PHYSICS

BOOKS - DC PANDEY PHYSICS (HINGLISH)

ELECTROSTATICS

Example

1. How many electrons are there in on coulomb of negative charge?

A. 1.6×10^{19}

B. 6.25×10^{20}

C. 6.25×10^{20}

D. 6.25×10^{18}

Answer: D

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2. If we comb our hair on a dry day and bring the comb near small pieces of paper, the comb attracts the pieces, why?

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3. Does the attraction between the comb and the piece of papers last for longer period of time?

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4. Can two similarly charged bodies attract each other?

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5. Does centre of mass of a body actually exist in reality? Does centre of mass of a solid body lie necessarily Inside it ?

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6. Why a third hole in a socket provided for grounding?

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7. What is the smallest electric force between two charges placed at a distance of $1.0m$?

A. $2.304 \times 10^{-25}N$

B. $4.4 \times 10^{-28}N$

C. $2.304 \times 10^{-28}N$

D. $4.4 \times 10^{-25}N$

Answer: C

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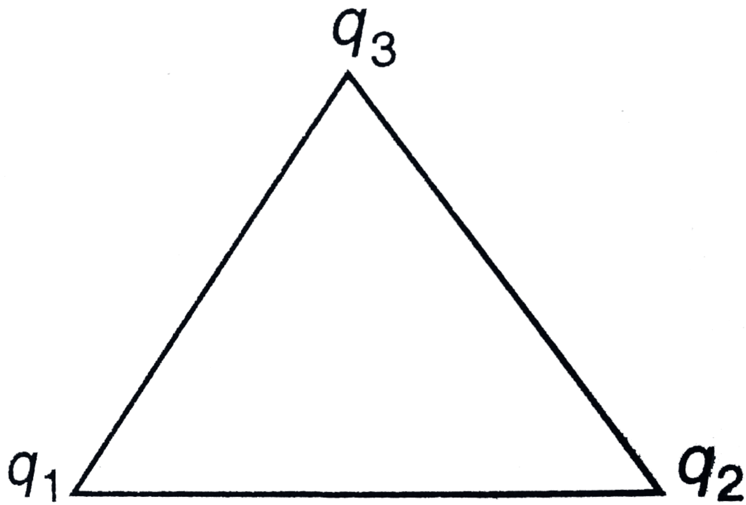
8. Three charges $q_1 = 1\mu C, q_2 = 2\mu C$ and $q_3 = 3\mu C$ are placed on the vertices of an equilateral triangle of side 1.0 m. Find the net electric force acting on charge q_1



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9. Two identical balls each having a density ρ are suspended from as common point by two insulating strings 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.

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10. An electric field of $10^5 N/C$ points due west at a certain spot. What are the magnitude and direction of the force that acts on a charge of $+2\mu C$ and $-5\mu C$ at this spot?

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11. Two positive point charges $q_1 = 16\mu C$ and $q_2 = 4\mu C$ are separated in vacuum by a distance of $3.0m$. Find the point on the line between the charges where the net electric field is zero.-

A. $2m$ from q_1

B. $1m$ from q_1

C. $2m$ from q_2

D. $0.5m$ from q_1

Answer: A

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12. As charge $q = 1\mu C$ is placed at point $(1m, 2m, 4m)$. Find the electric field at point $P(0, -4m, 3m)$

A. $236.8N/C$

B. $200N/C$

C. $23N/C$

D. $250N/C$

Answer: A

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13. A uniform electric field E_0 is directed along positive y-driection. Find the change in electric potential energy of a positive test charge q_0 when it is displaced in this field from $y_i = a$ to $y_f = 2a$ along the y-axis.

