap, inversely proportional to R^3

D. directed away from the gap, inversely proportional to R^2

Answer: A

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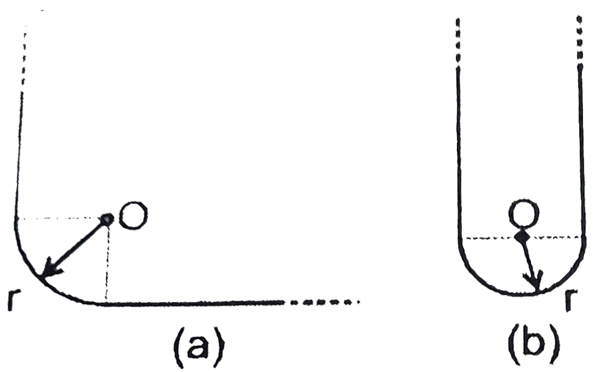
3. A thread carrying a uniform charge λ per unit length has the configuration shown in figure a and b. Assuming a curvature radius r to be considerably less than the length of the thread, find the magnitude of the electric field strength at the point O.



A. $\dfrac{\lambda\sqrt{2}}{4\pi\varepsilon_0 R}, 0$

B. $\dfrac{\lambda\sqrt{3}}{4\pi\varepsilon_0 R}. \dfrac{\lambda\sqrt{2}}{4\pi\varepsilon_0 R}$

C. $\dfrac{\lambda}{4\pi\varepsilon_0 R}, 0$

D. $\frac{\lambda\sqrt{5}}{4\pi\varepsilon_0 R}, \frac{\lambda\sqrt{3}}{4\pi\varepsilon_0 R}$

Answer: A

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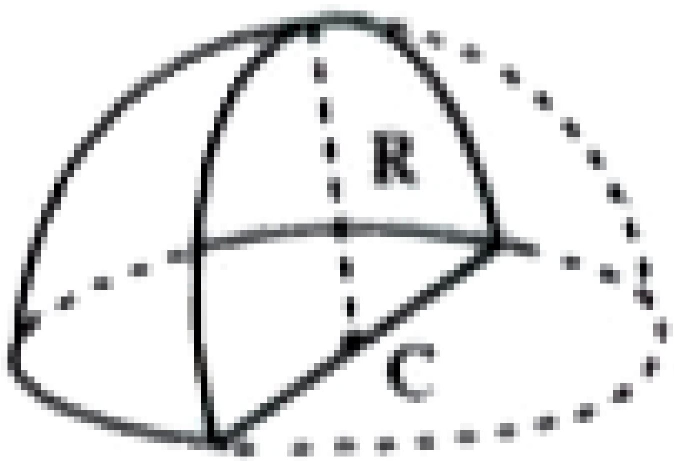
4. Charge density of the given surface is s. Then electric field stranght at the centre (of quarter sphere) is



A. $\frac{\sigma}{4\sqrt{2\varepsilon_0}}$

B. $\frac{\sigma}{2\sqrt{2\varepsilon_0}}$

C. $\frac{\sigma}{\sqrt{2\varepsilon_0}}$

D. $\frac{\sigma}{2\varepsilon_0}$

Answer: A

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5. A system consists of a thin charged wire ring of radius r and a very long uniformly charged wire oriented along the axis of the ring, with one of its ends coinciding with the center of the ring. The total charge on the ring is q. and he linear charge density on the straight wire is λ, The interaction force between the ring and the wire is

A. Zero

B. $\frac{\lambda q}{4\pi\varepsilon_0 R}$

C. $\frac{\lambda q}{2\pi\varepsilon_0 R}$

D. $\frac{\lambda q}{\pi\varepsilon_0 R}$

Answer: B

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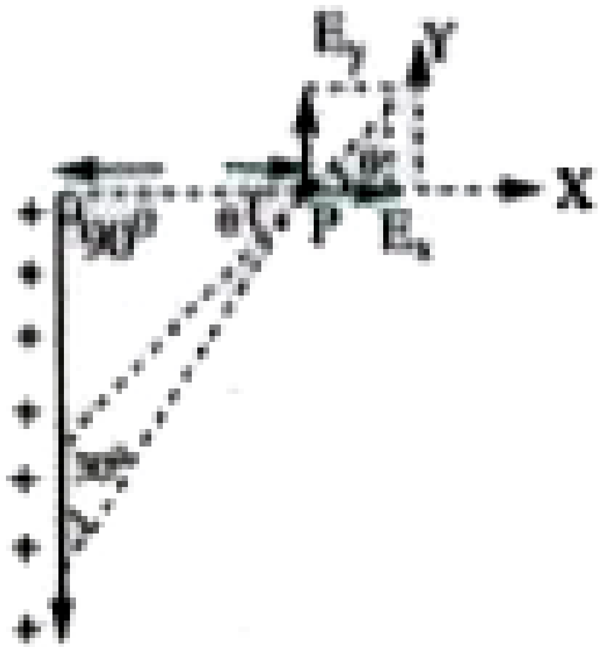
6. The direction (q) of $\vec{E}$ at point p due to uniformly charged rod will be



A. at angle 30° from x-axis

B. 45° from x - axis

C. 60° from x - axis

D. none of these

Answer: A

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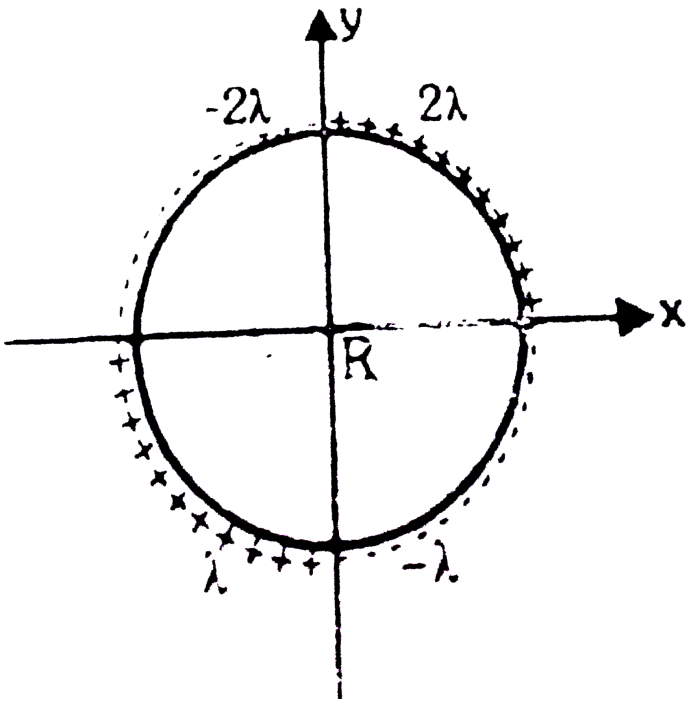
7. The charge per unit length of the four quadrant of the ring is $2\lambda, \; -2\lambda, \lambda$ and $-\lambda$ respectively. The electric field at the centre is:



A. $-\dfrac{\lambda}{2\pi\varepsilon_0 R}\hat{i}$

B. $-\dfrac{\lambda}{2\pi\varepsilon_0 R}\hat{j}$

C. $\dfrac{\sqrt{2}\lambda}{4\pi\varepsilon_0 R}\hat{i}$

D. None

Answer: A

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8. Three concentric conducting spherical shells of radii R, R2 and 3R carry charges Q,-2Q and 3Q, respectively compute the electric field at $r = \dfrac{5}{2}R$

A. $\dfrac{-Q}{3\pi\varepsilon_0 R^2}\hat{r}$

B. $\frac{-Q}{25\pi\varepsilon_0 R^2}\hat{r}$

C. $\frac{-Q}{5\pi\varepsilon_0 R^2}\hat{r}$

D. $\frac{-Q}{\pi\varepsilon_0 R^2}\hat{r}$

Answer: B

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9. The weight of an object on the surface of the Earth is 40 N. Its weight at a height equal to the radius of the Earth is

A. $E = \frac{a\rho}{\varepsilon_0}\bar{a}$ is directed toword the axis of cavity

B. $E = \frac{a\rho}{3\varepsilon_0}\bar{a}$ is directed away from the axis of cavity

C. $E = \frac{a\rho}{3\varepsilon_0}\bar{a}$ is directed away from the axis of cavity

D. $E = \frac{a\rho}{\varepsilon_0}\bar{a}$ is directed toword the axis of cavity.

Answer: D

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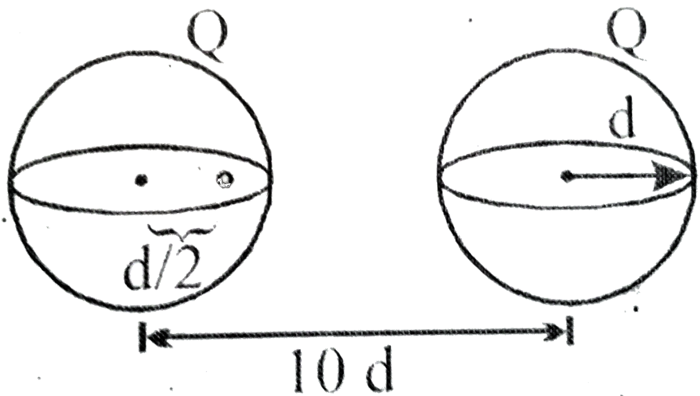
10. Two spherical, nonconducting, and very thin shells of uniformly distributed positive charge Q and radius d are located a distance 10d from each other. A positive point charge q is placed inside one of the shells at a distance d/2 from the center, on the line connecting the centers of the two shells, as shown in the figure. What is the net force on the charge q ?



A. $\dfrac{qQ}{361\pi\varepsilon_0 d^2}$ to the left

B. $\dfrac{qQ}{361\pi\varepsilon_0 d^2}$ to the right

C. $\dfrac{362qQ}{361\pi\varepsilon_0 d^2}$ to the left

D. $\dfrac{362qQ}{361\pi\varepsilon_0 d^2}$ to the right

Answer: A

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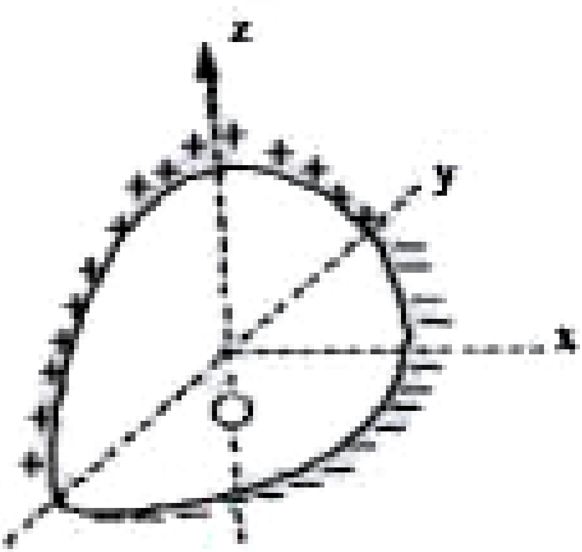
PRACTICE SHEET (EXERCISE - II INTENSITY OF ELECTRIC FIELD) (LEVEL - II (MAIN) MORE THAN ONE ANSWER TYPE QUESTION)

1. The semicircular non - conducting ring of radius R containing +ve and negative charge as shwon are joined in tw perpendicular planes. The magnitude of linear charge densities is unifrom and is λ. The electric field at O will be :



A. $\frac{\lambda}{2\pi\varepsilon_0 R}$

B. $\frac{\sqrt{2}\lambda}{\pi\varepsilon_0 R}$

C. $\frac{\lambda}{\sqrt{2}\pi\varepsilon_0 R}$

D. zero

Answer: C

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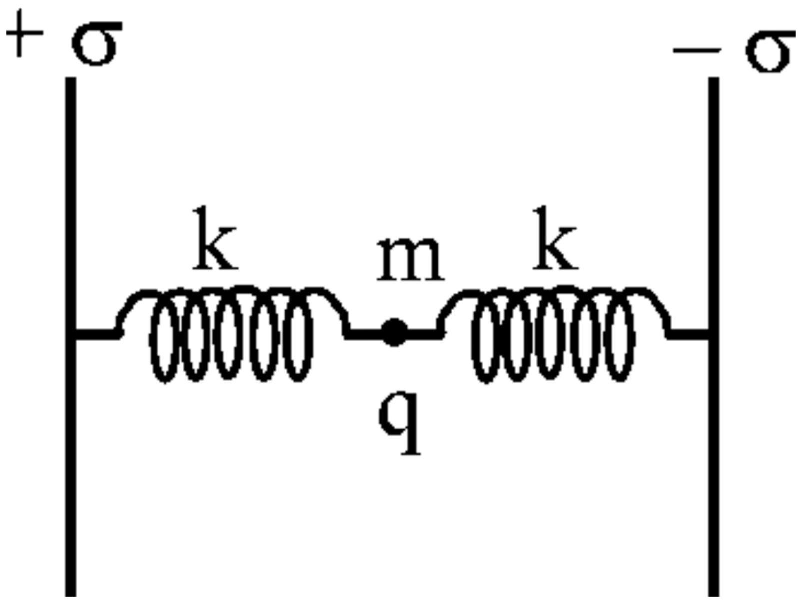
PRACTICE SHEET (EXERCISE - II INTENSITY OF ELECTRIC FIELD) (LEVEL - II (MAIN) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS

1. Two large insulating plates having surface charge densities $+\sigma$ and $+\sigma$ are fixed at a distance d frome each other . A small test charge q of mass m is attached to two identical spring as show in the fingure . The charge q is now released from rest with springs in natural lenth . Then q will

(Neglect gravity)



A. perform SHM with angular frequency $\sqrt{\frac{2k}{m}}$

B. perform SHM with amplitude $\frac{\sigma q}{2k \in_0}$

C. not perform SHM, but will have a periodic motion if charge are removed on plates as well as on m

D. remain stationary

Answer: A::B

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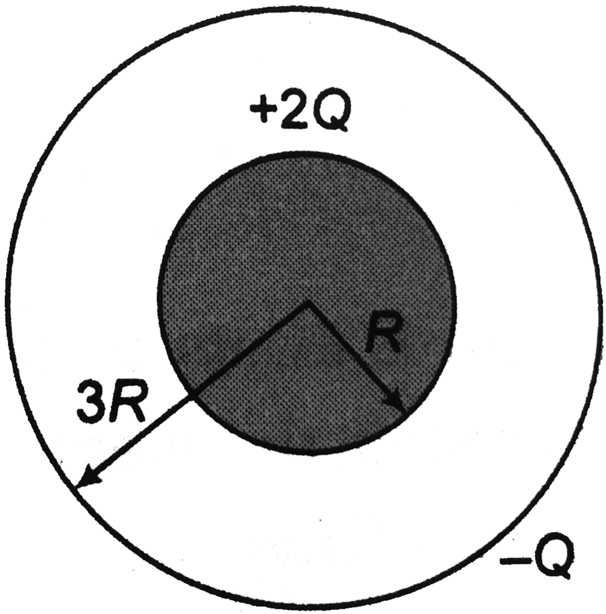
PRACTICE SHEET (EXERCISE - II INTENSITY OF ELECTRIC FIELD) (LEVEL - II (MAIN) LINKED COMPREHINSION TYPE QUESTION)

1. A solid sphere of radius R has a charge $+2Q$. A hollow spherical concentric with the first sphere that has net charge -Q.



(a) Find the electric field between the spheres at a distance r from the centre of the inner sphere. $[R < r < 3R]$

(b) Calculate the potential difference between the spheres.

(c) What would be the final distribution of charges, if a conducting wire joins the spheres?

(d) Instead of (c), if the inner sphere is earthed, what is the charge on it?

A. $\frac{Q}{2\pi\varepsilon_0 r^2}$

B. $\frac{Q}{\pi\varepsilon_0 r^2}$

C. $\frac{Q}{\varepsilon_0 r^2}$

D. $\frac{Q}{5\pi\varepsilon_0 r^2}$

Answer: A

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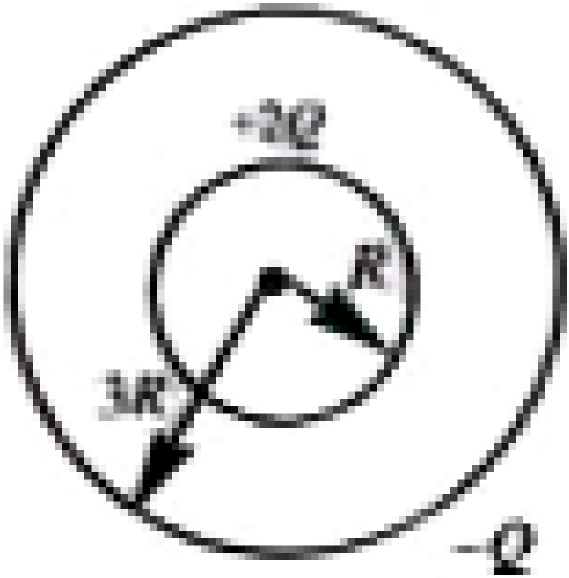
2. A solid metal sphere of radius R has a charg +2Q. A hollow spherical shell of radius 3R placed concentric with the frist sphere has net charge -Q.



What would be the final distribution of charges if the sphres are joined by a conducting wire

A. zero on outer and Q on outer sphere

B. $+Q$ on inner and $-Q$ on outer sphere

C. zero on inner and Q on outer sphere

D. $-Q$ on inner and $+2$ on outer sphere

Answer: C

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3. A solid metall sphere of radius R has a charge + 2Q. A hollow spherical shell of radius 3R placed concentric with the sphere has charge - Q. Calculate the potential difference between the spheres.

A. $\frac{2Q}{3}$

B. $\frac{Q}{2}$

C. $\frac{5Q}{2}$

D. $\frac{Q}{3}$

Answer: D

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PRACTICE SHEET (EXERCISE - II INTENSITY OF ELECTRIC FIELD) (LEVEL - II (MAIN) MATRIX MATCHING TYPE QUESTIONS)

1. Match the facts given in Column - I with the system given in Column - II

COLUMN-I	COLUMN-II
A) Electric field strength is zero in thevolume	p) A non conducting solid sphere charged unifor mly
B) Electric field strength is non-zero in the volume but zero at the centre	q) A conducting spherical shell charged uniformly
C) Electric field strength is maximum on the surface of	r) A non conducting hollow sphere charged uniformly
D) Electric field strength outside the system varies inversely as the square of the distance from the centre of	s) A conducting solid sphere charged uniformly

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PRACTICE SHEET (EXERCISE -III ELECTRO FLUX & GAUSS.S LAW) (LEVEL - I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. The electric field in a region of space is given by $E = 5i + 2jN/C$. The electric flux due to this field through an area $2m^2$ lying in the Yz plane, in S.I. units, is

A. 10

B. 20

C. $10\sqrt{2}$

D. $2\sqrt{29}$

Answer: A

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2. A charge Q is situated at the centre of a cube. The electric flux through one of the faces of the cube is

A. Q/ε_0

B. $Q/2\varepsilon lpon_0$

C. $Q/4\varepsilon_0$

D. $Q/6\varepsilon_0$

Answer: D

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3. Electric field due to an infinite sheet of charge having surface charge density σ is E. Electric field due to an infinite conducting sheet of same surface density of charge is

A. $E/2$

B. E

C. 2E

D. 4E

Answer: C

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4. The magnitude of the electric field on the surface of a sphere of radius r having a uniform surface charge density σ is

A. σ / ε_0

B. $\sigma / 2\varepsilon_0$

C. $\sigma / 2\varepsilon_0 r$

D. $\sigma / 2\varepsilon_0 r$

Answer: A

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5. If the electric flux entering and leaving an enclosed surface respectively, is ϕ_1 and ϕ_2, then the electric charge inside the surface will be

A. $(\phi_2 - \phi_1)\varepsilon_0$

B. $(\phi_1 + \phi_2) / \varepsilon_0$

C. $(\phi_2 - \phi_1) / \varepsilon_0$

D. $(\phi_1 + \phi_2)\varepsilon_0$

Answer: A

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6. a hemispherical hollow body is placed in a uniform electric field E. the total flux linked with the curved surface is

A. $2\pi R^2 E$

B. $\pi R^2 E$

C. $4\pi R^2 E$

D. $6\pi R^2 E$

Answer: B

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7. The electric flux through a Gaussian surface that encloses three charges given by $q_1 = -14nC$, $q_2 = 78.85nC$, $q_3 = -56nC$

A. $10^3 Nm^2C^{-1}$

B. $10^3 CN^{-1} m^{-2}$

C. $6.32 \times 10^3 Nm^2 C^{-1}$

D. $6.32 \times 10^3 CN^{-1} m^{-2}$

Answer: A

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8. An infinitely long thin straight wire has uniform linear charge density of $\frac{1}{3} cm^{-1}$. Then, the magnitude of the electric intensity at a point 18 cm away is (given, $\varepsilon_0 = 8.8 \times 10^{-12} C^2 Nm^{-2}$)