A. $-q_0E_0a$

B. q_0E_0a

C. $\frac{-q_0E_0}{a}$

D. $\frac{q_0E_0}{a}$

Answer: A

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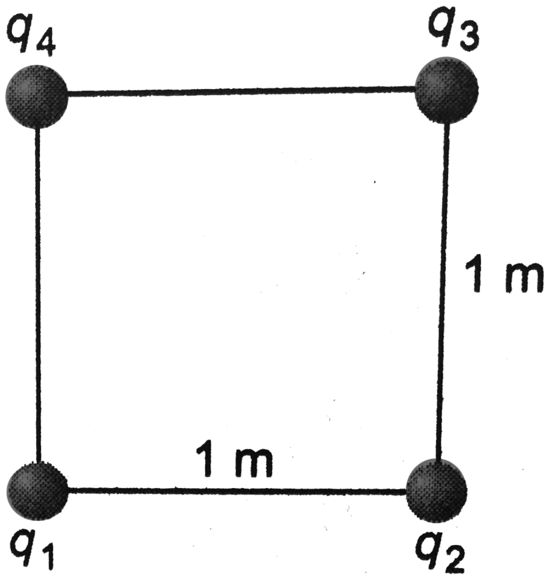
14. Four charges $q_1 = 1\mu C, q_2 = 2\mu C, q_3 = -3\mu C$ and $q_4 = 4\mu C$ are kept on the vertices of a square of side $1m$. Find the electric potential energy of this system of charges.



A. $-5.28 \times 10^{-2} J$

B. $-7.62 \times 10^{-2} J$

C. $-8.91 \times 10^{-2} J$

D. $-4.33 \times 10^{-2} J$

Answer: B

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15. Two points charges are located on the x-axis, $q_1 = -1\mu C$ at $x = 0$ and $q_2 = +1\mu c$ at $x = 1m$.

a. Find the work that must be done by an external force to bring a third point charge $q_3 = +1\mu C$ from infinity to $x = 2m$.

b. Find the total potential energy of the system of three charges.

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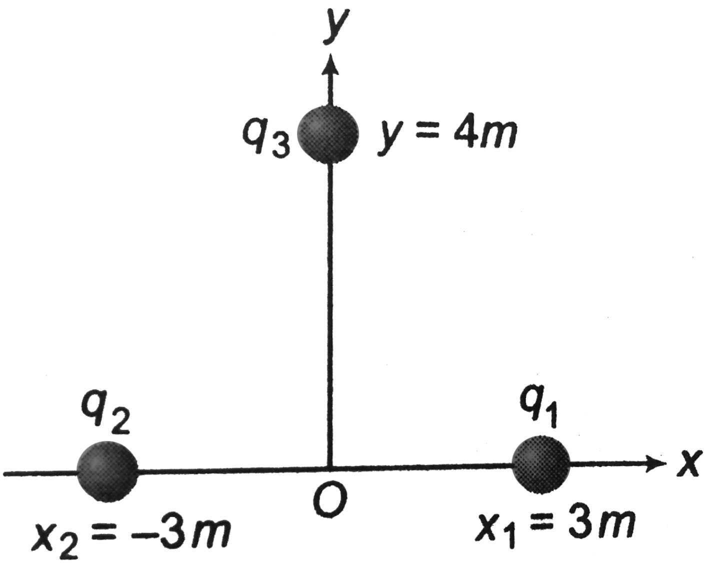
16. Two point charges $q_1 = q_2 = 2\mu C$ are fixed at $x_1 = +3m$ and $x_2 = -3m$ as shown in figure. A third particle of mass 1 g and charge $q_3 = -4\mu C$ is released from rest at $y = 4.0m$.Find the speed of the particle as it reaches the origin.



A. $4.2 m/s$

B. $6.2 m/s$

C. $7.2 m/s$

D. $8.2 m/s$

Answer: B

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17. The electric potential at point A is $20V$ and at B is $-40V$. Find the work done by an external and electrostatic force in moving an electron slowly from B to A.

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18. Find the work done by some external force in moving a charge $q = 2\mu C$ from infinity to a point where electric potential is 10^4 V.

A. $= 4 \times 10^{-2} J$

B. $= 2 \times 10^{-2} J$

C. $= 2 \times 10^{-3} J$

D. $= 2 \times 10^{-4} J$

Answer: B

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19. Three point charge $q_1 = 1\mu C, q_2 = -2\mu C$ and $q_3 = 3\mu C$ are placed at $(1m, 0, 0), (0, 2m, 0)$ and $(0, 0, 3m)$ respectively. Find the electric potential at the origin.

A. $2.0 \times 10^3 V$

B. $9.0 \times 10^3 V$

C. $1.0 \times 10^3 V$

D. $10 \times 10^3 V$

Answer: B

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20. A charge $q = 10\mu C$ is distributed uniformly over the circumference of a ring of radius 3m placed on x-y placed with its centre art origin. Find the electric potential at a point $P(0, 0, 4m)$

A. $2 \times 10^4 V$

B. $1.8 \times 10^4 V$

C. $4 \times 10^4 V$

D. $5 \times 10^4 V$

Answer: B

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21. Find out the points on the line joining two charges $+q$ and $-3q$(kept at as distance of $1.0m$) where electric potential is zero.

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22. The electric potential in a region is represented a $v = 2x + 3y - z$. Obtain expression for electric field strength.

A. $E = -2\hat{i} - 4\hat{j} + \hat{k}$

B. $E = -2\hat{i} - 3\hat{j} + 1\hat{k}$

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

D. $E = -2\hat{i} - 3\hat{j} + 5\hat{k}$

Answer: C

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23. The electric potential V at any point x,y,z (all in metre) in space is given by $V = 4x^2$ volt. The electric field at the point $(1m, 0, 2m)$ is .... $\frac{V}{m}$.

A. $-8\hat{i}V/m$

B. $8\hat{i}V/m$

C. $-18\hat{i}V/m$

D. $28\hat{i}V/m$

Answer: A

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24. Find the V_{ab} in an electric field $E = \left(2\hat{i} + 3\hat{j} + 4\hat{k}\right)\frac{N}{C}$, where $r_a = \left(\hat{i} - 2\hat{j} + \hat{k}\right)m$ and $r_b = \left(2\hat{i} + \hat{j} - 2\hat{k}\right)m$

A. $-1V$

B. $-2V$

C. $1V$

D. $2V$

Answer: A

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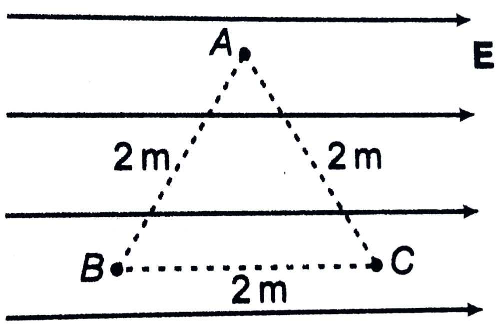
25. In uniform electric field $E = 10N/C$, find



a. $V_A - V_B$, b. $V_B - V_C$

A. $-10V$ and $20V$

B. $10V$ and $-10V$

C. $30V$ and $20V$

D. $-10V$ and $40V$

Answer: A

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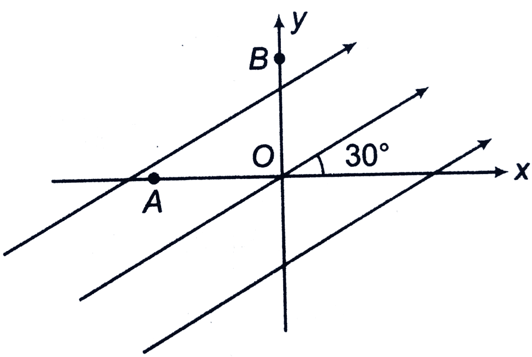
26. A uniform electric field of $100V/m$ is directed at 30° with the positive x-axis as shown in figure. Find the potential difference V_{BA} if $OA = 2$m and $OB = 4m$.



A. $-200(3+\sqrt{2})$

B. $50(2+\sqrt{3})$

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

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

Answer: D

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27. A uniform electric field pointing in positive x-direction exists in a region. Let A be the origin, B be the point on the x-axis at $x = +1cm$ and C be the point on the y-axis at $y = +1$cm. then the potetial at the points A,B and C satisfy

a. $V_A < V_B$, b. $V_A > V_B$ c. $V_A < V_C$ d. $V_A > V_C$

A. $V_C > V_A$ and $V_A = V_B$

B. $V_A > V_C$ and $V_A = V_B$

C. $V_A > V_C$ and $V_A > V_B$

D. $V_A = V_C$ and $V_A > V_B$

Answer: D

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28. A non-conducting ring of radius $0.5m$ carries a total charge of 1.11×10^{-10}C distributed non-uniformly on its circumference producing an electric field E everywhere in space. The value of the integral $\int_{l=\infty}^{l=0} -E.\,dl(l = 0$ being centre of the ring) in volt is

A. $+2$

B. -1

C. -2

D. zero

Answer: A

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29. What is the total charge of a system containing five charges $+1, +2, -3, +4$ and -5 in some arbitrary unit?