A. $0.33 \times 10^{11} NC^{-1}$

B. $3 \times 10^{11} NC^{-1}$

C. $0.66 \times 10^{11} NC^{-1}$

D. $1.32 \times 10^{11} NC^{-1}$

Answer: A

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9. Let $P(r) = \frac{Q}{\pi R^4} r$ be the charge desntiy distribution for a solid sphere of radius R and total charge Q. for a point 'p' inside the sphere at distance r_1 from the centre of the sphere, the magnitude of electric field is

A. $\frac{Q}{4\pi \in_0 r_1^2}$

B. $\frac{Q_1^2}{4\pi \in_0 R^4}$

C. $\frac{Q_1^2}{3\pi \in_0 R_4}$

D. 0

Answer: B

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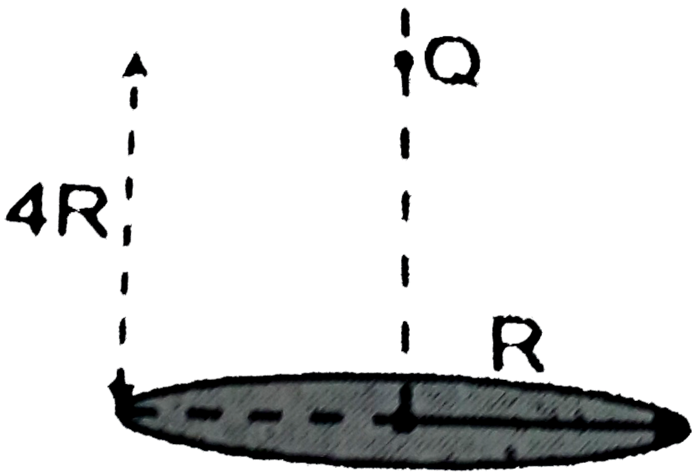
PRACTICE SHEET (EXERCISE -III ELECTRO FLUX & GAUSS.S LAW) (LEVEL - I (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTION)

1. A position charge q is placed at a distance of 4R above the centre of a disc of radius R. The magnitude of flux through the disc is ϕ. Now a hemispherical shell of radius R is placed over the disc such that it forms a closed surface. The flux through the curved surface (taking direction of area vector along outward normal as positive), is -



A. zero

B. ϕ

C. $-\phi$

D. 2ϕ

Answer: C

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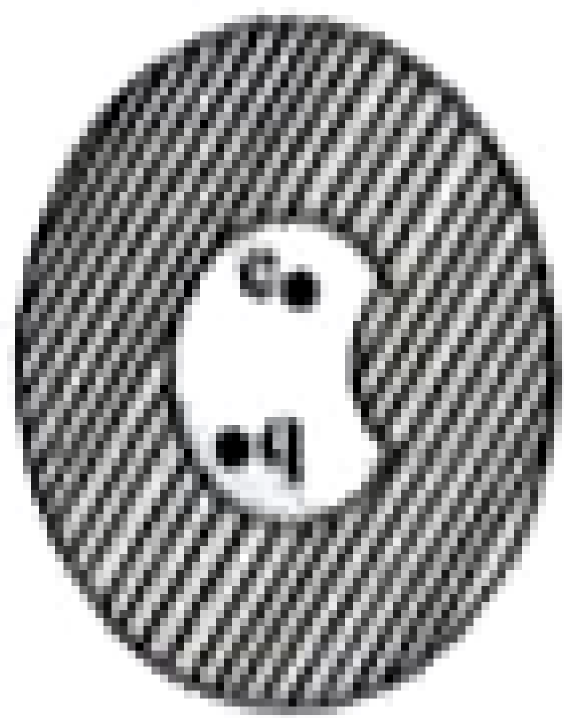
2. The figure shows a charge q placed inside a cavity in an uncharged conductor. Now if an external electric field is swiched on



A. only induced charge on outer surface will redistribute

B. only inducrd charge on inner surface will redistribute

C. both induced charge on outer and inner surface will redistribute

D. force on charge q placed inside the cavity will change

Answer: A

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3. Find the magnitude of the electric field at a point 4 cm away from a line charge of density $2 \times 10^{-6} Cm^{-1}$.

A. $9 \times 10^{9} N / C$

B. $9 \times 10^{5} N / C$

C. $5 \times 10^{8} N / C$

D. $8 \times 10^{-10} N / C$

Answer: B

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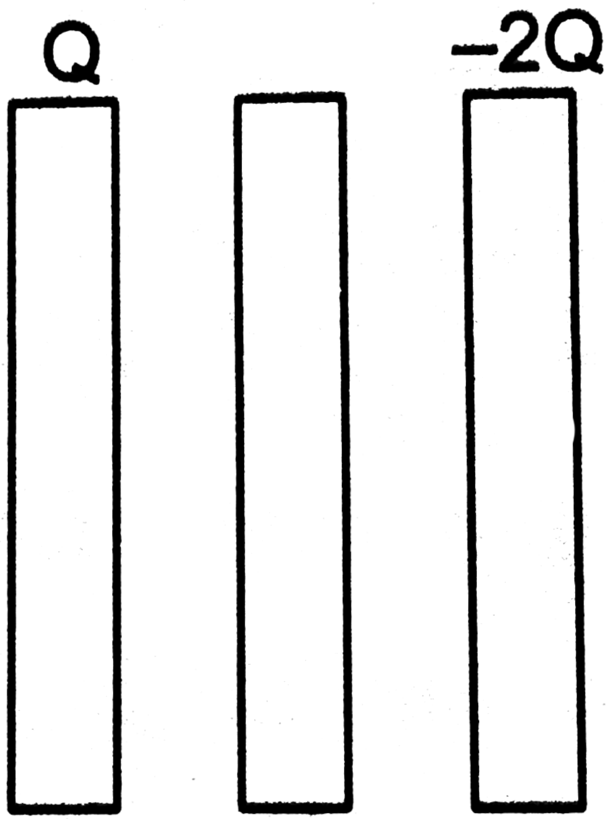
4. Three identical metal plates with large surface areas are kept parallel to each as shown in figure (30-E8). The leftmost plate is given a charge Q, the rightmost a chrgear2Q and the middle one remains neutral. Find the charge appearing on the outer surface of the rightmost plate.



A. $-\frac{Q}{2}$

B. $+\frac{Q}{2}$

C. $\dfrac{Q}{2\varepsilon_0}$

D. $\dfrac{Q}{\varepsilon_0}$

Answer: A

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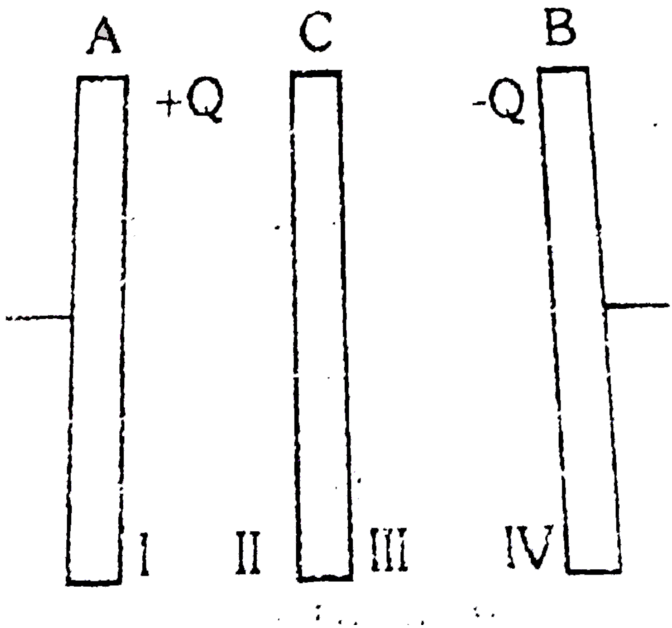
5. Plates A and B constitutes an isolated, charge parallel plate capacitor. The inner surface (I and IV) of A and B have charge +Q and -Q respectively. A third plate C with charge +Q is now introduced midways between A and

B. Which of the following statement is not correct?



A. The surface I and II will have equal and opposite charges.

B. The surfaces III and IV will have euqal and opposite charges.

C. The charge on surface III will be greater than Q.

D. The potential difference between A and C will be equal to the potential difference between C and B.

Answer: D

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6. Which of the following statements are correct

A. Electric field calculated by Gauss law is the field due to only those charges which are enclosed inside the Gaussian surface.

B. Gauss law is applicable only when there is a symmetrical distribution of charge.

C. Electirc flux through a closed surface will depends only an charges enclosed within that surface only.

D. None of these

Answer: C

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7. In a region of space the electric field is in the x- direction and proportional to x,i.e $\overrightarrow{E} = E_0 x \hat{i}$. Consider an imaginary cubical volume of edge a with its edges parallel to the axes of coordinates. The charge inside this valume will be

A. zero

B. $\in_0 \ E_0 a^3$

C. $\frac{1}{\in_0} E_0 a^3$

D. $\frac{1}{6} \in_0 \ E_0 a^2$

Answer: B

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8. A flat, square surface with sides of length L is described by the equations

$x = L, 0 \leq y \leq L, 0 \leq z \leq L$

The electric flux through the square due to a positive point charge q located at the origin $(x = 0, y = 0, z = 0)$ is

A. $\frac{q}{4\varepsilon_0}$

B. $\frac{q}{6\varepsilon_0}$

C. $\frac{q}{24\varepsilon_0}$

D. $\frac{q}{48\varepsilon_0}$

Answer: C

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9. The intensity of an electric field depends only on the coordinates x and y as follows

$$E = \frac{a\left(x\hat{i} + y\hat{j}\right)}{x^2 + y^2}$$

where a is a constant $\hat{i}$ and $\hat{j}$ are the unit vectors of the x and y-axes. Find the charge within a sphere of radius R with the centre at the origin.

A. $4\pi\varepsilon_0 aR$

B. $2\pi\varepsilon_0 aR$

C. $\pi\varepsilon_0 aR$

D. $3\pi\varepsilon_0 aR$

Answer: A

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10. A uniformly charged and infinitely long line having a linear charge density $'\lambda'$ is placed at a normal distance y from a point O. Consider a sphere of radius R with O as centre and $R > y$. Electric flux through the surface of the sphere is-

A. zero

B. $\dfrac{2\lambda R}{\varepsilon_0}$

C. $\dfrac{2\lambda\sqrt{R^2 - y^2}}{\varepsilon_0}$

D. $\dfrac{\lambda\sqrt{R^2 + y^2}}{\varepsilon_0}$

Answer: C

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11. Consider a uniform electric field $E = 3 \times 10^3 \hat{i} N/C$. (a) What is the flux of this field through a square of 10 cm on a side whose plane is parallel to the yz plane? (b) What is the flux through the same square if the normal to its plane makes a 60° angle with the x-axis?

A. $30NC^{-1}m^2$

B. $20NC^{-1}m^2$

C. $10NC^{-1}m^2$

D. zero

Answer: A

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12. what is the function of the leaves in plants.

A. $30NC^{-1}m^21$

B. $15\sqrt{3}NC^{-1}m^2$

C. $15\sqrt{2}NC^{-1}m^2$

D. $15NC^{-1}m^2$

Answer: D

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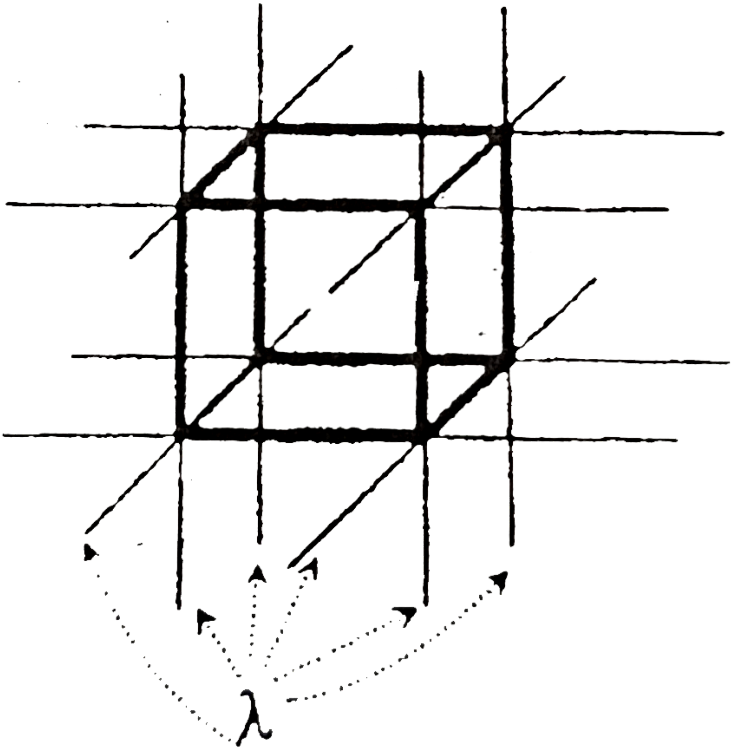
13. Twelve infinite long wire of uniform linear charge density (λ) are passing along the twelve edges of a cube. Find electric flux through any face of cube. ,



A. $\left(\frac{\lambda l}{2\varepsilon_0}\right)$

B. $\left(\frac{\lambda l}{\varepsilon_0}\right)$

C. $\left(\frac{\lambda l}{3\varepsilon_0}\right)$

D. $\left(\frac{3\lambda l}{\varepsilon_0}\right)$

Answer: A

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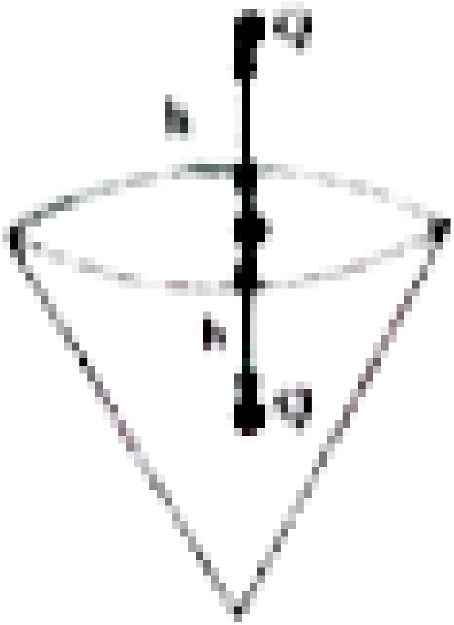
14. A point charge .Q. is placed at a point inside the cone as shown. The flux due to the charge through the curved surface is given as $\frac{2Q}{3\varepsilon_0}$. Now another charge .Q. is placed vertically above at the same distance from the base. The flux through the curved surface due to both charges is .



A. $\frac{Q}{3\varepsilon_0}$

B. $\frac{2Q}{3\varepsilon_0}$

C. $\frac{Q}{\varepsilon_0}$

D. $\frac{2Q}{\varepsilon_0}$

Answer: C

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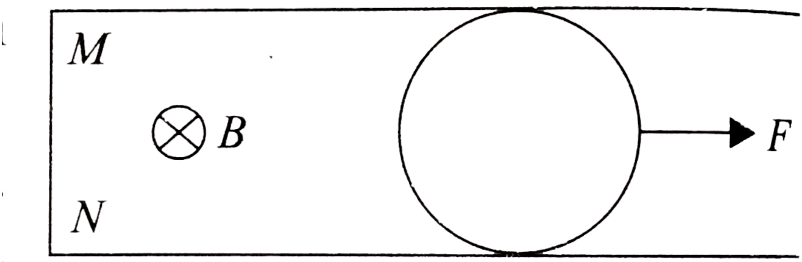
PRACTICE SHEET (EXERCISE -III ELECTRO FLUX & GAUSS.S LAW) (LEVEL - I (ADVANCED) MORE THAN ONE CORRECT ANWER TYPE QUESTIONS

1. Two long parallel conducting horizontal rails are connected by a conducting wire at one end. A uniform magnetic field B (directed vertically downwards) exists in the region of space.



A light uniform ring of diameter d which is practically equal to separation between the rails is placed over the rails as shown in Fig. If resistance of ring be (λ) per unit length

The force required to pull the ring with uniform velocity v is

A. The flux of electric field through the differential cube is zero

B. The flux of electric field through the cube = 12 dx dy dz

C. The charge enclosed by the cube is zero.

D. The charge enclosed by a spherical surface of radius r, centered at origin is $16\pi\varepsilon_0 r^3$

Answer: B::D

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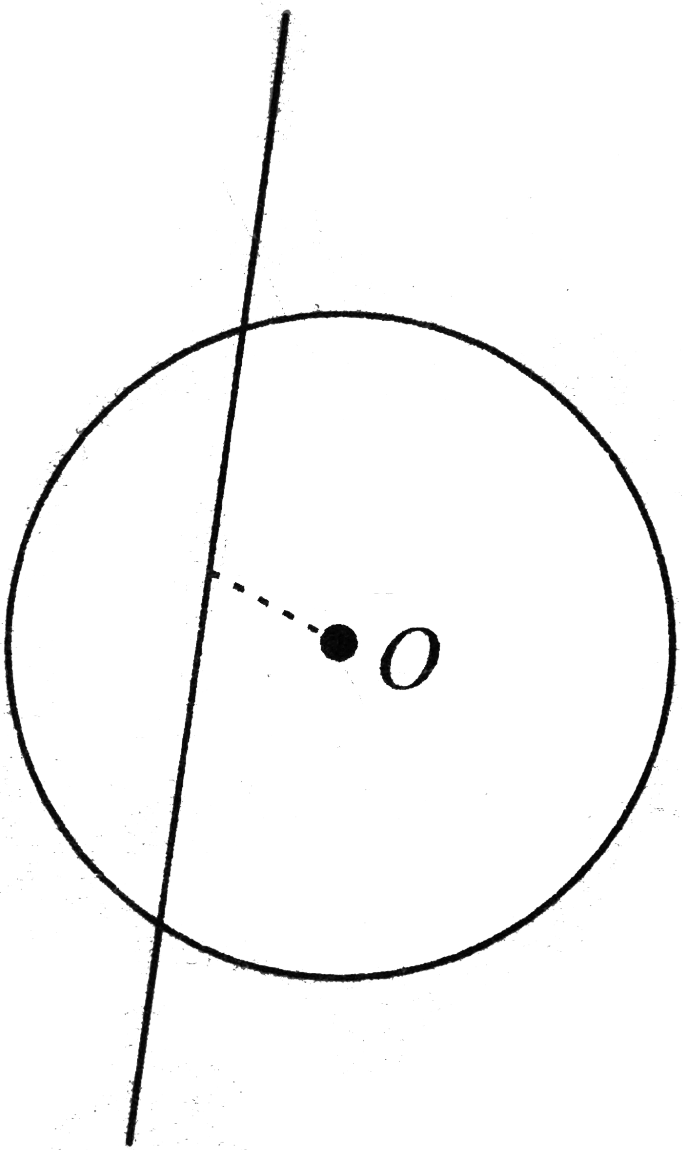
2. A uniformly charged and infinitely long line having a liner charge density λ is placed at a normal distance y from a point O. Consider a sphere of radius R with O as the center and Rgty. Electric flux through the surface of the sphere is



A. flux crossing the sphereis zero if $d > R$

B. flux crossing the sphere is $\frac{2l\sqrt{R^2-d^2}}{\varepsilon_0}$ if $d < R$

C. If $d > R$, the magnitude of maximum potential of maximum potential difference between two points on the sphere is $\frac{\lambda}{2\pi\varepsilon_0}\text{In}\left(\frac{d+R}{d-R}\right)$

D. When a charge is moved along any diameter of the sphere in the plane perpendicular to the wire, work done is zero.

Answer: A::B::C::D

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3. A thin-walled spherical conducting shell S of radius R is given charge Q. The same amount of charge is also placed at its center C. Which of the following statements are correct?