A. 1 unit

B. 15 unit

C. -1 unit

D. None of these

Answer: C

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30. How many electrons are there in one coulomb of negative charge?

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31. A sphere of lead of mass 10 g has net charge $-25 \times 10^{-9} C$.

(i) Find the number of excess electrons on the sphere.

(ii) How many excess electrons are per lead atom ? Atomic number of lead is 82 and its atomic mass is 207 g/mol.

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32. A proton and an electron are placed 1.6 cm apart in free speace. Find the magnitude and nature of electrostatic force between them.

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33. The electrostatic force on a small sphere of charege $0.4\mu C$ due to anther small sphere of charge -$0.8\mu C$ in air 0.2 N (i) What is the distance between the two spheres? (ii) What is the force on the second sphere due to the first ?

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34. Nucleus $\cdot_{92}U^{238}$ emits α-particle $\left(\cdot_{2}He^{4}\right)$. α - particle has atomic number 2 and mass number 4. At any instant α - particle is at distance of $9 \times 10^{-15}m$ from the centre of nucleus of uranium. What is the force on α - particle at this instant?

$\cdot_{92}U^{238} \rightarrow \cdot_{2}He^{4} + \cdot_{90}Th^{234}$

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35. (a) Two identical sphereshaving positive charges are placed $3m$ apart repel each other with a force $8 \times 10^{-3}N$. Now charges are connected by a metallic wire, they begin to repel each other with a force of $9 \times 10^{-3}N$. Find initial charges on the spheres.

(b) Two identical spheres having charges of opposite signare placed $3m$ apart attract other with a force $2.4 \times 10^{-3}N$. Now spheres are touched and then placed at original separation repel with a force $10^{-3}N$. Find initial charges on the spheres.

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36. (a) Two protons are placed at some separation in vacuum. Find the ratio of electric and gravitational force acting between them.

(b) Two point charges are placed at separation $3m$ in vacuum. What can be the minimum force between them.

(c) A charge Q is to be divided on two objects. What should be the value of the charges in the objects so that the force between them is maximum ?

(d) Two insulating small spheres are rubbed against each other and placed $1.6cm$ apart. If they attract each other with a force of $0.9N$, how many electrons were transferred from one sphere to the other during rubbing ?

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37. Equal charges each of $20\mu C$ are placed at $x = 0, 2, 4, 8, 16cm$ on X-axis. Find the force experienced by the charge at $x = 2cm$.

A. 21000

B. $19200N$

C. $15000N$

D. $25000N$

Answer: B

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38. Five point charges, each of value +q are placed on five vertices of a regular hexagon of side Lm. What is the magnitude of the force on a point charge of value -q coulomb placed at the centre of the hexagon?

A. $\left(K\frac{Q^2}{L^2}\right)$

B. $\left(K4\frac{Q^2}{L^2}\right)$

C. $\left(K\frac{Q^2}{4}L^2\right)$

D. $\left(K\frac{Q^2}{L}\right)$

Answer: A

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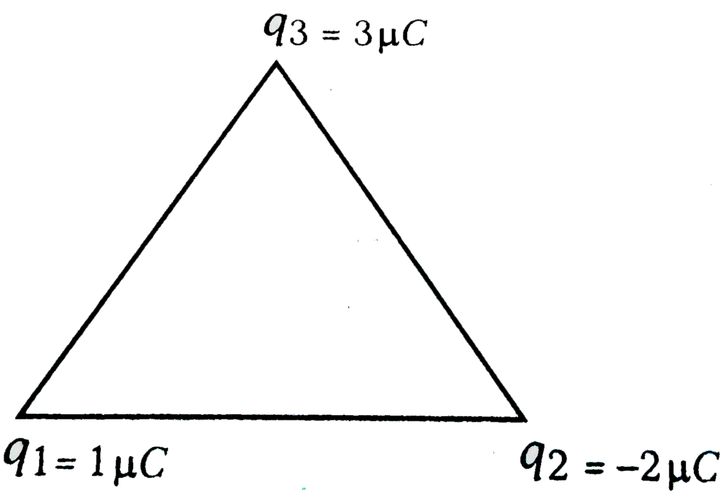
39. Three charges $q_1 = 1\mu C, q_2 = -2\mu C$ and $q_3 = 3\mu C$ are placed on the vertices of an equilateral triangle of side 1.0 m. find the net electric force acting on charge q_1.