A. On the outer surface of S, the charge density is $\frac{Q}{2\pi R^2}$

B. The electric field is zero at all points inside S.

C. At a point just outside S. the electric field is double the field at a point just inside S.

D. At any point inside S, the electric field is inversely proportional to the square of its distance from C.

Answer: A::C::D

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4. A common test to find the genotype of a hybrid is by

A. The field is at a distance r from C, where $a < r < b$ is $\frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$

B. The potential at a distance r from C, where a $a < r < b$ is $\frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$

C. The potential difference betwee A and B is $\frac{l}{4\pi\varepsilon_0}Q\left(\frac{1}{a}-\frac{1}{b}\right)$

D. The potential at a distance r from C, where $a < r < b <, \frac{1}{4\pi\varepsilon_0}Q\left(\frac{1}{a}-\frac{1}{b}\right)$

Answer: A::C::D

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5. Two thin conducting shells of radii R and 3R are shown in the figure. The outer shell carries a chage Q and the inner shell is neutral. The inner shell is earthed with the help of a switch S

A. With the switch S open, the potential of the inner sphere is equal to that of the outer.

B. When th switch S is closed, the potential of the inner sphere becomes zero.

C. With the switch S closed, the charge attained by the inner sphere is - q/3.

D. By closing the switch the capacitance of the system increases.

Answer: A::B::C::D

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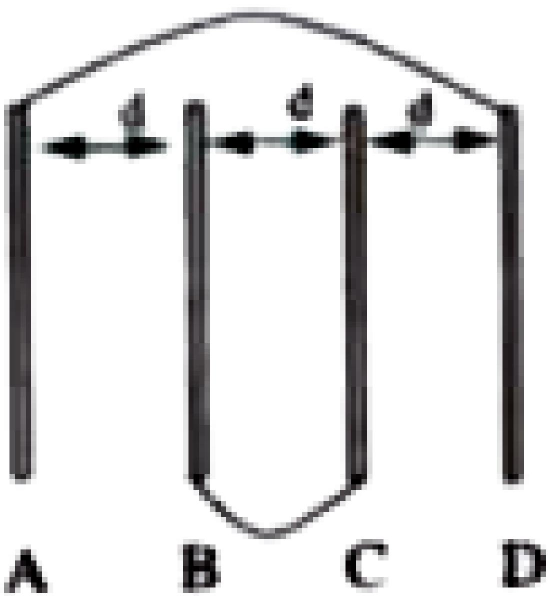
PRACTICE SHEET (EXERCISE -III ELECTRO FLUX & GAUSS.S LAW) (LEVEL - I (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. Four initially uncharaged thin, large, plane idential metallic plates A,B,C and D are arranged parallel to each other as shown. Now plates A,B,C and D are given charges Q,2Q,3Q and 4Q respectively. Plates A and D are connected by a mtallic wire while plates B and C connected by other metallic wire then after Electrostatic equilibrium is reached.



Total charge on plates after earthing plates A and B will be

A. zero

B. $\frac{3Q}{2}$

C. $\frac{-9Q}{2}$

D. $\frac{5Q}{2}$

Answer: D

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2. Auxospores and hormocysts are formed, respectively, by

A. zero

B. $\frac{5Q}{2}$

C. $\frac{-5Q}{2}$

D. 6Q

Answer: C

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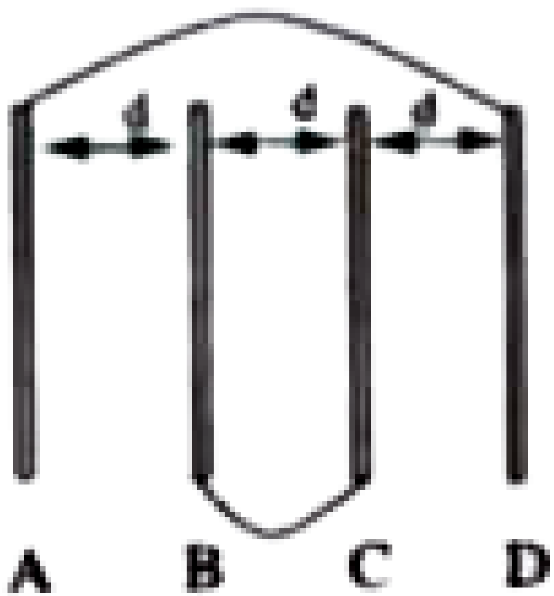
3. Four initially uncharaged thin, large, plane idential metallic plates A,B,C and D are arranged parallel to each other as shown. Now plates A,B,C and D are given charges Q,2Q,3Q and 4Q respectively. Plates A and D are connected by a mtallic wire while plates B and C connected by other metallic wire then after Electrostatic equilibrium is reached.



Total charge on plates after earthing plates A and B will be

A. zero

B. 6Q

C. $\frac{-7Q}{2}$

D. $-2Q$

Answer: A

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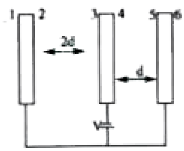
PRACTICE SHEET (EXERCISE -III ELECTRO FLUX & GAUSS.S LAW) (LEVEL - I (ADVANCED) MATRIX MATCHING TYPE QUESTIONS

1. In the figure shown, area of each plate is A. Match the following

COLUMN - I	COLUMN - II
A) Charge on plate 3	p) Zero
B) Charge on plate 5	q) V
C) Potential difference between plates 2 and 3	r) $\frac{\varepsilon_0 A}{2d}V$
D) Potential difference between plates 2 and 5	s) $\frac{\varepsilon_0 A}{d}V$
	t) None



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PRACTICE SHEET (EXERCISE -III ELECTRO FLUX & GAUSS.S LAW) (LEVEL - I (MAIN) INTEGER TYPE QUESTIONS

1. If the charge is placed at the center of one side, flux through the cube is $\frac{q}{n\varepsilon_0}$ where .n. is

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2. A charger Q is distributed uniformly on a ring of radius of r. A sphere of equal radius r is constructed with its centre a t the periphery of the ring. The flux of the electric field through the surface of the sphere is $\frac{Q}{n\varepsilon_0}$, The value of n is

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PRACTICE SHEET (EXERCISE -IV ELECTRIC POTENTIAL & POTENTIAL ENERGY) (LEVEL - I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTION)

1. Which of the following is a true nut?

A. E is always zero where V is zero

B. V is always zero where E is zero

C. E can be zero where V is non zero

D. E is always nonzero where V is nonzero

Answer: C

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2. Two electric charges of 9 μC and -3 μC are placed 0.16 m apart in air. There will be a point P at which electric potential is zero on the line joining two charges and in between them. The distance of P from 9 μC is

A. 0.14 m

B. 0.12 m

C. 0.08 m

D. 0.06 m

Answer: B

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3. Charges $5\mu C, -2\mu C, 3\mu C$ and $-9\mu C$ are placed at the corners A,B,C and D of a square ABCD of side 1m. The net electric potential at the centre of th square is

A. $-27KV$

B. $-27\sqrt{2}KV$

C. $-90KV$

D. zero

Answer: B

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4. An electric charge $10^{-3}\mu C$ is placed at the origin (0, 0) of xy-coordinate system. Two points A and B are situated at $(\sqrt{2}, \sqrt{2})$ and $(2, 0)$, respectively. The potential difference between the points A and B will be

A. 9 V

B. zero

C. 2 V

D. 4.5 V

Answer: B

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5. In Millikan's oil drop experiment, an oil drop carrying a charge Q is held stationary by a potential difference 2400 V between the plates. To keep a drop of half the radius stationary, the potential difference had to be made 600 V. what is the charge on the second drop

A. $\frac{Q}{4}$

B. $\frac{Q}{2}$

C. Q

D. $\frac{3Q}{2}$

Answer: B

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6. Two parallel plates separated by a distance of 5 mm are kept at a potential difference of 50 V. A particle of mass 10^{-15} and charge 10^{-11} C enters in it with a velocity $10^7 m/s$. The acceleration of the particle will be

A. $10^8 m/s^2$

B. $5 \times 10^5 m/s^2$

C. $10^5 m/s^2$

D. $2 \times 10^3 m/s^2$

Answer: A

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7. A cloud is at a potential of 8×10^6 volt relative to the ground. A charge of 80 coulomd is transferred in lightening stroke betwee the cloud and the gorund. Assuming the potential of the cloud of remain constant, the energy dissipated is

A. 6.4×10^8 joule

B. 6.4×10^5 joule

C. 10^5 joule

D. 10^7 joule

Answer: A

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8. Surface charge density of a sphere of a radius 10 cm is $8.85 \times 10^{-8} c / m^2$. Potential at the centre of the sphere is

A. 1000 V

B. 885 V

C. 10^{-3} V

D. 442.5 V

Answer: A

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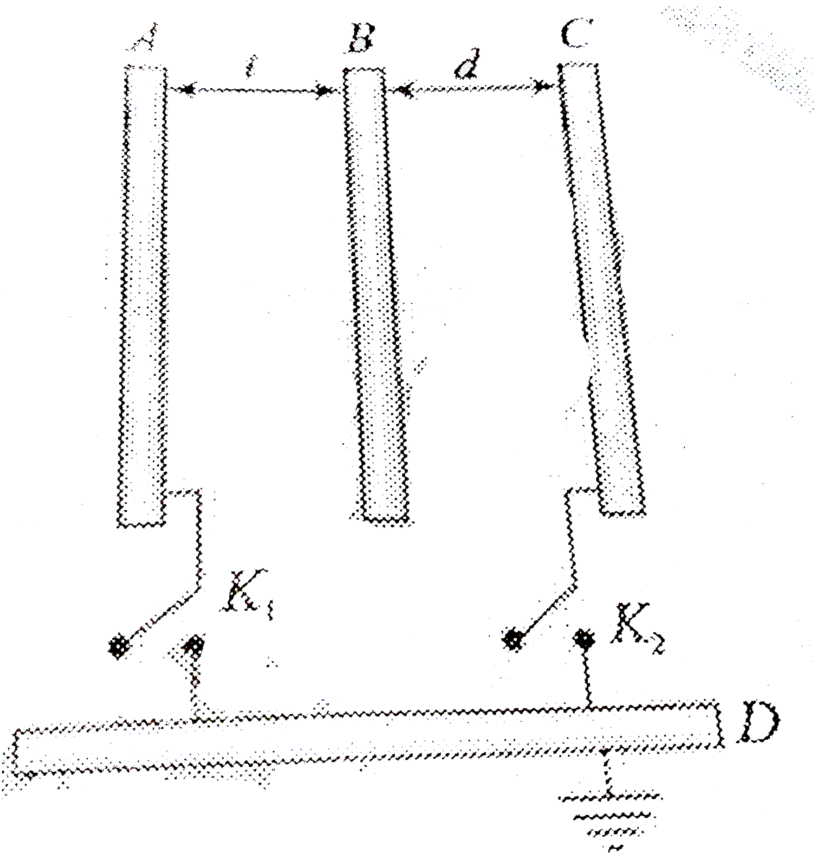
9. Three plates A, B and C are placed close to each other with $+Q$ charge given to the middle plate. The inner surfaces to A and C can be connected to earth through plate D and keys K_1 and K_2 . The plates D is a dielectric slab with dielectric constant K_1 then the charge that will flow through plate D and keys K_1 and K_2 . The plate D is a dielectric slab with dielectric constant K, then the charge that will flow though plate D when K_2 is closed and K_2 is open is



A. $1:1$

B. $R_1:R_2$

C. $R_2:R_1$

D. $R_1^2:R_2^2$

Answer: C

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10. As a charged particle 'q' moving with a velocity $\vec{v}$ enters a uniform magnetic field $\vec{B}$, it experience a force $\vec{F} = q\left(\vec{v} \times \vec{B}\right)$. F or $\theta = 0^\circ$ 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 $\left(mv^2/r\right)$. For other values of $\theta(\theta \neq 0^\circ, 180^\circ, 90^\circ)$, 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 $\vec{v} = \left(8\hat{i} - 6\hat{j}4\hat{k}\right) \times 10^6 ms^{-1}$ and force acting on it has a magnitude 1.6 N

Angular frequency of rotation of particle, also called the `cyclotron frequency' is

A. $2 \times 10^{-6} N$

B. $4 \times 10^{-6} N$

C. $6 \times 10^{-6} N$

D. $8 \times 10^{-6} N$

Answer: D

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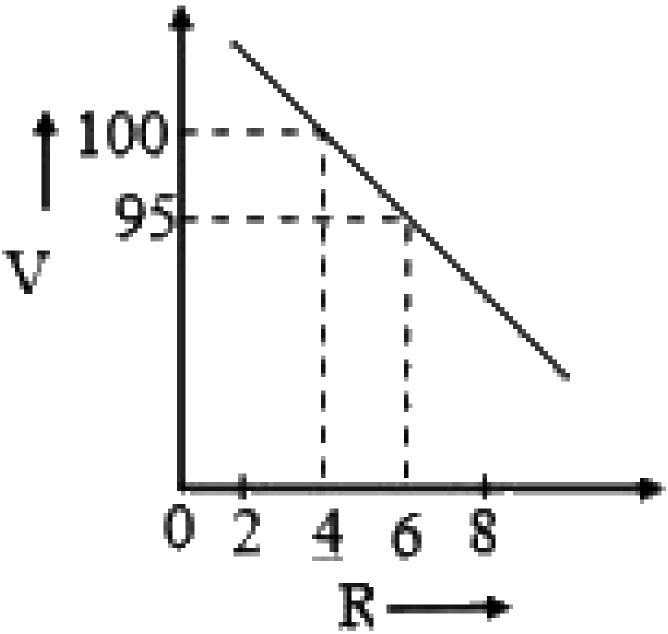
11. The variation of potential with distance R from a fixed point is shown in figure. The electric field at R = 5 m is -



A. $2.5Vm^{-1}$

B. $-2.5Vm^{-1}$

C. $0.4Vm^{-1}$

D. $-0.4Vm^{-1}$

Answer: A

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12. The electric potential decreases unifromly from 120 V to 80 V as one moves on the x-axis from x=-1 cm to x=+1 cm. The electric field at the origin

A. must be equal to 20 V/cm

B. may be equal to 20 V/cm

C. may be greater than 20 V/cm

D. may be less than 20 V/cm

Answer: A

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13. Choose the correct alternatives.

(i) Acceleration due to gravity increases/decreases with increasing altitude.

(ii) Acceleration due to gravity increases/decreases with increasing depth (assume the earth to be a sphere of uniform density.

(iii) Acceleration due to gravity is independent of the mass of the earth/mass of the body.

(iv)The formula $-GMm\left(\frac{1}{r_2}-\frac{1}{r_1}\right)$ is more/less accurate than the formula mg $(r_2 - r_1)$ for the difference of potential energy between two points r_2 and r_1 distance away from the centre of the earth.

A. 10 V

B. 250 V

C. 1000 V

D. 2500 V

Answer: A

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14. There is an electric field E in x-direction. If the work done on moving a charge of $0.2C$ through a distance of 2 m along a line making an angle 60° with x-axis is 4 J, then what is the value of E?

A. $\sqrt{3}NC^{-1}$

B. $4NC^{-1}$

C. $5NC^{-1}$

D. $20NC^{-1}$

Answer: D

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15. There are 27 drops of a conducting fluid. Each has a radius r and they are charged to a potential V_0. They are then combined to form a bigger drop. Find its potential.

A. V_0

B. $3V_0$

C. $9V_0$

D. $29V_0$

Answer: C

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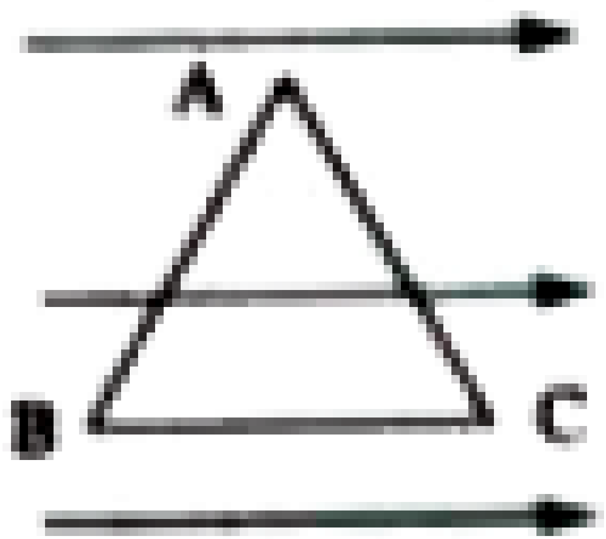
16. ABC is an equilateral triangle of side 2m. If $\vec{E} = 10NC^{-1}$ then $V_A - V_B$ is



A. 10V

B. $-10V$

C. 20V

D. `-20V

Answer: B

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17. The charges - q, Q, -q are placed along x-axis at x = 0, x = a and x = 2a. If the potential energy of the system is zero, then Q:q is

A. $1:2$

B. $2:1$

C. $1:4$

D. $4:1$

Answer: C

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18. A satellite orbiting close to the surface of earth does not fall down because the gravitational pull of earth :

A. 6 V

B. $\sqrt{6}V$

C. $V/56$

D. $\frac{3V}{2}$

Answer: B

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19. Four equal charges q each are placed at four corners of a square of a square of side a each. Work done incarrying a charge -q from its centre to infinity is

A. zero

B. $\frac{\sqrt{2}Q^2}{4\pi \in_o a}$

C. $\frac{\sqrt{2}Q^2}{\pi \in_o a}$

D. $\frac{Q^2}{2\pi \in_o a}$

Answer: C

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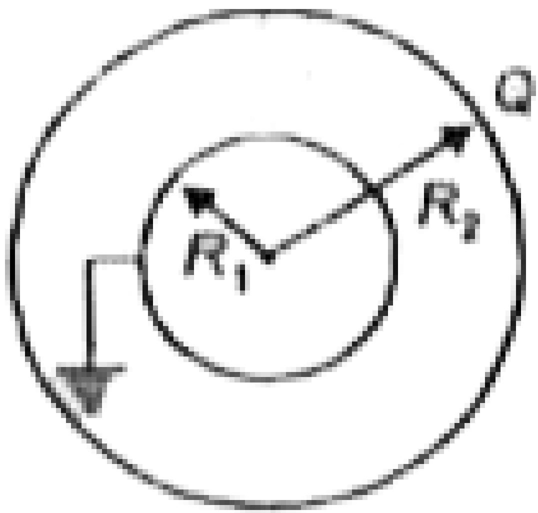
PRACTICE SHEET (EXERCISE -IV ELECTRIC POTENTIAL & POTENTIAL ENERGY) (LEVEL - II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTION)

1. Two concentric hollow metal sphere have radii R_1 and R_2 The outer sphere is given a positive charge Q and the inner is earthed. What is the charge on the inner sphere ? $(R_2 > R_1)$



A. Zero

B. $-q$

C. $-\frac{r_1}{r_2}q$

D. $\frac{r_1}{r_2}q$

Answer: C

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2. Consider two concentric conducting spheres. The outer sphere is hollow and initially has a charge $-7Q$ on it. The inner sphere is solid and has a charge $+2Q$ on it.

a. How much charge is on the outer surface and inner surface of the outer sphere.

b. If a wire is connected between the inner and outer sphere, after electrostatic equilibrium is established how much total charge is on the outer sphere? How much charge is on the outer surface and inner surface of the outer sphere? Does the electric field at the surface of the inside sphere change when the wire is connected?

c. We return to original condition in (a). We now connect the outer sphere to ground with a wire and then disconnect it. How much total charge will be on the outer sphere? How much charge will be on the inner surface and outer surface of the outer sphere?

A. $-2Q, \ -7Q$

B. $+2Q-9Q$

C. $-2Q, \ -5Q$

D. $+2Q, \ +5Q$

Answer: C

Watch Video Solution

3. A charge Q is placed at each corner of a cube of side a. The potential at the centre of the cube is

A. $\dfrac{8Q}{\pi \in_a a}$

B. $\dfrac{4Q}{4\pi \in_0 a}$

C. $\frac{4Q}{\sqrt{3}\pi \in_0 a}$

D. $\frac{4Q}{\pi \in_a a}$

Answer: C

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4. A charge q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium if q is equal to

A. $-\frac{Q}{2}$

B. $+\frac{Q}{2}$

C. $-\frac{Q}{4}$

D. $+\frac{Q}{4}$

Answer: C

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5. Two point charges $-q$ and $+q$ are located at points $(0, 0, -a)$ and $(0, 0, a)$ respectively. The potential at a point $(0, 0, z)$, where $z > a$ is

A. $\frac{q\alpha}{4\pi \in_0 z^2}$

B. $\frac{q}{4\pi \in_0 \alpha}$

C. $\frac{2q\alpha}{4\pi \in_0 (z^2 - \alpha^2)}$

D. $\frac{2q\alpha}{4\pi \in_0 (z^2 + \alpha^2)}$

Answer: C

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6. Two points P and Q are maintained at the potentials of 10V and $-4V$ respectively. The work done in moving 100 electrons forom P to Q is

A. $9.60 \times 10^{-17} j$

B. $-2.24 \times 10^{-16} j$

C. $2.24 \times 10^{-16} j$

D. $-9.60 \times 10^{-17} j$

Answer: C

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7. A charge Q is placed at each of the opposite corners of a square. A charge q is placed at each of the other two corners. If the net electrical force on Q is zero, then the Q/q equals

A. -1

B. 1

C. $-\frac{1}{\sqrt{2}}$

D. $-2\sqrt{2}$

Answer: D

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8. At y = 1 cm, y = 3 cm y = 9 cm, y = 27 cm ... and so on , an infinite number of charges equal to 5C are placed. At x = 1 cm, x = 2 cm, x = 4 cm, x = 8 cm .... And so on, an infinite number of charges equal to - 5C are placed. Find the electirc potential at origin is volts . $\left(K = \frac{1}{4\pi\varepsilon_0}\right)$

A. 250 K

B. $-250K$

C. zero

D. 100 K

Answer: B

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9. In the hexaploid wheat, the haploid (n) and basic (x) numbers of chromosomes are

A. $+100, \ -200$

B. $-100, 100$

C. 200, 100

D. $-200, \ -100$

Answer: B

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10. A charge .q. is distrubuted over two concertric hollow conducting sphere of radii r and R $(<r)$ such that their surface charge densite are equal. The potential at their common centre is

A. A) Zero

B. B) $\frac{q}{4\pi\varepsilon_0}\frac{(r+R)}{(r^2+R^2)^2}$

C. C) $\frac{q}{4\pi \in_0}\left[\frac{1}{r}+\frac{1}{R}\right]$

D. D) $\frac{q}{4\pi \in_0}\left[\frac{r+R}{(r^2+R^2)}\right]$

Answer: D

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11. Two concentric, thin metallic spheres of radii R_1 and $R_2 (R_1 > R_2)$ charges Q_1 and Q_2 respectively Then the potential at radius r between R_1 and R_2 will be $(k = 1/4\pi \in)$

A. A) $k\left(\frac{Q_1 + Q_2}{r}\right)$

B. B) $K\left(\frac{Q_1}{r} + \frac{Q_2}{R_2}\right)$

C. $k\left(\frac{Q_2}{r} + \frac{Q_1}{R_1}\right)$

D. D) $k\left(\frac{Q_1}{R_1} + \frac{Q_2}{R_2}\right)$

Answer: C

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12. A point charge Q is placed inside a conducting spherical shell of inner radius 3R and outer radius 5R at a distance R from the centre of the shell. The electric potential at the centre of the shell will be

A. A) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{Q}{R}$

B. B) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{5Q}{6R}$

C. C) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{13Q}{15Q}$

D. D) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{7Q}{9Q}$

Answer: C

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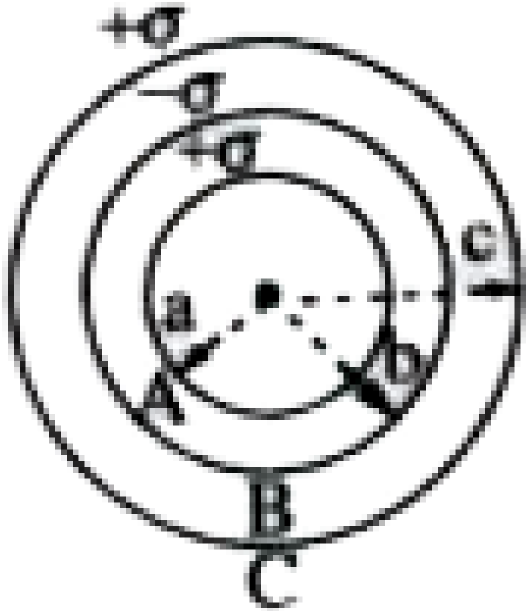
13. Three concentric spherical metal shells A.B.C of radii a,b,c$(c > b > a)$ have surface charge density $+\sigma, -\sigma$ and $+\sigma$ respectively. The potential of the middle shell is $\frac{\sigma}{\varepsilon_0}$ times



A. $\left(\frac{a^2}{b} - b + c\right)$

B. (a-b+c)

C. $\left(\frac{a^2 - b^2}{b} + (c)\right)$

D. $\left(a - b + \frac{c^2}{b}\right)$

Answer: A

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14. A body of mass 1 g and carrying a change $10^{-8}C$ passes from two points P and Q . P and Q are at electric potentials 600 V and 0 V respectively . The velocity of the body at Q is $20cms^{-1}$ its velocity in ms^{-1} at P is

A. $\sqrt{0.028}$

B. $\sqrt{0.056}$

C. $\sqrt{0.56}$

D. $\sqrt{5.6}$

Answer: A

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15. Two identical charges are placed at the two corner an equilateral triangle. The potential energy of the system is U. The work done in bringing an identical charge from infinty to the thrid vertex is xU. Find value of x

A. V

B. 2V

C. 3V

D. 4V

Answer: B

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16. Two equal point charges are fixed at x = -a and x = +a on the x-axis. Another point charge Q is placed at the origin. The change in the electrical potential energy of Q, when it is displaced by a small distance x along the x-axis, is approximately proportional to

A. x

B. x^2

C. x^3

D. 1/x

Answer: B

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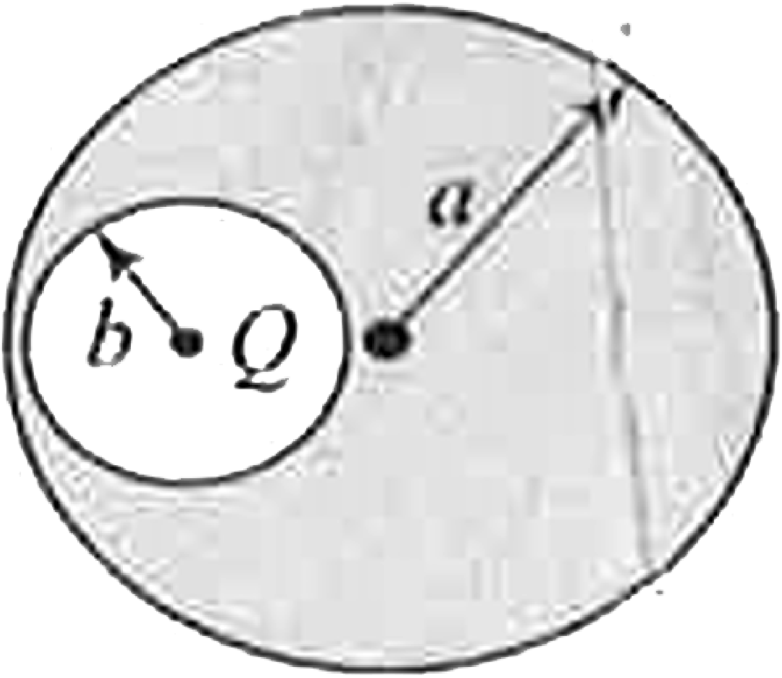
17. A point charge $'Q'$ is placed at the centre of a spherical cavity of radius 'b' curve inside a soild conducting sphere of radius 'a'. Then total energy of the system is : $\left[k = \frac{1}{4\pi\varepsilon_0}\right]$



A. $\frac{KQ^2}{2}\left[\frac{1}{a} - \frac{1}{b}\right]$

B. $\frac{KQ^2}{2}\left[\frac{1}{a}+\frac{1}{b}\right]$

C. $KQ^2\left[\frac{1}{a}+\frac{1}{b}\right]$

D. $2KQ^2\left[\frac{1}{a}+\frac{1}{b}\right]$

Answer: A

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18. An electric kettle has two coils. When one of these is switched on, thje water in the kettle boils in 6 minutes. When the other coil is switched on, the water boils in 3 minutes. If the two coils are connected in series, the time taken to boil the water in the kettle is

A. Zero

B. $\frac{1}{4\pi \in_0}.\frac{Q^2}{2a}$

C. $\frac{1}{4\pi \in_0}.\frac{Q^2}{4a}$

D. $\frac{1}{4\pi \in_0}.\frac{Q^2}{a}$

Answer: C

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19. Electric potential inside hollow charged sphere of radius .r. is ______ $\left[k = \frac{1}{4\pi\varepsilon_0}\right]$

A. zero

B. $k\frac{q}{r}$

C. $k\frac{q}{r^2}$

D. $k\frac{q^2}{r}$

Answer: B

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20. Electric potentiall at centre of non conducting sphere of radii .r. is ____ $\left[\text{q is charge in it} k = \frac{1}{4\pi\varepsilon_0}\right]$

A. A) $\frac{3}{2}\frac{kq}{r}$

B. B) $\frac{2}{3}\frac{kq}{r}$

C. C) $\frac{3kq}{r}$

D. D) $\frac{kq}{r}$

Answer: A

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21. A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10 V. The potential at the centre of the sphere is

A. $\frac{11}{13}V$

B. $\frac{14}{11}V$

C. 3/2V`

D. $\frac{23}{16}V$

Answer: D

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22. (A): potential near infinite sheet is not defined

(B): potential near finite charged sheet is not defined.

A. A & B are false

B. A & B are true

C. A true, B false

D. A false, B true

Answer: B

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23. (A): potential near infinite sheet is not defined

(B): potential near finite charged sheet is not defined.

A. A & B are true

B. A true, B false

C. A & true, B false

D. A false, B true

Answer: B

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24. A ring of radius 3 m has charge density λ. Electric potential at 4 m from its centre on its axis is ____ $\left[k = \frac{1}{4\pi\varepsilon_0}\right]$

A. $\frac{2}{5}\pi k\lambda$

B. $\frac{1}{5}\pi k\lambda$

C. $\frac{6}{5}\pi k\lambda$

D. $\frac{3}{5}\pi k\lambda$

Answer: C

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25. A metal sphere A of radius a is charged to potential V. What will be its potential if it is enclosed By a spherical conducting shell B of radius b and the two are connected by a wire ?

A. $\frac{a^2}{b}(V)$

B. $\frac{b}{a}(V)$

C. $\frac{a}{b}(V)$

D. $\frac{ab}{V}$

Answer: C

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26. Potential difference beween centre and surface of the sphere of radius R and uniorm volume charge density ρ within it will be

A. $\frac{\rho R^2}{6 \in_0}$

B. $\frac{\rho R^2}{4 \in_0}$

C. 0

D. $\frac{\rho R^2}{2 \in_0}$

Answer: A

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27. The electric potential in a region is represented as

$V = 2x + 3y - z$

obtain expression for electric field strength.

A. $\overrightarrow{E} = 2\hat{i} + 3\hat{j} - \hat{k}$

B. $\overrightarrow{E} = -2\hat{i} - 3\hat{j} + \hat{k}$

C. $\overrightarrow{E} = 2\hat{i} - \hat{j} + 3\hat{k}$

D. $\overrightarrow{E} = \hat{i} + 2\hat{i} - 3\hat{k}$

Answer: B

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28. The electric field in a region is given by

$E = (4axy\sqrt{z})\hat{i} + (2ax^2\sqrt{z})\hat{j} + (ax^2y/\sqrt{z})\hat{k}$

where A is a positive constant. The equation of an equipotential surface will be of the form.

A. z = constant / $[x^2y^2]$

B. z = constant / $[xy^2]$

C. z = constant / $[(x^2y^2]$

D. None

Answer: C

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PRACTICE SHEET (EXERCISE -IV ELECTRIC POTENTIAL & POTENTIAL ENERGY) (LEVEL - II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTION)

1. A conducting sphere of radius b has a spherical cavity with its centre displaced by 'a' from centre of sphere O_1. A point charged q is placed at the centre of cavity O_2. Q charge is given to conducting sphere and charge q_0 is placed at P, a distance c from centre O_1. Further O_1, O_2 and P are collinear

A. charge distribution on inner surface of cavity is uniform

B. potential of conductor is $\left(\frac{q_0}{4\pi\varepsilon_0 c}+\frac{Q+q}{4\pi\varepsilon_0 b}\right)$

C. charge distribution of outer surface of conducting spher is non uniform

D. Intensity of electric field at O_1 is $\frac{1}{4\pi\varepsilon_0 c^2}$

Answer: A::B::C

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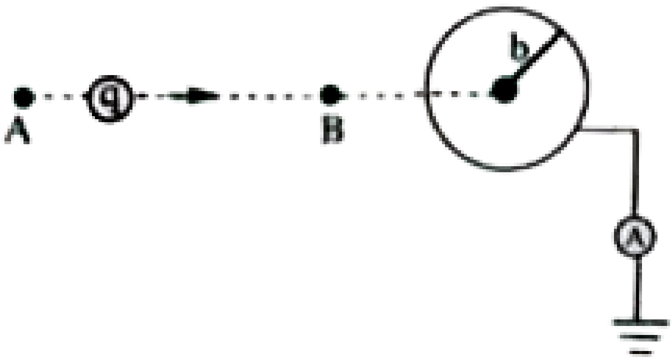
PRACTICE SHEET (EXERCISE -IV ELECTRIC POTENTIAL & POTENTIAL ENERGY) (LEVEL - II (ADVANCED) LINKED COMPREHENSION TYPE QUESTION)

1. If a charge is moving towards the centre of an earthed conducting sphere of radius b with uniform velocity v. Distance of two points A and B from centre of sphere are 3a & 2a. Conducting sphere is earthed with an ammeter and resistance in series (as shown)



Net charge on surface of conductor at this instant

A. $+q$

B. $-q$

C. $-q\frac{x}{b}$

D. $-q\frac{b}{x}$

Answer: D

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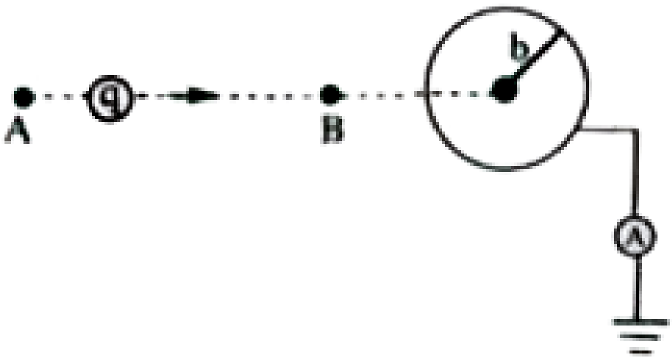
2. If a charge is moving towards the centre of an earthed conducting sphere of radius b with uniform velocity v. Distance of two points A and B from centre of sphere are 3a & 2a. Conducting sphere is earthed with an ammeter and resistance in series (as shown)



Net charge on surface of conductor at this instant

A. $q\frac{xV}{b^2}$

B. $q\frac{V}{b}$

C. $\frac{qbV}{x^2}$

D. zero

Answer: C

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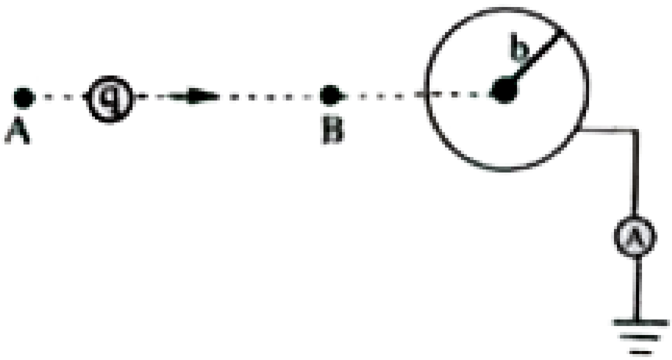
PRACTICE SHEET (EXERCISE -IV ELECTRIC POTENTIAL & POTENTIAL ENERGY) (LEVEL - II (ADVANCED) MATRIX MATCHING TYPE QUESTIONS)

1. If a charge is moving towards the centre of an earthed conducting sphere of radius b with uniform velocity v. Distance of two points A and B from centre of sphere are 3a & 2a. Conducting sphere is earthed with an ammeter and resistance in series (as shown)



Net charge on surface of conductor at this instant

A. Zero at any instant

B. Increasing

C. Decreasing

D. Infinite

Answer: A

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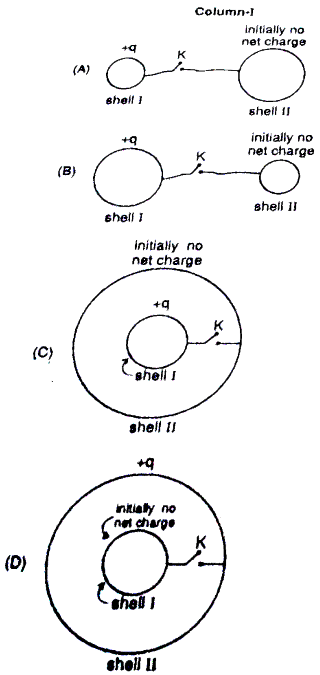
2. Column I gives certain situations involving two thin conducting shells connected by a conducting wire via a key K. In all situations, one sphere has net charge +q and other sphere has not net charge. After the key K is pressed, column II gives some resulting effects. Match the figures in

Column I with the statement in Column II.



Column-II

(p) Charge flows through connecting wire

(q) Potential energy of system of spheres decreases.

(r) No heat is produced.

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

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PRACTICE SHEET (EXERCISE -IV ELECTRIC POTENTIAL & POTENTIAL ENERGY) (LEVEL - II (ADVANCED) INTEGER TYPE QUESTIONS)

1. A given length of a wire is doubled on itself and this process is repeated once again. By what factor does the resistance of the wire change?

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2. A uniform wire of resistance r is cut into n parts and they are connected in parallel. Effective resistance of the combination is

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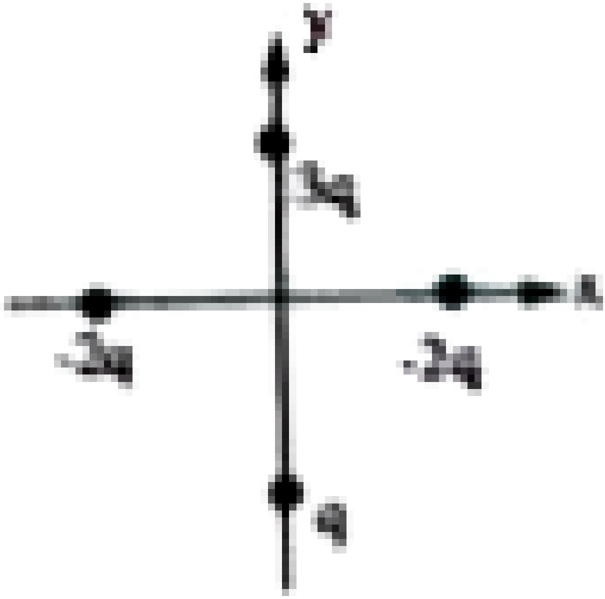
PRACTICE SHEET (EXERCISE -V ELECTRIC DIPOLE) (LEVEL - I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. 4 charges are placed each at a distance .a. from origin. The distance .a. from origin. The dipole moment of configuration is :



A. $2qa\hat{j}$

B. $3qa\hat{j}$

C. $2qa\left(\hat{i}+\hat{j}\right)$

D. $qa\hat{j}$

Answer: A

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2. A tiny electric dipole of dipole moment $\overrightarrow{P} = P_0 \hat{j}$ is placed at point (l,0). There exists an electric field $\overrightarrow{E} = 2ax^2 \hat{i} + (2by^2 + 2cy) \hat{j}$.

A. force on dipole is $2\rho_c \hat{j}$

B. force on dipole is $p(2c + 4bl) \hat{j}$

C. Torque on dipole about its centroidal axis is $2\rho_0 a \hat{k}$

D. Torque on dipole about its centroidal axis is zero

Answer: A

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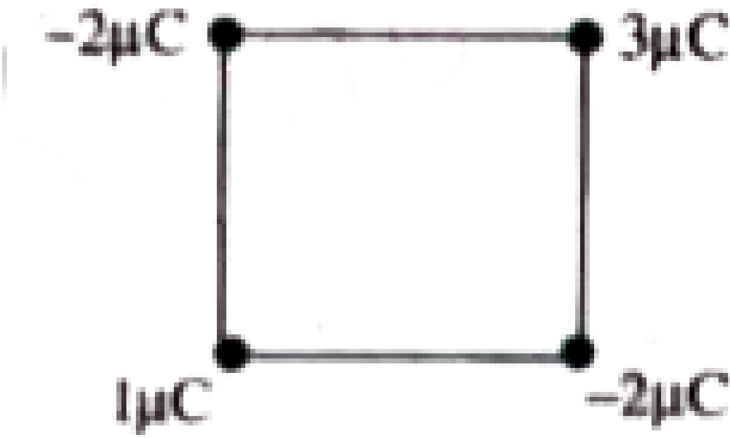
3. Four point charges $1\mu C, 3\mu C, -2\mu C$ and $-2\mu C$ are arranged on the four vertices of a square of side 1 cm. The dipole moment of this charge assembly is



A. zero

B. $\sqrt{2} \times 10^{-8} C.m$

C. $2\sqrt{2} \times 10^{-8} C.m$

D. $2 \times 10^{-8} C.m$

Answer: B

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4. Two short dipole $p\hat{k}$ and $\frac{p}{2}\hat{k}$ are located at $(0, 0, 0)$ and $(1m, 0, 2m)$ respectively. The resultant electric field due to the two dipoles at the point $(1m, 0, 0)$ is

A. $\frac{9p}{32\pi\varepsilon_0}\hat{k}$

B. $\frac{-7p}{32\pi\varepsilon_0}\hat{k}$

C. $\frac{7p}{32\pi\varepsilon_0}\hat{k}$

D. none of these

Answer: B

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PRACTICE SHEET (EXERCISE -V ELECTRIC DIPOLE) (LEVEL -II STRAIGHT OBJECTIVE TYPE QUESTION)

1. A current carrying conductor is in the form of a sine curve as shown, which carries current I. If the equation of this curve is $Y = 2\sin\left(\frac{\pi x}{L}\right)$

and a uniform magnetic field B exists in space.