How to proceed Charge q_2 will attract charge q_1 (along the line joining them) and charge q_3 will repel charge q_1. Therefore, two forces will act on q_1, one due to q_2 and another due to q_3. Since , the force is a vector quantity both of these force (say F_1 and F_2) will be added by vector method. Following are two methods of their addition



A. $500\sqrt{7}$

B. $700\sqrt{7}$

C. $900\sqrt{7}$

D. $800\sqrt{7}$

Answer: C

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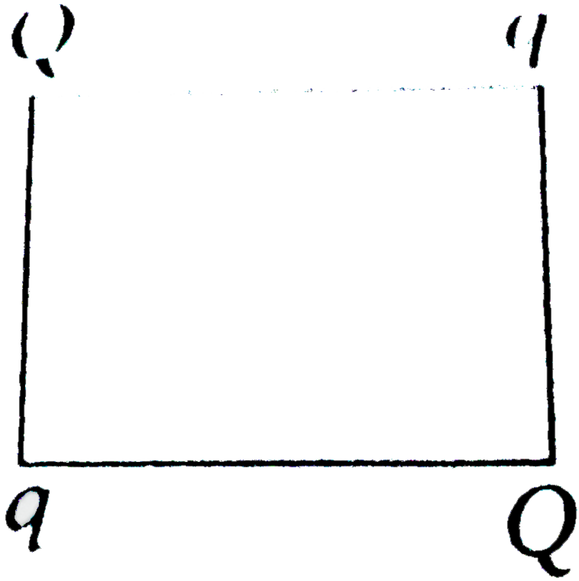
40. Four charge Q, q, Q and q are kept at the four corners of a square as shown below. What is the relation between Q and q, so that the net force on a charge q is zero ?



A. $Q = -\left(\frac{q}{2\sqrt{2}}\right)$

B. $Q = -\left(\frac{q}{\sqrt{2}}\right)$

C. $Q = \left(\frac{q}{2\sqrt{2}}\right)$

D. $Q = -\left(\frac{q}{\sqrt{2}}\right)$

Answer: A

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41. Two identical helium filled balloons A and B fastened to a weight of 5 g by threads floats in equilibrium as shown in figure. Calculate the charge on each balloons, assuming that they carry equal charge.

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42. Two indentical pith balls, each carrying charge q, are suspended from a common point by two strings of equal length l. Find the mass of each ball if the angle between the strings is 2θ in equilibrium.

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43. Two identical balls , each having a charge q and mass m , are suspended from a common point by two insultating strings each of length L. The balls are held at a separation x and then released. Find

(a) the electric force on each ball

(b) the component of the resultant force on a ball along and perpendicular to string

(c) the tension in the string

(d) the acceleration of one of the balls. Consider the situation only for the instant just after the release.

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44. Two identical balls each having a density ρ are suspended from as common point by two insulating strings 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.

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45. An electric field of $10^5 N/C$ points due west at a certain spot. What are the magnitude and direction of the force that acts on a charge of $+2\mu C$ and $-5\mu C$ at this spot?

A. $0.2N$ (due west) $0.5N$ (due east)

B. $0.2N$ (due east) $0.5N$ (due west)

C. $0.5N$ (due west) $0.5N$ (due east)

D. $0.2N$ (due west) $0.6N$ (due east)

Answer: A

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46. Calculate the magnitude of the electric field which can just balance a deuteron of mass $3.2 \times 10^{-27} kg$

A. 2×10^{-7}

B. $3 \cdot 10^{-7}$

C. $4 \cdot 10^{-7}$

D. $5 \cdot 10^{-7}$

Answer: A

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47. find the electric field strength due to a point charge of $5\mu C$ at a distance of 80 cm from the charge.