A. $x^2 + y^2 + x^2 = \left(\frac{kp}{E}\right)^{2/3}$

B. $x^2 + y^2 = \left(\frac{kp}{E}\right)^{2/3}$

C. $x^2 + y^2 + z^2 = \left(\frac{kp}{E}\right)^{1/3}$

D. none

Answer: A

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2. A point electric dipole of moment $\overrightarrow{p}_1 = \left(\sqrt{3}\hat{i} + \hat{j}\right)$ is held fixed at the origin. Another point electric dipole of moment $\overrightarrow{p}_2$ held at the point A (+a, 0, 0) will have minimum potential energy, if its orientation is given by the vector

A. $\sqrt{3}\hat{i} + \hat{j}$

B. $\hat{i} - \sqrt{3}\hat{j}$

C. $2\sqrt{3}\hat{i} - \hat{j}$

D. $\hat{i} - 2\sqrt{3}\hat{j}$

Answer: C

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3. A dipole of dipole moment P is kept at the centre of a ring of radius R and charge Q. If the dipole lies along the axis of the ring. Electric force on the ring due to the dipole is : $\left(K = \frac{1}{4\pi\varepsilon_0}\right)$

A. zero

B. $\frac{KPQ}{R^3}$

C. $\frac{2KPQ}{R^3}$

D. depends on the distribution of Q on the ring

Answer: B

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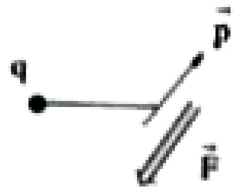
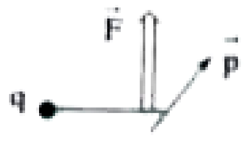
4. An electric dipole $\overrightarrow{P}$ and a point charge q (>0) are located at a separation r as shown. Force on the dipole $(\overrightarrow{F})$ due to the point charge on the qualitatively dinoted as :

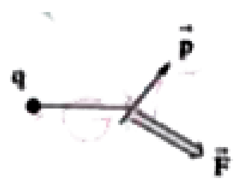
A.

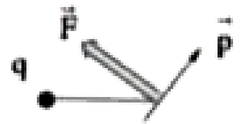


B.



C.



D. 

Answer: D

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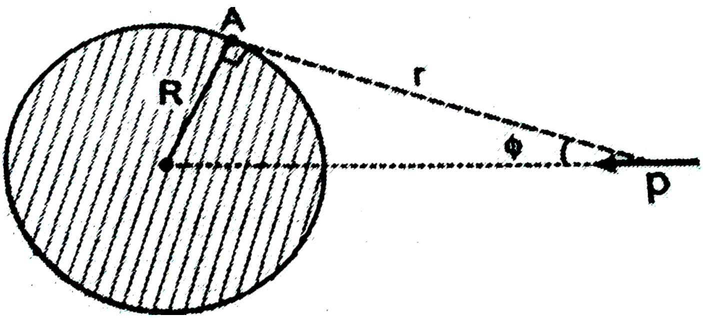
5. A dipole having dipole moment p is placed in front of a solid uncharged conducting sphere as shown in the diagram. The net potential at point A lying on the surface of the sphere is :



A. $\dfrac{kp\cos\phi}{r^2}$

B. $\dfrac{kp\cos^2\phi}{r^2}$

C. $\dfrac{2kp\cos^2\phi}{r^2}$

D. $\frac{kp}{r^2}$

Answer: B

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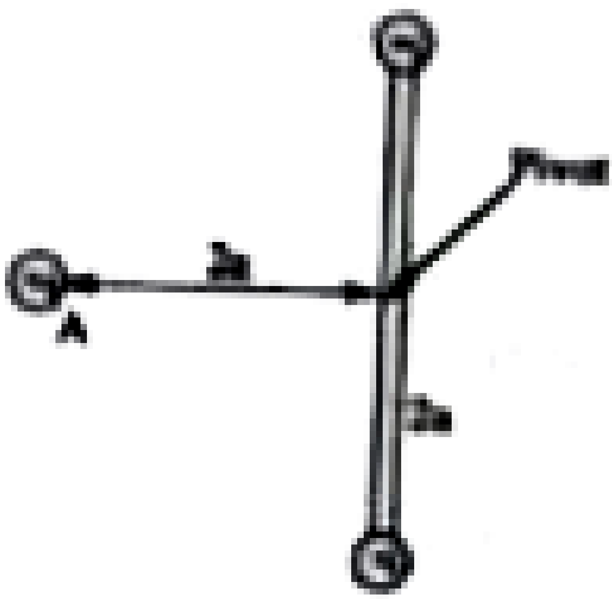
6. Fig. shows a ball having a charge q fixed at a point A. Two identical balls of mass m having charge $+q$ and $-q$ are attaached to the end of a light rod of length 2a. The system is released from the situation shown in fig. Find the angular velocity of the rod when the rod turns through 90°



A. $\frac{\sqrt{2}q}{3\pi\varepsilon_0 ma^3}$

B. $\frac{q}{\sqrt{3\pi\varepsilon_0 ma^3}}$

C. $\frac{q}{\sqrt{6\pi\varepsilon_0 ma^3}}$

D. $\frac{\sqrt{2}q}{\sqrt{4\pi\varepsilon_0 ma^3}}$

Answer: C

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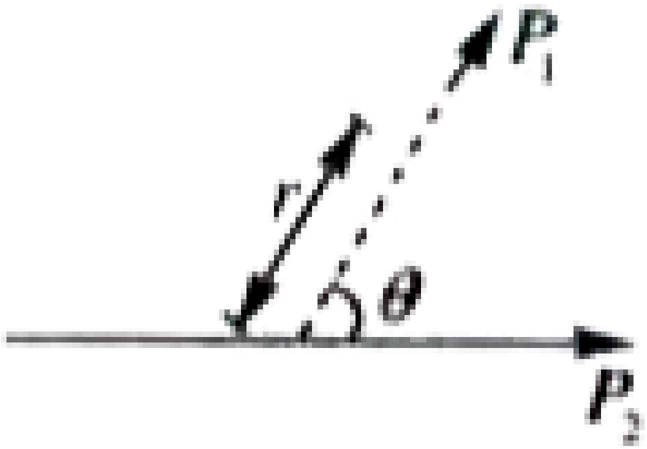
7. Two short electric dipoles are placed as shown. The energy of electric interaction these dipoles will be



A. A) $\dfrac{2kp_1p_2\cos\theta}{r^3}$

B. B) $\dfrac{-2kp_1p_2\cos\theta}{r^3}$

C. C) $\dfrac{2kp_1p_2\sin\theta}{r^3}$

D. D) $\dfrac{-4kp_1p_2\cos\theta}{r^3}$

Answer: B

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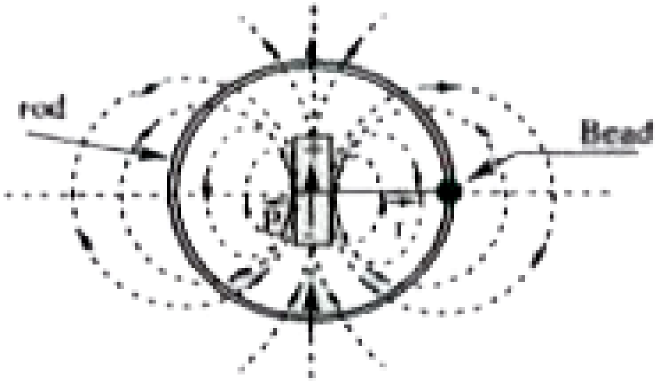
PRACTICE SHEET (EXERCISE -V ELECTRIC DIPOLE) (LEVEL -II LINKED COMPREHENSION TYPE QUESTION)

1. A small, electrically charged bead can slide on a circular, frictioless, insulating rod. A point - like electric dipole $\left(\overrightarrow{P}\right)$ is fixed at the centre of the circle with the dipole.s axis lying in the plane of the circle. Intially the bead is on the plane of symmetry of the dipole, as shown in the figure. The bead is slightly displaced along ring, tangentially with intial speed very close to zero. (Ignore the effect of gravity, assuming that the electric forces are much greater than the gravitational ones).



The normal force exerted by rod on the bead is (q = angle between an radius vector of bead, (considering dipole as origin)

A. $\frac{2K\left|\vec{p}\right|\theta.\cos\theta}{r^3}$

B. $\frac{K\left|\vec{p}\right|\theta.\cos\theta}{r^3}$

C. zero

D. $\frac{K\left|\vec{p}\right|\theta.\sin\theta}{r^3}$

Answer: C

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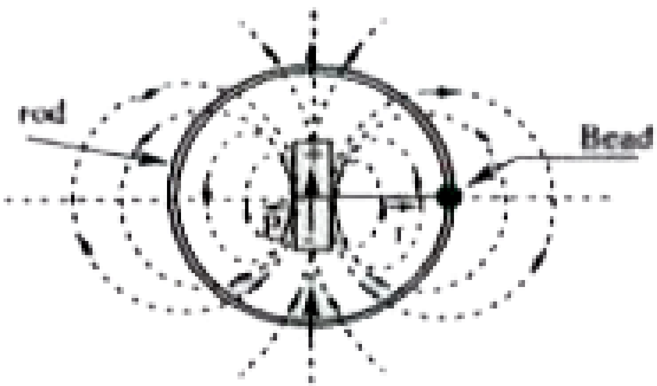
2. A small, electrically charged bead can slide on a circular, frictioless, insulating rod. A point - like electric dipole $\left(\overrightarrow{P}\right)$ is fixed at the centre of the circle with the dipole.s axis lying in the plane of the circle. Intially the bead is on the plane of symmetry of the dipole, as shown in the figure. The bead is slightly displaced along ring, tangentially with intial speed very close to zero. (Ignore the effect of gravity, assuming that the electric forces are much greater than the gravitational ones).



The normal force exerted by rod on the bead is (q = angle between an radius vector of bead, (considering dipole as origin)

A. On circular path, as it was moving with the frictionless, circular, insulating rod

B. radially towards dipole

C. tangential intially, but afterward it can not be predicted

D.

Answer: A

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PRACTICE SHEET (EXERCISE -V ELECTRIC DIPOLE) (LEVEL -II INTEGER TYPE QUESTION)

1. Two point charges of $5\mu C$ and $20\mu C$ are separated by a distance of 2m. Find the point on the line joining them at which electric field intensity is zero.

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2. Two small electric dipoles each of dipole moment $p\hat{i}$ are situated at $(0, 0, 0)$ and $(r, 0, 0)$. The electric potential at a point $\left(\frac{r}{2}, \frac{\sqrt{3}r}{2}, 0\right)$ is:

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ADDITIONAL PRACTICE EXERCISE (LEVEL - I (MAIN) (STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. Two charges $-q$ each are separated by distance $2d$. A third charge $+q$ is kept at mid-point O. Find potential energy of $+q$ as a function of small distance x from O due to $-q$ charges. Prove that the charge at O is in an unstable equilibrium.

A. $\frac{1}{4\pi\varepsilon_0}Q_1Q_2Q_3$

B. $\frac{Q_1Q_2}{\pi\varepsilon_0}$

C. $\frac{Q_2Q_3}{\pi\varepsilon_0}$

D. $\frac{4Q_1Q_2}{\pi\varepsilon_0}$

Answer: C

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2. A positive charge .Q. is fixed at a point, A negatively charged of mass .m. and charge .q. is revolving in a circular path of radius radius r_1 with .Q. as the centre. The change in potential energy to change the radius of the circular path from r_1 and r_2 in joule is

A. zero

B. $\frac{1}{4\pi \in o} Qq\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$

C. $\frac{1}{\pi \in o} Qq\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$

D. $\frac{Qq}{4\pi \in o}\left[\frac{1}{r_2} - \frac{1}{r_1}\right]$

Answer: B

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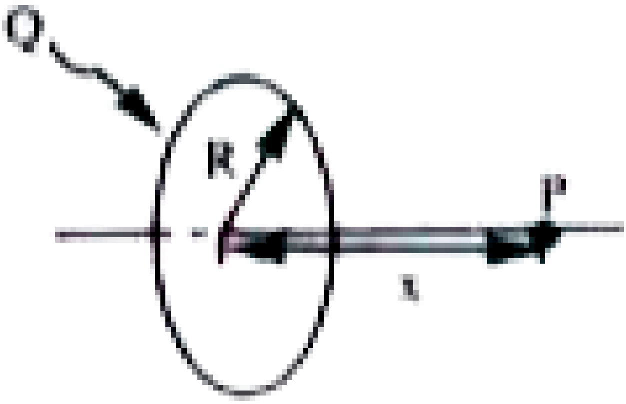
3. A non conducting ring of radius R has uniformly distributed positive chargeq. A small particle of mass m and charge $-q$ is placed on the axis of the ring at point P and released If $R >\ > x$. The particle will undergo oscillations along the axis of symmerty with an angular frequency that is equal to



A. $\sqrt{\frac{qQ}{4\pi\varepsilon_0 mR^3}}$

B. $\sqrt{\frac{qQx}{4\pi\varepsilon_0 mR^4}}$

C. $\frac{qQ}{4\pi\varepsilon_0 mR^3}$

D. $\frac{qQx}{4\pi\varepsilon_0 mR^4}$

Answer: A

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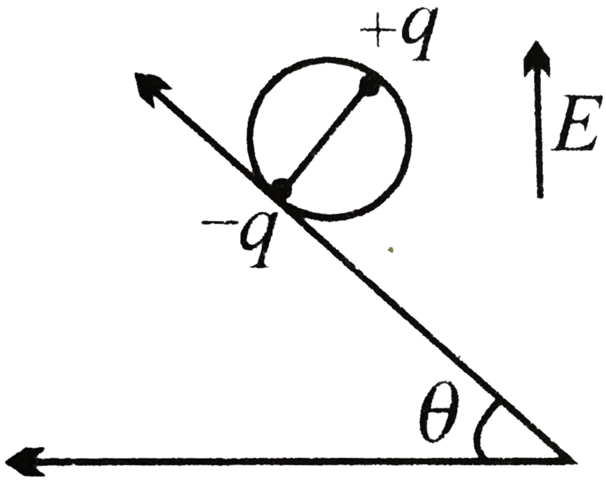
4. A wheel having mass μ has charges $+q$ and $-q$ on diametrically opposite points. It remains in equilibrium on a rough inclined plane in the presence of uniform vertical electric field E =



A. $\dfrac{mg}{q}$

B. $\dfrac{mg}{2q}$

C. $\dfrac{mg\tan\theta}{2q}$

D. none

Answer: B

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5. A particle of charge $1\mu C\&$ mass $1g$ moving with a velocity of $4m/s$ is subjected to a uniform electric field of magnitude $300Vm$ for $10\sec$. Then it's final speed cannot be :

A. 0.5 m/s

B. 4 m/s

C. 3 m/s

D. 6 m/s

Answer: A

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6. A planet of small mass m moves around the sun of mass M, along an elliptical orbit such that its minimum and maximum distance from sun are r and R, respectively. Its period of revolution will be:

A. $T=2\pi r(m/2k\lambda q)^{1/2}$

B. $T^2=4\pi^2 mr^3/2qk\lambda$

C. $T=1/2\pi r(2k\lambda q/m)^{1/2}$

D. $T=1/2\pi r(m/k\pi\lambda q)^{1/2}\text{where}\quad K=\dfrac{1}{4\pi\varepsilon_0}$

Answer: A

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7. Two identical balls each having a density ρ are suspended from a common point by two insulating string of equal length. Both the balls have equal mass and charge. In equilibrium each string makes an angle θ with vertical. Now, both the balls are immersed in a liquid. As a result the angle θ does not change. The density of the liquid is σ. find the dielectric constant of the liquid.

A. $\dfrac{\rho}{\rho-\sigma}$

B. $\dfrac{\sigma}{\rho-\rho}$

C. $\frac{\rho - \sigma}{\rho}$

D. $\frac{\rho - \sigma}{\sigma}$

Answer: A

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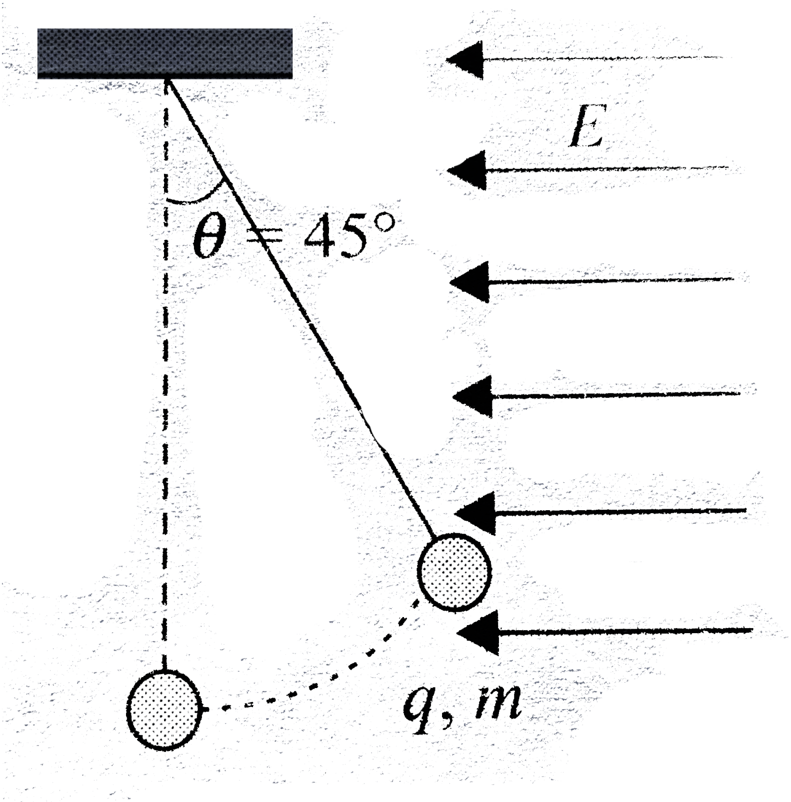
8. A horizontal electric field (E = (mg /q) exist in space, as shown in (Fig. 3.24.) A particle of mass m, having charge q, is attached at the end of a light insulated rod. If the particle is released from the position shown in the figure. Find the angular velocity of the rod when it passes through the bottom most position.



A. $\sqrt{\frac{g}{l}}$

B. $\sqrt{\frac{2g}{l}}$

C. $\sqrt{\frac{3g}{l}}$

D. $\sqrt{\frac{5g}{l}}$

Answer: B

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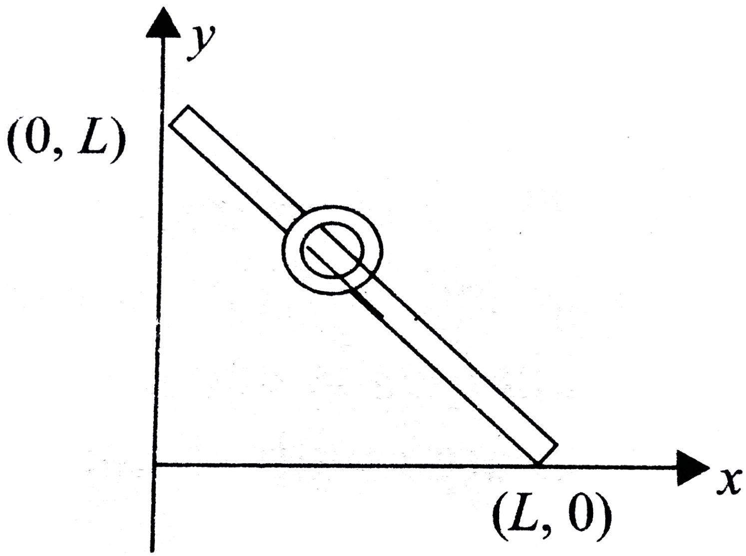
9. Electric field given by the vector $\overrightarrow{E} = x\hat{i} + y\hat{j}$ is present in the x y plane. A small ring carrying $+Q$, which can freely slide on a smooth nonconducting rod, is projected along the rod from the point $(0, L)$ such that it can reach the other end of the rod. What minimum velocity should be given to the ring ? (Assume zero gravity).



A. $(QL^2/m)^{1/2}$

B. $2(QL^2/m)^{1/2}$

C. $4\left(QL^2 / m\right)^{1/2}$

D. $\left(\frac{2QL^2}{m}\right)^{1/2}$

Answer: D

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10. A unit positive point charge of mass m is projected with a velocity V inside the tunnel as shown. The tunnel has been made inside a uniformly charged nonconducting sphere. The minimum velocity with which the point charge should be projected such that it can reach the opposite end of the tunnel is equal to

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A. $\left[\rho R^2 / 4m\varepsilon_0\right]^{1/2}$

B. $\left[\rho R^2 / 24m\varepsilon_0\right]^{1/2}$

C. $\left[\rho R^2 / 6m\varepsilon_0\right]^{1/2}$

D. zero because the intial and the final points are at same potential

Answer: A

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11. A plane π passes through the point (1,1,1) and is parallel to the vectors $\overrightarrow{b} = (1, 0 - 1)$ and $\overrightarrow{c} = (- 1, 1, 0)$. If π meets the axes in A,B, and C, find the volume of the tetrahedron OABC.

A. only [i] is correct

B. only [ii] is correct

C. both [i] and [ii] are correct

D. both [i] and [ii] are wrong

Answer: C

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12. A particle of mass m and charge Q is placed in an electric filed W which varies with time t as E = $E_0 \sin \omega t$. It will undergo simple harmonic motion of amplitude.

A. $\frac{QE_0^2}{m\omega^2}$

B. $\frac{QE_0}{m\omega^2}$

C. $\sqrt{\frac{QE_0}{m\omega^2}}$

D. $\frac{QE_0}{m\omega}$

Answer: B

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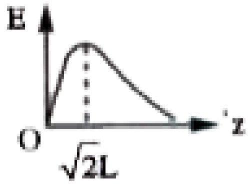
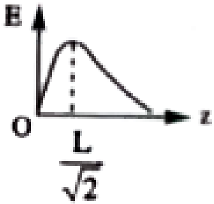
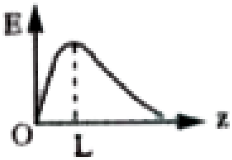
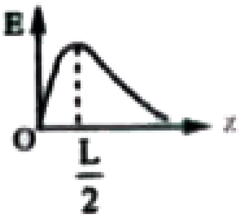
13. Four equal positive charge are fixed at the vertical of a square of side L. Z-axis is perpendicular to plane of the square. The point $Z = 0$ is the point where the diagonals of the square intersect each other. The plot of electic field due to the charges, as one moves on the Z-axis is

A. 

B. 

C. 

D. 

Answer: D

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14. Each of the two long parallel threads carries a uniform λ per unit length. The threads are separated by a distance l. Find the maximum magnitude of the electric field strenght in the symmetry plane of this system located between the threads.

A. $E_{\max} = \lambda / 2\pi\varepsilon_0 l$

B. $E_{\max} = \lambda / 3\pi\varepsilon_0 l$

C. $E_{\max} = \lambda / \pi\varepsilon_0$

D. $E_{\max} = \lambda / \pi\varepsilon_0 l$

Answer: D

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15. Mid way between two fixed equal and similar charges, we placed a third equal and similar charge. Which of the following statements is correct, concerned to the equilibrium along the line joining the charges ?

A. The third charge experienced a net force inclined to the line joining the charges

B. The third charge is in stable equilibrium

C. The third charge is in unstable equilibrium

D. The third charge experiences a net force perpendicular to the line joining the charges

Answer: B

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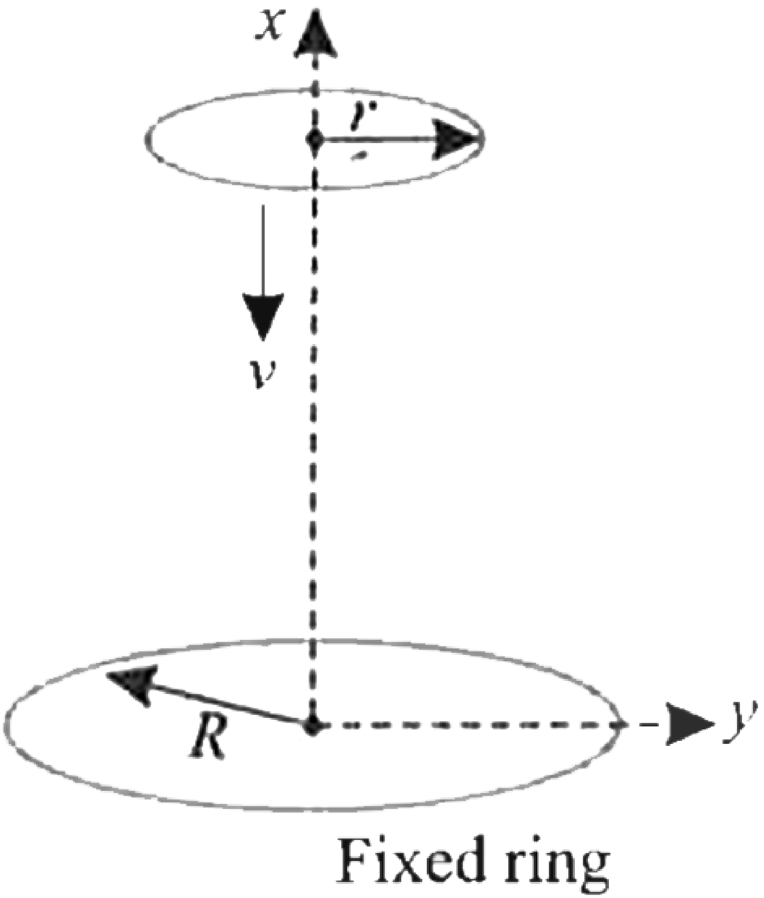
16. A ring of radius R is placed in the plane its centre at origin and its axis along the x-asis and having uniformly distributed positive charge. A ring of radius $r(< < R)$ and coaxial with the larger ring is moving along the axis with constant velcity , then the variation of electrical flux (ϕ) passing through the smaller ring with position will be best represent by :



A. $\frac{\rho R}{6\varepsilon_0}+E$

B. $\frac{\rho R}{12\varepsilon_0}-E$

C. $\frac{-\rho R}{6\varepsilon_0}+E$

D. $\frac{\rho R}{24\varepsilon_0}+E$

Answer: B

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17. Select the correct statement : (Only force on a particle is due to electric field)

A. A charged particle moves along the electric line of force.

B. A charged particle may move along the line of force

C. A charged particle never moves along the line of force

D. A charged particle moves along the line of force only if relased from rest.

Answer: B

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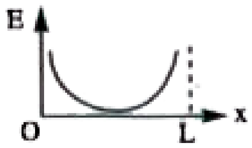
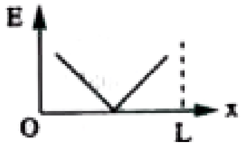
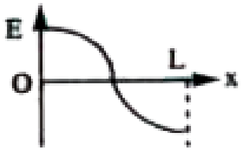
18. Two identical point charges are placed separation of l. P is a point on the line joining charges, at a distance x from any one charge field at P is E. E is plotted against x for value from closeo to zero to slightly less than l. Which following best represents the resulting curve ?



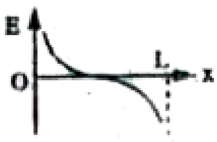
A.



B.



C.



D.

Answer: D

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19. If three uniform spheres, each having mass M and radius R, are kept in such a way that each touches the other two, the magnitude of the gravitational force on any sphere due to the other two is:

A. 0.25 KN

B. 0.5 KN

C. 1 KN

D. 2 KN

Answer: C

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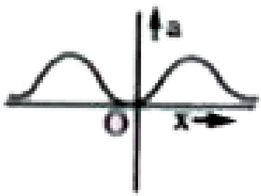
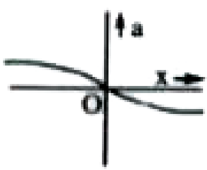
20. Two identical positive charges are fixed on the y-axis, at equal distances from the origin O. A particle with a negative charges starts on the x-axis at a large distance from O. moves along the x-axis passes through O, and moves far away from O on the other side. Its acceleration a is taken as positive along its direction of motion. Plot acceleration a of the particle against its x-coordinate.

A. 

B. 

C. 

D. 

Answer: B

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21. A very long straight uniformly charged thread carries a charge λ per unit length, Find the magnitude and direction of the electric field strenght at a point which is at a distance y from the thread and lies on the perpendicular passing through one of the thread.s ends.

A. $\dfrac{\lambda\sqrt{3}}{4\pi\varepsilon_0 y}, \theta = 40^0$

B. $\dfrac{\lambda\sqrt{5}}{4\pi\varepsilon_0 y}, \theta = 40^0$

C. $\dfrac{\lambda\sqrt{5}}{4\pi\varepsilon_0 y}, \theta = 40^0$

D. $\dfrac{\lambda\sqrt{2}}{4\pi\varepsilon_0 y}, \theta = 45^0$

Answer: D

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22. A system consits of a uniformly charged sphere of radius R and a surrounding medium filled by a charge with the volume density $\rho = \dfrac{\alpha}{r}$, where α is a positive constant and r is the distance from the centre of the sphere. Find the charge of the sphere for which the electric field intensity E outside the sphere is independent of R.

A. $q = \pi R^2 \alpha, E = \alpha / \varepsilon_0$

B. $q = 2\pi R^2 \alpha, E = \frac{1}{2} \alpha / \varepsilon_0$

C. $q = 2\pi R \alpha^2, E = \frac{1}{3} \alpha / \varepsilon_0$

D. $q = 3\pi R \alpha^2, E = \frac{1}{5} \alpha / \varepsilon_0$

Answer: B

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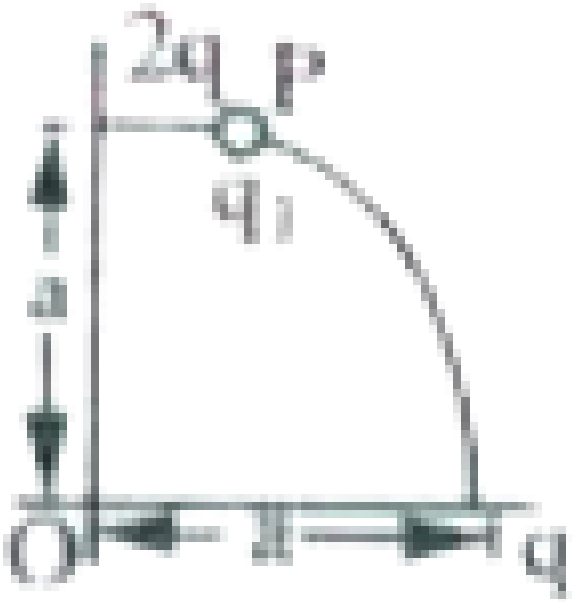
23. Two point charges q AND 2q are placed at (a,0) and (0,a) A point charge q^1 is placed at a P on the quarter circle of radius a as shown in the diagram so that the electric field at the origin becomes zero



A. the point P is $\left(\frac{a}{\sqrt{3}}, \frac{\sqrt{2}a}{\sqrt{3}}\right)$

B. the point P is $\left(\frac{a}{\sqrt{5}}, \frac{\sqrt{2}a}{\sqrt{5}}\right)$

C. $q_1 = -5q$

D. none of these

Answer: B

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24. A solid sphere of radius $2.45m$ is rotating with an angular speed of $10rad/s$. When this rotating sphere is placed on a rough horizontal surface then after sometime it starts pure rolling. Find the linear speed of the sphere after it starts pure rolling.

A. rolls towards left

B. under goes translational motion towards left

C. rotates about its centre

D. continues to remain at rest

Answer: B

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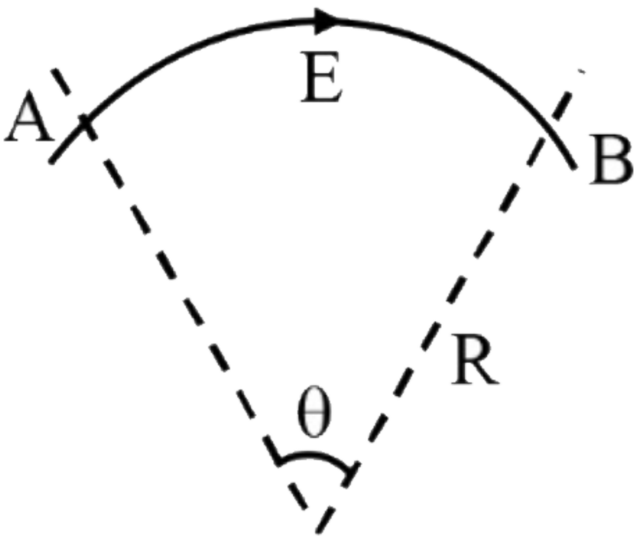
ADDITIONAL PRACTICE EXERCISE (LEVEL -II LECTURE SHEET (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. The figure shows an electric line of force which curves along a circular arc. The magnitude of electric field intensity is the same at all points on this curve and is equal to E. If the potential at Ais V, then the potential at B is



A. $V - ER\theta$

B. $V - E2R\sin = \frac{\theta}{2}$

C. $V + ER\theta$

D. $V + 2ER\frac{\sin(\theta)}{2}$

Answer: A

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2. Three concentric metallic spherical shell A,B and C or radii a,b and c $(a < b < c)$ have surface charge densities $-\sigma, +\sigma$ and $-\sigma$. Respectively. The potential of shel A is :

A. $(\sigma / \varepsilon_0)(a + b - c)$

B. $(\sigma / \varepsilon_0)(a - b + c)$

C. $(\sigma / \varepsilon_0)(a - b - c)$

D. none

Answer: C

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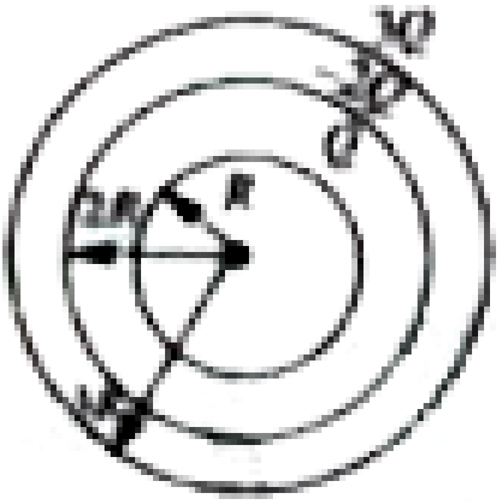
3. Three concentric conducting spherical shells of radii R,2R carry charges Q, -2Q and 3Q, respectively. Find the electric potential at r = R and at r = 3 R, where r is the radii distance from the centre.



A. $\dfrac{Q}{4\pi\varepsilon_0 R}, \dfrac{Q}{6\pi\varepsilon_0 R}$

B. $\dfrac{Q}{6\pi\varepsilon_0 R}, \dfrac{Q}{\pi\varepsilon_0 R}$

C. $\dfrac{Q}{\pi\varepsilon_0 R}, \dfrac{Q}{4\pi\varepsilon_0 R}$

D. $\dfrac{Q}{2\pi\varepsilon_0 R}, \dfrac{Q}{4\pi\varepsilon_0 R}$

Answer: A

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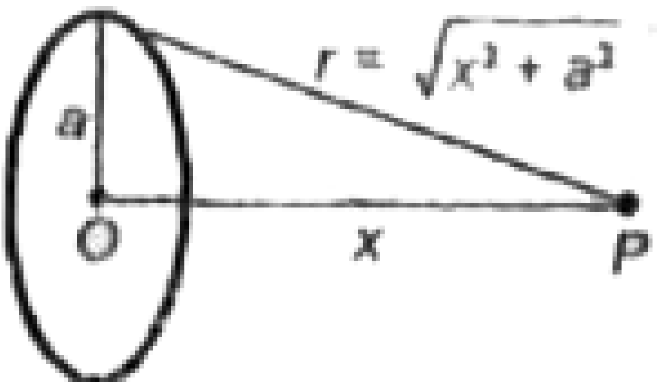
4. Electric charge Q is uniformly distributed around a thin ring of radius a. find the potential a point P on the axis of the ring at a distance x from the centre of the ring .



A. Potential at p is $\frac{KQ}{2R}$

B. Magnitude of electric field at P may be greater than $\frac{\sqrt{3}KQ}{8R^2}$

C. Magnitude of electric field at P must be equal to $\frac{\sqrt{3}KQ}{8R^2}$

D. Magnitude of electric field at P cannot be less than $\frac{\sqrt{3}KQ}{8R^2}$

Answer: C

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5. A, B, C, D, P and Q are points in a uniform electric field. The potentials at these points are $V(A) = 2V. V(P) = V(B) = B(D) = 5V. V(C) = 8V.$ The electric field at P is

A. $10Vm^{-1}$ along PQ

B. $15\sqrt{2}Vm^{-1}$ along PA

C. $5Vm^{-1}$ along PC

D. $5Vm^{-1}$ along PA

Answer: B

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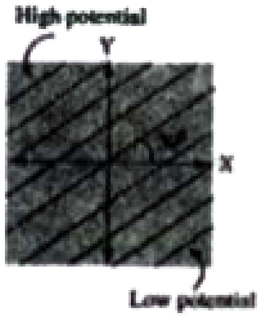
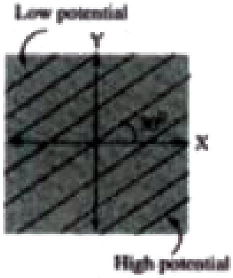
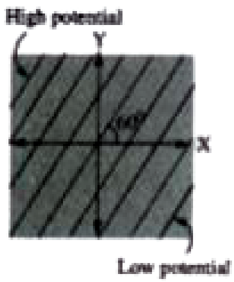
6. The electric field intensity at all points in space is given by $\overrightarrow{E} = \sqrt{3}\hat{i} - \hat{j}\ V/m$. The nature of equipotential lines is x-y plane is given by



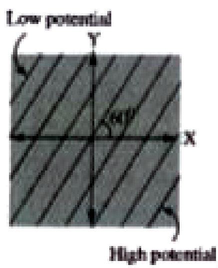
A.



B.



C.



D.

Answer: C

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7. Electric potential V in space as a function of cartesian co-ordinates is given by $V = \frac{1}{x} + \frac{1}{y} + \frac{1}{z}$. Then find electric field intensity at (1, 1, 1)

A. $\left(\hat{i} + \hat{j} + \hat{k}\right)$

B. $\hat{i} + \hat{J} + \widehat{K}$

C. zero

D. $\frac{1}{\sqrt{3}}\left(\hat{i} + \hat{j} + \hat{k}\right)$

Answer: B

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8. In a uniform electric field, the potential is $10V$ at the origin of coordinates and 8 V at each of the points $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$.

The potential at the point $(1, 1, 1)$ will be

A. 0

B. 4 V

C. 8 V

D. 10 V

Answer: B

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9. A circular ring of radius R with uniform positive charge density λ per unit length is located in the y z plane with its center at the origin O. A particle of mass m and positive charge q is projected from that point $p(-\sqrt{3}R, 0, 0)$ on the negative x - axis directly toward O, with initial speed V. Find the smallest (nonzero) value of the speed such that the particle does not return to P ?

A. The particle corses O and goes to infinity.

B. The particle returns to P.

C. The particle will just reach O.

D. The particle crosses O and goes to $-R\sqrt{3}$.

Answer: C

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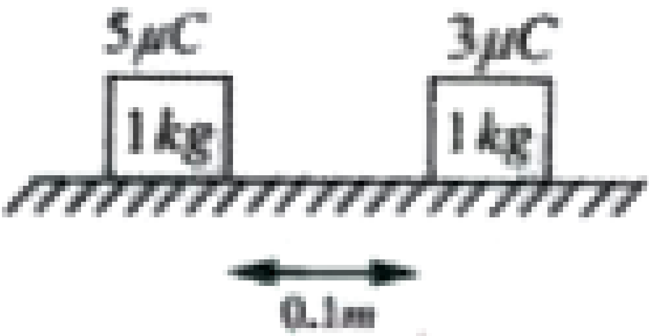
10. Two small charged blocks of charges $5\mu C$ and $3\mu C$ are kept on a rough surface $(\mu = 0.5)$ at a separation of 0.1 m Find the separation between the two blocks when they come to rest.



A. 0.36 m

B. 0.18 m

C. 0.27 m

D. 0.15 m

Answer: C

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11. A point charge .q. is placed at the centre of an uncharged conducting shell of inner radius R and outer radius 2R. If the point charge is removed from the centre of the shell, to infinity (without any electric contact with the shell). Work done by electric force is

A. $\frac{q^2}{16\pi \in_0 R}$

B. $\frac{-q^2}{8\pi \in_0 R}$

C. $\frac{3q^2}{8\pi \in_0 R}$

D. $\frac{-3q^2}{8\pi \in_0 R}$

Answer: B

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12. Two charged particles having charges $1 \text{ and } -1\mu C$ and of mass $50g$ each are held at rest while their separation is $2m$. Now the charges are released. Find the speed of the particles when their separation is $1m$.