A. ~70000

B. ~60000

C. ~50000

D. ~40000

Answer: A

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48. Two positive point charges $q_1 = 16\mu C$ and $q_2 = 4\mu C$ are separated in vacuum by a distance of $3.0m$. Find the point on the line between the charges where the net electric field is zero.

A. 2 m from q_2

B. at the mid point

C. 0.5 m from q_1

D. 2 m from q_1

Answer: D

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49. As charge $q = 1\mu C$ is placed at point $(1m, 2m, 4m)$. Find the electric field at point $P(0, -4m, 3m)$

A. $236.8N/C$

B. $230N/C$

C. $136.8N/C$

D. $36.8N/C$

Answer: A

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50. A ball having charge q and mass m is suspended from a string of length L between two parallel plates where a vertical electric field E is established . Find the time period of simple pendulum if electric field is directed (a) downward and (b) upward.

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51. A ball of mass m having a charge q is released from rest in a region where a horizontal electric field E exists.

(a) Find the resultant force acting on the ball.

(b) Find the trajectory followed by the ball.

A. $\sqrt{(mg)^2 + (qE)^2)}$ *Parabola*

B. $\sqrt{(mg) + (qE))}$ *Straight*

C. $\sqrt{(mg)^{-2} + (qE)^{-2})}$Parabola`

D. $\sqrt{(mg)^2}$Parabola`

Answer: A

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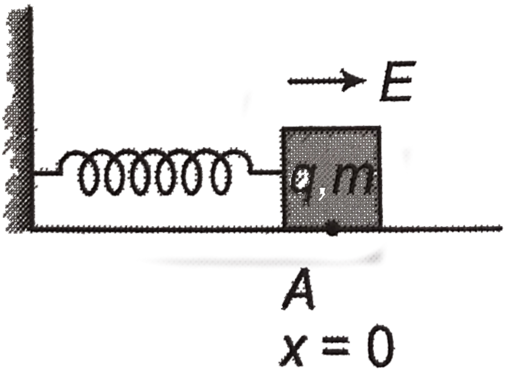
52. A block of mass m having charge q is attached to a spring of spring constant k. This arrangement is placed in uniform electric field E on smooth horizontal surface as shown in the figure. Initially spring is unstretched. Find the extension of spring in equilibrium position and maximum extension of spring.



A. $\left(\frac{qE}{k}\right), \left(\frac{2qE}{k}\right)$

B. $\left(\frac{4qE}{k}\right), \left(\frac{2qE}{k}\right)$

C. $\left(\frac{q}{k}\right), \left(\frac{2q}{k}\right)$

D. $\left(\frac{qE}{k}\right), \left(\frac{2qk}{E}\right)$

Answer: A

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53. An infinite number of charges each equal to q, are placed along the X-axis at $x = 1, x = 2, x = 4, x = 8$,........ and so on.

(i) find the electric field at a point $x = 0$ due to this set up of charges.

(ii) What will be the electric field if the above setup, the consecutive charges have opposite signs.

A. $4K\frac{q}{3}$

B. $2K\frac{q}{3}$

C. $4K\frac{q}{2}$

D. $K\frac{q}{3}$

Answer: A

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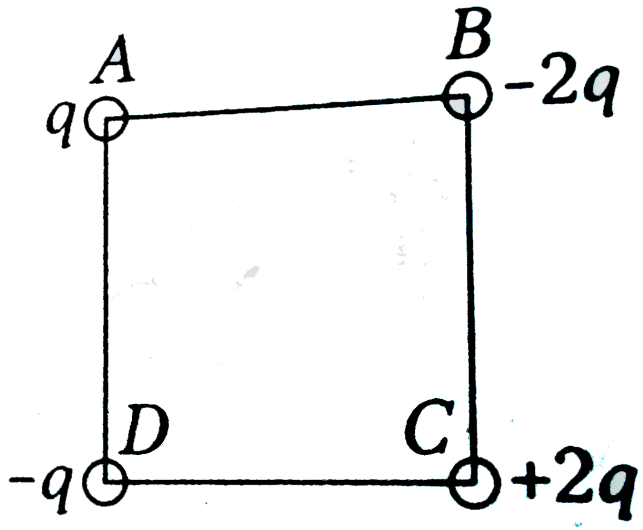
54. Four charges are placed at the corners of a square of side 10 cm as shown in figure. If q is $1\mu C$, then what will be electric field intensity at the centre of the square?



A. $18\sqrt{2} \times 10^5 N/C$

B. $20\sqrt{2} \times 10^5 N/C$

C. $1.8\sqrt{2} \times 10^5 N/C$

D. $0.18\sqrt{2} \times 10^5 N/C$

Answer: A

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55. What charge would be required to electrify a sphere of radius 25 cm, so as to get a surface charge density of $\frac{3}{\pi}Cm^{-2}$?

A. $\frac{3}{4}C$

B. $\frac{2}{4}C$

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

D. $3C$

Answer: A

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56. Sixty four spherical drops each of radius $2cm$ and carrying $5C$ charge combine to form a bigger drop. Its capacity is.

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57. A charge of $4 \times 10^{-9}C$ is distributed uniformly over the circumference of a conducting ring of radius 0.3m. Calculate the field intensity at a point on the axis of the ring at 0.4m from its centre, and also at the centre.

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58. Charges $\pm 20nC$ are separated by $5mm$. Calculate the magnitude and direction of dipole moment.

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59. A system has two charges $q_A = 2.5 \times 10^{-7}C$ and $q_B = -2.5 \times 10^{-7}C$ located at points A, $(0, 0, -0.15m)$ and B, $(0, 0, +0.15m)$ respectively. What is the total charge and electric dipole moment of the system?

A. $0C$, 7.5×10^{-8} C m along positive z-axis

B. $5C$, 7.5×10^{-7} C m along positive z-axis

C. $10C$, 7.5×10^{-8} C m along negative z-axis

D. $15C, 1.5 \times 10^{-8}$ C m along positive z-axis

Answer: A

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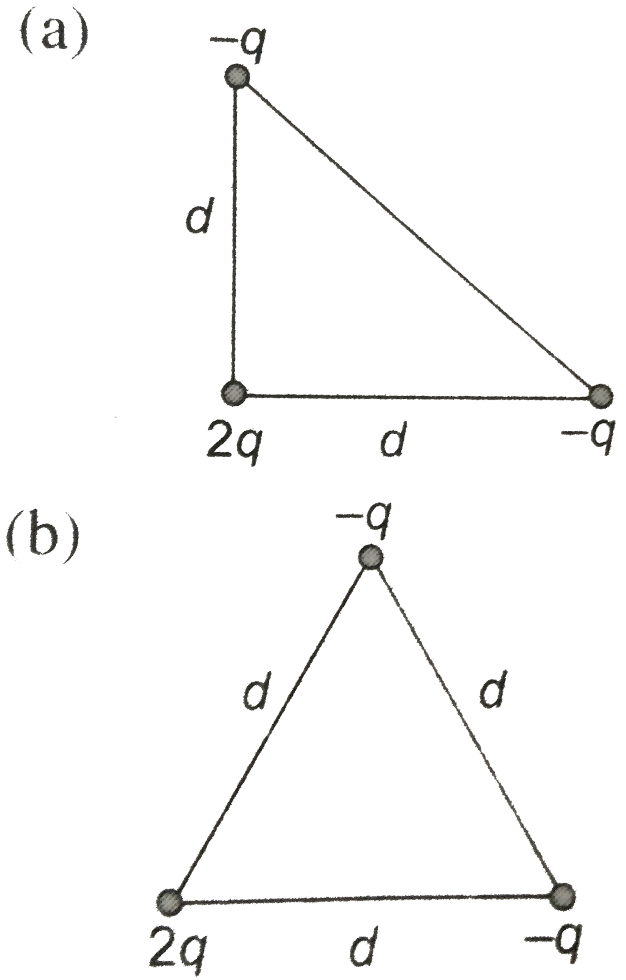
60. Three charges are placed as shown . Find dipole moment of the arrangements .