A. $\frac{1}{5}m/s$

B. $\frac{3}{5}m/s$

C. $\frac{3}{10}m/s$

D. $\frac{2}{7}m/s$

Answer: C

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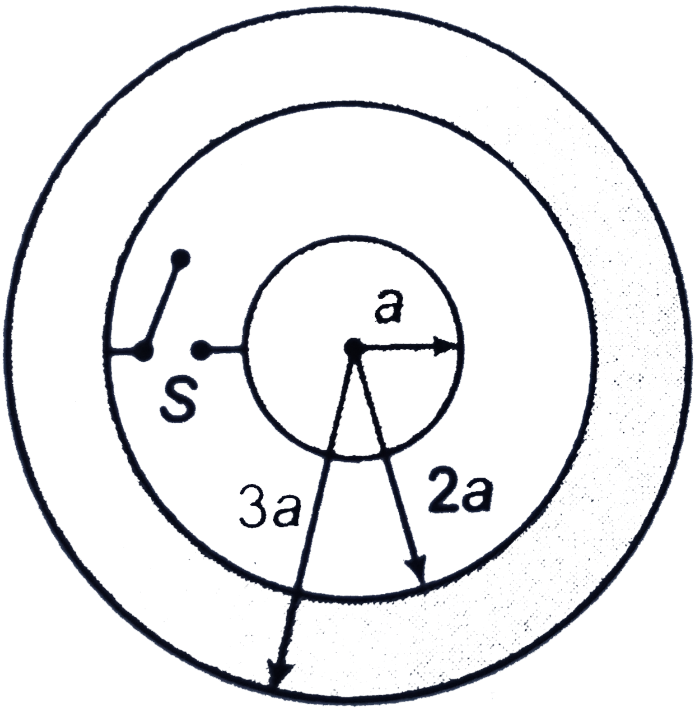
13. A solid conducting sphere of radius a having a charge q is surrounded by a concentric conducting spherical shell of inner radius $2a$ and outer radius $3a$ as shown in figure. Find the amount of heat porduced when

switch is closed $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$



A. $\frac{5}{12}\frac{KQ^2}{a}$

B. $\frac{11}{12}\frac{KQ^2}{a}$

C. $\frac{KQ^2}{2a}$

D. none

Answer: A

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14. A spherical shell of radius R_1 with a uniform charge q has a point charge q_0 at its center. Find the work performed by the electric forces during the shell expansion from radius R_1 to radius R_2.

A. $W = \frac{q(q_0 + q/2)}{2\pi\varepsilon_0}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

B. $W = \frac{q(q_0 + q/2)}{\pi\varepsilon_0}\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$

C. $W = \frac{q(q_0 + q/2)}{4\pi\varepsilon_0}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

D. $W = \frac{q(q_0 + q/2)}{4\pi\varepsilon_0}\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$

Answer: C

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15. Self energy of conducting sphere of radius .r. carrying charge .Q. is

______

A. $\frac{2}{5}\frac{kq^2}{r}$

B. $\frac{3}{5}\frac{kq^2}{r}$

C. $\frac{1}{5}\frac{q^2}{kr}$

D. None

Answer: B

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16. Self energy of conducting sphere of radius .r. carrying charge .Q. is

______

A. $\frac{Q^2}{8\pi\varepsilon_0 r}$

B. $\frac{Q^2}{4\pi\varepsilon_0 r}$

C. $\frac{Q^2}{6\pi\varepsilon_0 r}$

D. $\frac{Q^2}{2\pi\varepsilon_0 r}$

Answer: A

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17. A thin wire of linear charge density λ is bent in the form of a triangle ABC and an imaginary cube of side .a. is taken with vertex A at the centre of the top face and vertices B,C at the opposite edge centres of the bottom face. The total electric flux linked with the cube is

A. $\dfrac{\lambda a\left(\sqrt{3}+1\right)}{\in_0}$

B. $\dfrac{\lambda a\left(\sqrt{3}+\frac{1}{2}\right)}{\in_0}$

C. $\dfrac{\lambda a\left(\sqrt{5}+1\right)}{\in_0}$

D. $\dfrac{\lambda a\left(\sqrt{5}+\frac{1}{2}\right)}{\in_0}$

Answer: C

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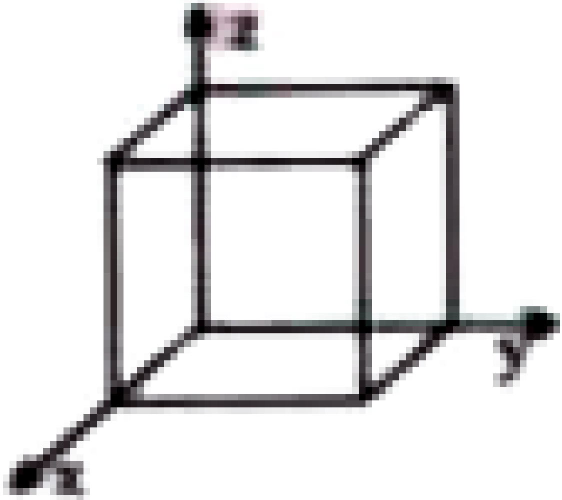
18. Electric field in a region is given by $\overrightarrow{E} = -4x\hat{i}+6y\hat{j}$. Then find the charge enclosed in the cube of side 1m oriented as shown in the diagram



A. ε_0

B. $2\varepsilon_0$

C. $3\varepsilon_0$

D. $10\varepsilon_0$

Answer: B

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

A. $-\frac{4x}{\varepsilon_0}$

B. $-\frac{4}{\varepsilon_0}$

C. $-4\varepsilon_0$

D. $-2\varepsilon_0$

Answer: C

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20. Two thin conducting shells of radii R and 3R are shown in the figure. The outer shell carries a chage Q and the inner shell is neutral. The inner shell is earthed with the help of a switch S

A. With the switch S open, the potential of the sphere is equal to that of the outer.

B. When the switch S is closed, the potential of the inner sphere becomes zero

C. With the switch S closed, the charge attained by the inner sphere is

-q/3.

D.

Answer: A::B::C::D

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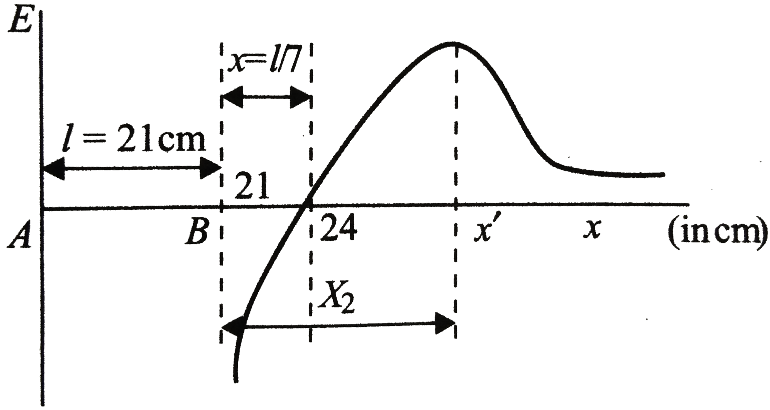
ADDITIONAL PRACTICE EXERCISE (LEVEL -II LECTURE SHEET (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS)

1. Two point charge Q_a and Q_b are positional at point A and B. The field strength to the right of charge Q_b on the line that passes through the two charges varies according to a law represented schematically in fig. (without employing a definite scale). The field strength is assumed to be positive if its direction coincides with the positive direction of the x-axis. The distance between the charges is $l = 21cm$.



(a) Find the sign of the charges.

(b) Find the ratio between the absolute value of charge Q_a and Q_b.

(c) Find the coordinate x of the point where the field strength is maximum.

A. Q_1 is positive charge while Q_2 is negative charge

B. The ratio of the absoulte value of the charges $\left|\frac{Q_1}{Q_2}\right|\left(\frac{a+l}{a}\right)^2$

C. The value of b, where the field intensity is maximum is

$$b=\frac{l}{\left(\frac{l+a}{2a}\right)^{2/3}-1}$$

D. The value of b , where the filed intesity is maximum is

Answer: A::B::D

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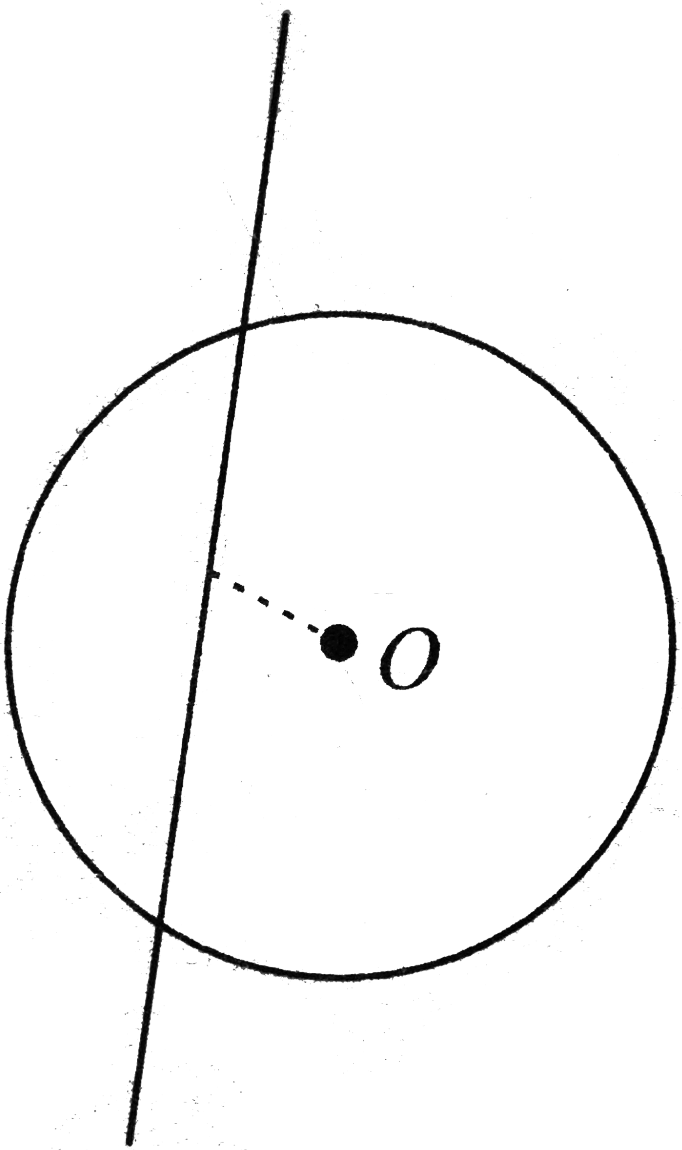
2. A uniformly charged and infinitely long line having a liner charge density λ is placed at a normal distance y from a point O. Consider a sphere of radius R with O as the center and Rgty. Electric flux through the surface of the sphere is



A. Flux crossing the sphere is zero if d gt R b)

B. Flux crossing the sphere is $\frac{2\lambda\sqrt{R^2-d^2}}{\varepsilon_0}$, if $d < R$

C. If $d > R$, the magnitude of maximum potential difference two points on the sphere is $\frac{\lambda}{2\pi\varepsilon_0}\text{In}\left(\frac{d+R}{d-R}\right)$

D. When a charge is moved along any dimeter of the sphere in the plane perpendicular to the wire, work done is zero.

Answer: A::B::C

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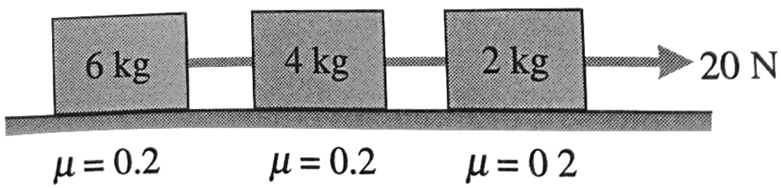
3. 

Three blocks of masses 6 kg, 4 kg and 2 kg are pulled on a rough surface by applying a constant force 20 N. The values of coefficient of friction between blocks and suface are shown in figure.

Q. Friction force on 6 kg block is

A. Electric field anywhere in the given region is directed towards + ve x-axis

B. Work done by the electric field in bringing a + ve test charge from $\left(0, \frac{a}{\sqrt{2}}, \frac{a}{\sqrt{2}}\right)$ to $\left(0, \frac{a}{\sqrt{2}}, \frac{a}{\sqrt{2}}\right)$ is zero

C. Electric potential throught the given region is zero

D. Flux crossing this surface is $\frac{dq}{\varepsilon_0}\left(\frac{1}{a}-\frac{1}{b}\right)$

Answer: A::B::C::D

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4. Four concentric conducting spherical shells A, B, C and D of radii a, 2a, 3a and 4a respectively. Shell B and D are given charges q and $-q$ respectively. If shell C is grounded then potential difference (VA — VC) is

A. Charge appearing on .C. after earthing is $\frac{Q}{4}$

B. Charge appearing on .C. after earthing is $-\frac{Q}{R}$

C. Potential of shell .A. after .C. is earthed is $\dfrac{Q}{24\pi\varepsilon_0 a}$

D. Potential of shell .A. after .C. is earthed is $\dfrac{Q}{12\pi\varepsilon_0 a}$

Answer: B::C

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ADDITIONAL PRACTICE EXERCISE (LEVEL -II LECTURE SHEET (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. An empty thick conducting shell of inner radius a and outer radius b is shown in figure. If it is obseved that the inner face of the carries a uniform charge density $-\sigma$ and the surface carries a uniform charge density . σ.

If a point charge q_A is placed at the center of the shell, then choose the correct statement(s)

A. The charge must be positive

B. The charge must be negative

C. The magnitude of charge must be $4\pi\sigma a^2$

D. The magnitude of charge must be $4\pi\sigma(b^2 - a^2)$

Answer: C

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2. An empty thick conducting shell of inner radius a and outer radius b is shown in figure. If it is obseved that the inner face of the carries a uniform charge density $-\sigma$ and the surface carries a uniform charge density . σ.

If a point charge q_A is placed at the center of the shell, then choose the correct statement(s)

A. force experienced by charge A is $\frac{\sigma q_A b^3}{\varepsilon_0 c^2}$

B. force experienced by charge A is zero

C. The force experienced by charge B is $\frac{\sigma q_a b}{\varepsilon_0 c^2}$

D. The force experienced by charge B is $\frac{kq_Aq_B}{c^2}$

Answer: B

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ADDITIONAL PRACTICE EXERCISE (LEVEL -II LECTURE SHEET (ADVANCED)MATRIX MATCHING TYPE QUESTIONS)

1. Match the column I with Column II

Column-I	Column-II
(a) Relaxin	(i) Anti abortion hormone
(b) L.H.	(ii) Testesterone secretion
(c) Progesterone	(iii) Widening of birth canal
(d) F.S.H.	(iv) Folliculogenesis

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ADDITIONAL PRACTICE EXERCISE (LEVEL -II LECTURE SHEET (ADVANCED)INTEGER TYPE QUESTIONS)

1. A clock face has charges $-q, -2q, , \ldots . -12q$ fixed at the position of the corresponding numerals on the dial. The clock hands do not disturb the net field due to point charges. At what time does the hour hand point in the direction of the electric field at the centre of the dial.

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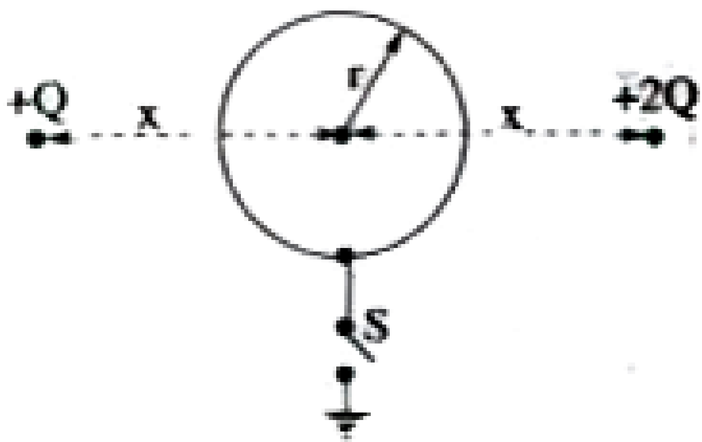
2. Two particles having positive charges +Q and +2Q are fixed at equal distance x from centre of a conducting sphere having zero net charge and radius r as shown. Initially the switch S is open. After the switch S is closed, the net charge flowing out of sphere is $\frac{(5-P)Qr}{x}$. find P



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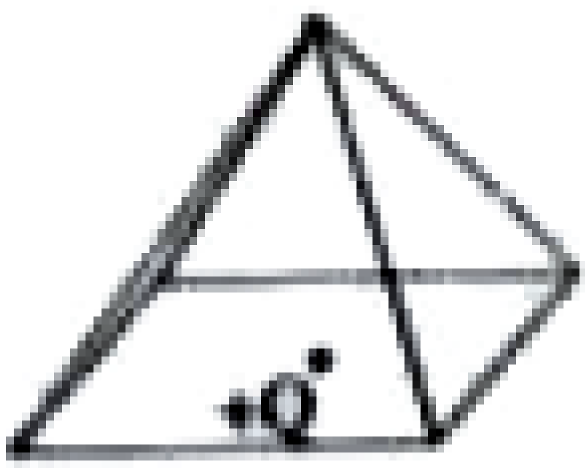
ADDITIONAL PRACTICE EXERCISE (PRACTICE SHEET (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTION)

1. A point charge is positioned at the centre of the base of a square pyramid as shown. The flux through one of the four identical upper faces of the pyramid is, $\frac{q}{P\varepsilon_0}$ then P is



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2. A point charge q is placed at a distance of r from cebtre of an uncharged conducting sphere of rad $R(<r)$. The potential at any point on the sphere is

A. $\frac{1}{4\pi\varepsilon_0}, \frac{Q}{(d-R)}$

B. $\frac{1}{4\pi\varepsilon_0}. \frac{Q}{d}$

C. $\frac{1}{4\pi\varepsilon_0}. \frac{Q}{R}$

D. Zero

Answer: B

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3. A solid conducting sphere of radius 'a' is surrounded by a thin uncharged concentric conducting shell of radius $2a$. A point charge q is placed at a distance $4a$ from common centre of conducting sphere and shell. The inner sphere is then grounded

The charge on solid sphere is

A. $-\frac{q}{2}$

B. $-\frac{q}{4}$

C. $-\frac{q}{8}$

D. $-\frac{q}{16}$

Answer: B

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4. The potential of outer shell is

A. $\frac{q}{32\pi\varepsilon_0 a}$

B. $\frac{q}{16\pi\varepsilon_0 a}$

C. $\frac{q}{8\pi\varepsilon_0 a}$

D. $\frac{q}{4\pi\varepsilon_0 a}$

Answer: A

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5. A point charge q is placed inside a conducting spherical shell of inner radius 2R and outer radius 3R at a distance of R from the centre of the shell. The electric potential at the centre of shell will be $\frac{1}{4\pi\varepsilon_0}$ times

A. $\frac{q}{2R}$

B. $\frac{4q}{3R}$

C. $\frac{5q}{6R}$

D. $\frac{2q}{3R}$

Answer: C

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6. Two charges $-q$ each are separated by distance $2d$. A third charge $+q$ is kept at mid-point O. Find potential energy of $+q$ as a function of small distance x from O due to $-q$ charges. Prove that the charge at O is in an unstable equilibrium.

A. $\frac{Q_0}{3}$

B. $\frac{2Q_0}{3}$

C. $\frac{4Q_0}{3}$

D. Q_0

Answer: B

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7. Three concentric metallic spherical shells of radii R, 2R, 3R are given charges $Q_1Q_2Q_3$, respectively. It is found that the surface charge densities on the outer surface of the shells are equal. Then, the ratio of the charges given to the shells $Q_1 : Q_2 : Q_3$ is

A. $1:2:3$

B. $1:3:5$

C. $1:4:9$

D. $1:8:18$

Answer: B

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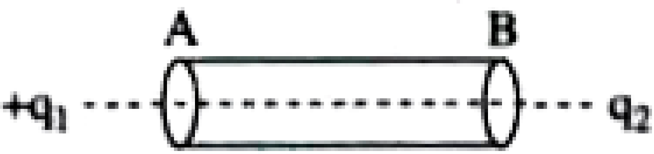
8. A thin conductinrod AB is introduced in between the two point charges $+q_1$ and q_2 as shown in figure.For this situtation mark the correct statement (s).



A. The total force experienced by q_1 is vector sum of electric force experienced by q_1 due to q_2 and due to induced charges on rod.

B. The end A will become negatively charged

C. The total force acting on $+q_1$. Will be greater than as compared to the case without rod

D. The total force acting on $-q_2$ will be greater than as compared to the case without rod

Answer: A

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9. Two point charges of +Q each have been placed at the positions $(-a/2, 0, 0)$ and $(a/2, 0, 0)$.The locus of the points where - Q charge can be placed such the that total electrostatic potential energy of the system can become equal to zero, is represented by which of the following equations ?

A. A) $Z^2 + (Y-a)^2 = 2a$

B. B) $Z^2 + (Y-a)^2 = 27a^2/4$

C. C) $Z^2 + Y^2 = 15a^2/4$

D. D) None

Answer: C

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10. A conducting sphere of radius R has a charge. Then,

A. The charge is uniformly distributed over its surface, if there is an external electric field.

B. Distribution of charge over its surface will be non uniform if no external electric field exist in space.

C. Electric field strenght inside the sphere will be equal to zero only when no external electric field exists

D. Potential at every point of the sphere must be same

Answer: D

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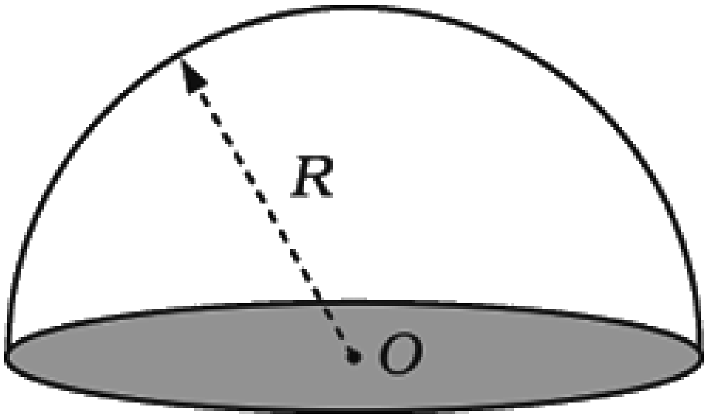
11. Charge Q is uniformly distributed throughout the volume of a solid hemisphere of radius R metres. Then the potential at centre O of hemisphere in volts is:



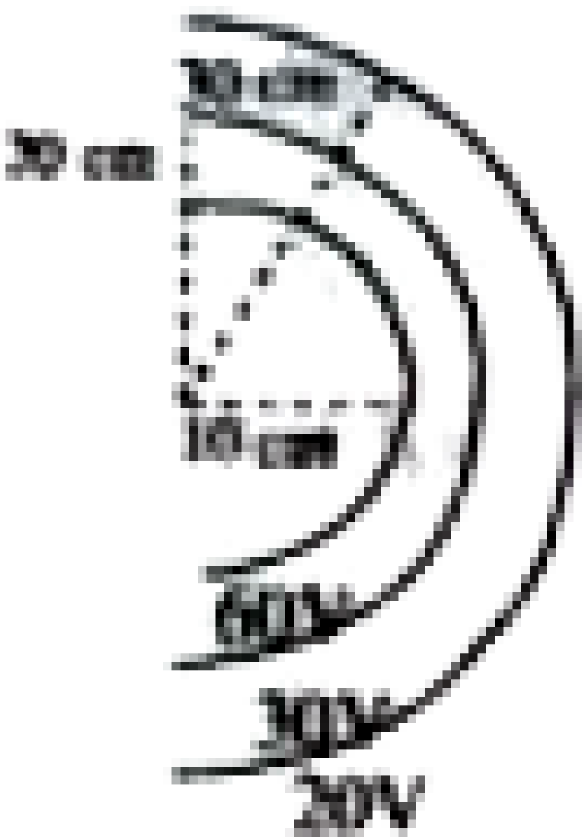
A. $\frac{1}{4\pi\varepsilon_0}\frac{3Q}{2R}$

B. $\frac{1}{4\pi\varepsilon_0}\frac{3Q}{4R}$

C. $\frac{1}{4\pi\varepsilon_0}\frac{Q}{4R}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{Q}{4R}$

12. Figure shows equipotential surfaces concentric at O the magnitude of electric field at a distance r measured from O is



A. $\frac{9}{r^2}(Vm^{-1})$

B. $\frac{6}{r^2}(Vm^{-1})$

C. $\frac{2}{r^2}(Vm^{-2})$

D. $\frac{16}{r^2}(Vm^{-2})$

Answer: B

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13. Figure shows three concentric thin spherical shells A, B and C of radii a, b, and c. The shells A and C are given charge q and -q, respectively, and shell B is earthed. Then,

A. charge on inner surface of shell is $\frac{4}{3}q$

B. charge on outer surface of shell B is $-\frac{4}{3}q$

C. charge on outer surface of shell C is $\frac{2}{3}q$

D. charge on outer surface of shell C is $\frac{4}{3}q$

Answer: D

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14. Two charges $5\mu C$ and $4\mu C$ are separated by a distanc 20 cm in air. Work to be done to decrease the distance to 10 cm is

A. 1.8 j

B. 0.45 j

C. 2.7 j

D. 0.9 j

Answer: D

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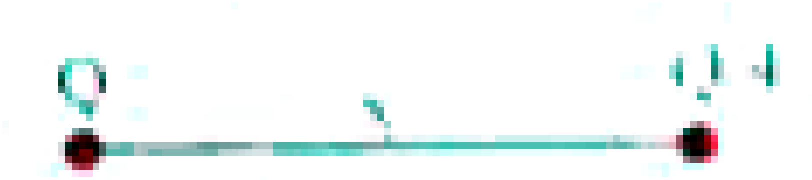
ADDITIONAL PRACTICE EXERCISE (PRACTICE SHEET (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS)

1. Two point charges Q and -Q/4 are separated by a distance x.



A. Potential is zero at a point on the axis which is x/3 on the right side of the charge - Q/4

B. Potential is zero at a point on the axis which is x/5 on the left side of the charge -Q/4

C. electric field is zero at a point on the axis which is at a distance x on the right side of the charge - Q/4

D. there exist two points on the axis where electric field is zero

Answer: A::B::C

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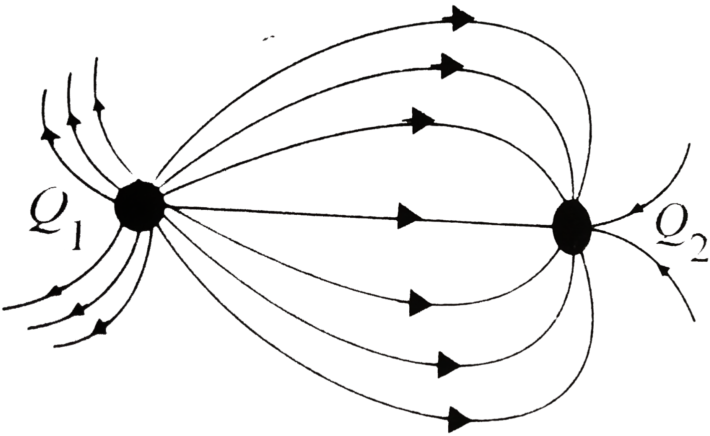
2. A few electric field lines for a system of two charges Q_1 and Q_2 fixed at tow different points on the x-axis are shown in the figure. These lines suggest that



A. $|Q_1| > |Q_2|$

B. $Q_1| < |Q_2|$

C. At a finite distance to the left of Q_1 the electric field is zero

D. At a finite distance to the right of Q_2 the electric field is zero

Answer: A::D

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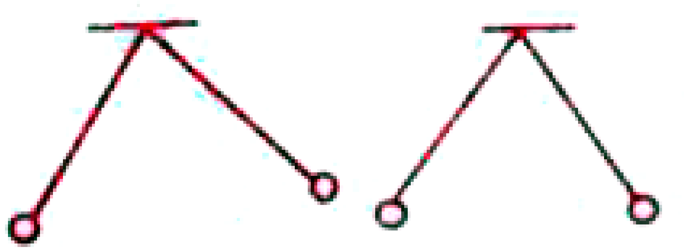
3. Two metal sphers of masses m_1 and m_2 are suspended from a common point by a light insulting strings of same length. The length of each string is same. The spheres are given positive charges q_1 and q_2. Figure A shows angles made by the strings with vertical are different where as for figure B same. Then, which of the following is possible



A. For figure $Am_1 > m_2$ and $q_1 = q_2$

B. For figure $Am_1 > m_2$ and $q_1 < q_2$

C. For figure $Bm_1 = m_2$ and $q_1 = q_2$

D. Fo figure $Am_1 > m_2$ and $q_1 \neq q_2$

Answer: A::B::C

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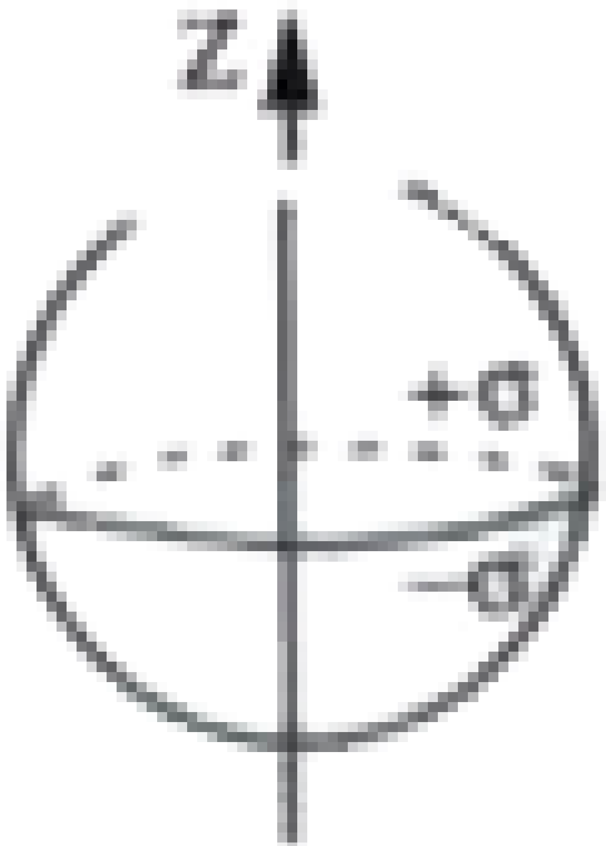
4. A hollow insulating spherical shell has a surfac charge distribution placed upon it, such that the upper hemisphere has a uniform surface charge density σ. While the lower hemisphere has a uniform surface charge density $-\sigma$.as shown in the figure. Their interface lies in x-y plane which



A. The field at all points of x-y plane within the sphere points in the -ve z-directior.

B. All the points of the x-y plane within the sphere are equipotential

C. The field at all points on z-axis outside the sphere point along positive z-direction.

D. The field at points on z-axis which are on either side of origin outside the sphre is in opposite directions.

Answer: A::B::C

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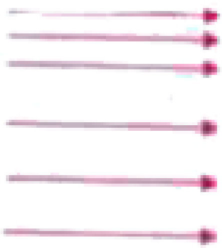
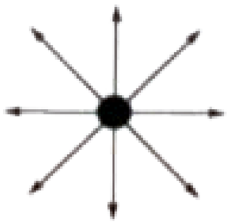
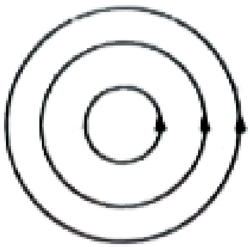
5. Which of the following is/are a valid configuration for an electric field?

A. 

B. 

C. 

D. 

Answer: B::C::D

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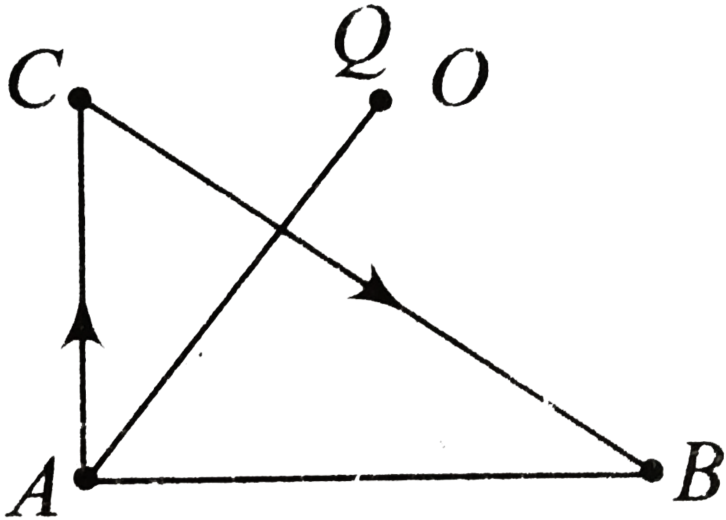
6. There is a fixed positive charges Q at O, and A and B are points equidistant from O. A positive charge +q is taken slowly by an external agent from A to B along the line AC and then along the line CB.



A. The toal work done on the charge is zero

B. The work done by the electrostatic force from A to C is negative

C. The work done by the electrostatic force from C to B is positive

D. The work done by electrostatic force in taking the charge from A to B is dependent on the actual path followed

Answer: A::B::C

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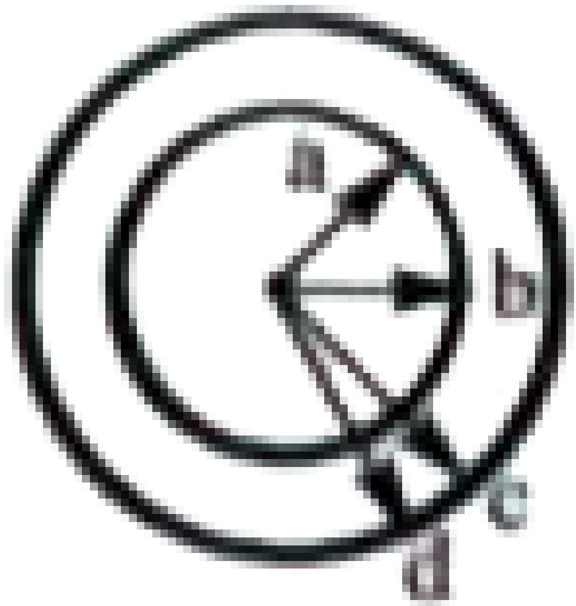
ADDITIONAL PRACTICE EXERCISE (PRACTICE SHEET (ADVANCED) LINKED COMPPREHENSION TYPE QUESTIONS)

1. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d. The inner shell has total charge +2q, and the outer shell has charge +4q. $\left(K=\frac{1}{4\pi\epsilon_0}\right)$



Find the electric in terms of q and the distance r from the common centre of the two shells for $r > d$.

A. 0,0

B. $+q, \ -q$

C. 2q, -2q

D. $-q, q/2$

Answer: A

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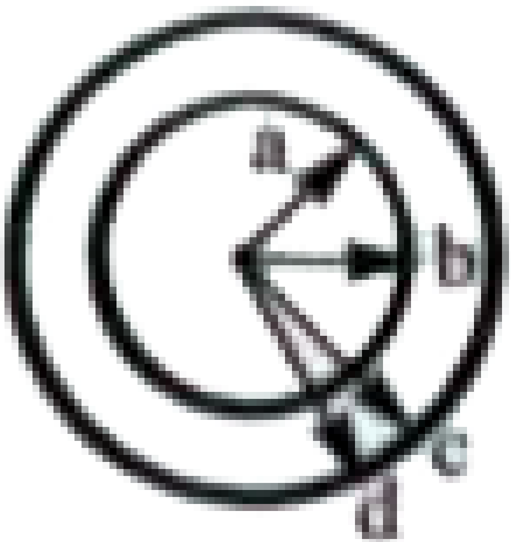
2. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d. The inner shell has total charge +2q, and the outer shell has charge +4q. (K=(1)/(4piepsilon_(0)))



Find the electric field in terms of q and the distance r from the common centre of the two shells for (i) $b < r < c$ (ii) $c < r < d$

A. $\frac{2q}{r^2}, 0$

B. $\frac{2kq}{r^2}, 0$

C. $\frac{kq}{r^2}, q$

D. $\frac{q}{r^2}, kq$

Answer: B

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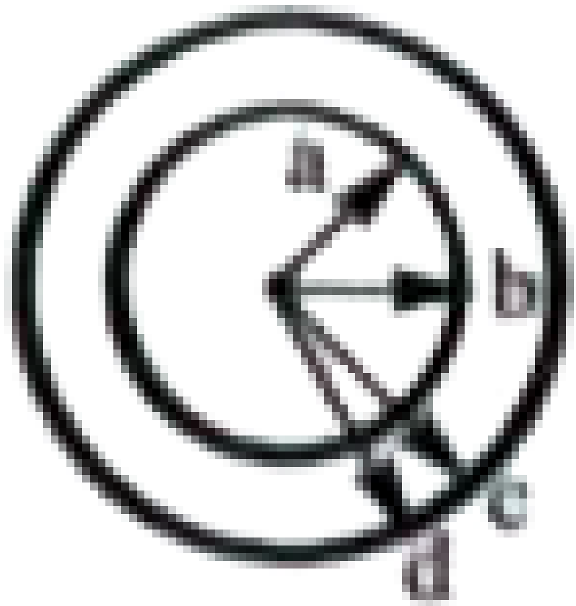
3. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d. The inner shell has total charge +2q, and the outer shell has charge +4q. (K=(1)/(4piepsilon_(0)))



Find the electric in terms of q and the distance r from the common centre of the two shells for $r > d$.

A. $\frac{kq}{r^2}$

B. $\frac{2kq}{r^2}$

C. $\frac{6kq}{r^2}$

D. $\frac{3kq}{r^2}$

Answer: C

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ADDITIONAL PRACTICE EXERCISE (PRACTICE SHEET (ADVANCED) MATRIX MATCHING TYPE QUESTIONS)

1. In Fig a conducting spherical shell of inner radius .x. and outer radius .y. is concentric with a larger conducting spherical shell of inner radius .a. and outer radius .b.. Inner shell has a total charge +3Q and the outer shell has a charge +5Q. Let r be the distance of any point from the common centre O.

Match Column-I with Column-II

COLUMN-I	COLUMN-II
A) Electric field strength is zero	p) Outer surface of the larger spherical shell
B) Electric field strength is non-zero	q) Inner surface of the larger spherical shell
C) Magnitude of charge on this surface is 3Q	r) Outer surface of the smaller spherical shell
D) Charge on this surface is +8Q	s) For $a < r < b$

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ADDITIONAL PRACTICE EXERCISE (PRACTICE SHEET (ADVANCED) INTEGER TYPE QUESTIONS)

1. The linear charge density on a dielectric ring of radius R vanes with θ as $\lambda = \lambda_0 \cos \theta / 2$, where λ_0 is constant. Find the potential at the center O of the ring [in volt].

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2. Four identical positive point charges Q are fixed at the four corners of a square of side length l. Another charged particle of mass m and charge $+q$ is projected towards centre of square from a large distance along the line perpendicular to plane of square. The minimum value of initial velocity v_0 (in m/s) required to cross the square is ?

$\left(m = 1gm, l = 4\sqrt{2}m, Q = 1\mu c, q = 0.5\mu c\right)$

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3. A solid sphere of radius r has a charge Q distributed in its volume with a charge density $\rho = kr^a$ where k and a are constants and r is the distance from its centre. If the electric field at $r = R/2$ is $1/8$ times that at $r = R$, find the value of a.

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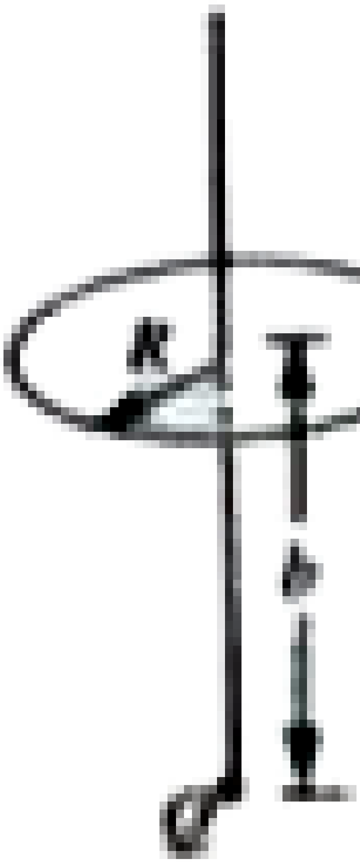
4. A point charge Q is located on the axis of a disc of radius R at a distance b from the plane of the disk. If one - fourth of the electric flux from the charge passes through the disk, then $R = \sqrt{kb}$. Find k.



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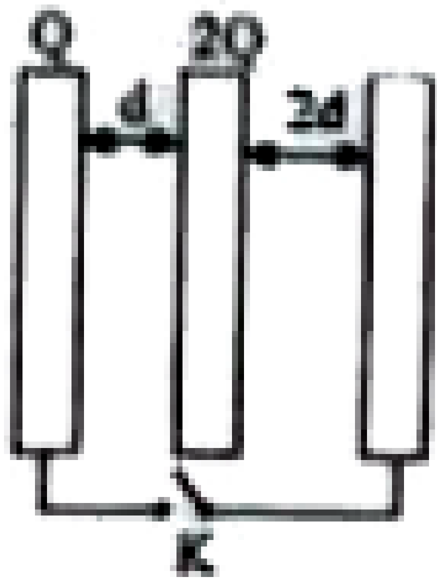
5. Three large plates are arranged as shown. The charge will flow through the key K if it is closed if $\frac{nQ}{6}$ find the value of n.


Q
2Q
d
3d
K