(a)

A. $(qd)\sqrt{2}$, $(qd)\sqrt{3}$

B. $(qd)\sqrt{2}$, $(qd)\sqrt{5}$

C. $(qd)\sqrt{3}$, $(qd)\sqrt{3}$

D. $(qd)\sqrt{2}$, $(qd)\sqrt{7}$

Answer: A

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61. Two opposite charges each of magnitude $2\mu C$ are 1 cm apart. Find electric field at a distance of 5 cm from the min-point on axid line of the dipole. Also, find the field on equatorial line at the same distance from mid-point

A. $0.288 \cdot 10^7$

B. $0.288 \cdot 10^8$

C. $0.5 \cdot 10^7$

D. $0.288 \cdot 10^{-7}$

Answer: A

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62. What is the magnitude of electric intensity due to a dipole of moment $2 \times 10^{-8} C - m$ at a point distant $1m$ from the centre of dipole, when line joining the point to the center of dipole makes an angle of 60° with dipole axis ?

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63. An electric dipole with dipole moment $4 \times 10^{-9} Cm$ is aligned at 30° with the direction of a uniform electric field of magnitude $5 \times 10^{4} NC^{-1}$. Calculate the magnitude of the torque acting on the dipole .

A. $10^{-4} Nm$

B. $10^{-5} Nm$

C. $10^{-2} Nm$

D. $10^{-6} Nm$

Answer: A

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64. An electric dipole of dipole moment $p = 5 \times 10^{-18} C - m$ is lying along uniform electric field $E = 4 \times 10^4 NC^{-1}$. Calculate the work done in rotating the dipole by 60°.

A. $10^{-13} J$

B. $10^{-12} J$

C. $10^{-15} J$

D. $10^{-16} J$

Answer: A

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65. The electric field in a region is given by $E = a\hat{i} + b\hat{j}$. Hence as and b are constants. Find the net flux passing through a square area of side l parallel to y-z plane.

A. al^3

B. al

C. al^2

D. $zero$

Answer: C

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66. A rectangular surface of sides $10cm$ and $15cm$ is palaced inside a uniform electric field fo $25Vm^{-1}$, such that normal to the surface makes an angle of 60° with the direction of electric field. Find the flux of electric field through the rectangular surface.

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67. The electric field in a region is given by $\vec{E} = \frac{E_0}{a}x\hat{i}$. Find the electric flux passing through a cubical volume bounded by the surfaces

$x = 0, x = a, y = 0, y = a, z = 0$ and $z = a$.

A. a^2E_0

B. aE_0

C. a^3E_0

D. $zero$

Answer: A

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68. A cylinder of radius R and length L is placed in a uniform electric field E parallel to the axis. The total flux for the surface of the cylinder is given by

A. $2\pi R^2 E$

B. $\dfrac{\pi R^2}{E}$

C. $\left(\pi R^2 - \pi R\right)E$

D. zero

Answer: D

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69. A uniformly charged conducting sphere of 2.4m diameter has a surface density of $80.0\mu C/m^2$. (a) Find the charge on the sphere (b) What is the total electric flux leaving the surface of the sphere ?

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70. A point charge causes an electric flux of $-1.0 \times 10^3 Nm^2/C$ to pass through a spherical Gaussian surface of 10.0 cm radius centred on the charge. (a) If the radius of the Gaussian surface were doubled, how much flux would pass through the surface ? (b) What is the is the value of the point charge ?

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71. A point charge q is placed at the centre of a cube. What is the flux linked.

a with all the faces of the cube?

b. with each face of the cube?

c. if charge is not at the centre, then what will be the answer of parts a and b ?

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72. If a point charge q is placed at one corner of a cube, what is the flux linked with the cube?

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73. A hemispherical body of radius R is placed in a uniform electric field E. What is the flux linked with the curved surface if, the field is (a) parallel to the base, (b) perpendicular to the base.

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74. An infinite line charge produces a field of $9 \times 10^4 NC$ at a distance of $2cm$. Calculate the linear charge density.

A. $10^{-5} C/m$

B. $10^{-9} C/m$

C. $10^{-7} C/m$

D. $10^{-6} C/m$

Answer: C

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75. A long cylindrical wire carries a positive charge of linear density λ. An electron $(-e, m)$ revolves around it in a circular path under the influence of the attractive electrostatic force. Find the speed of the electron.

A. $\sqrt{\frac{e\lambda}{4\pi\varepsilon_0 m^2}}$

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

C. $\sqrt{\frac{e^2 m}{2\pi\varepsilon_0 \lambda}}$

D. $\sqrt{\frac{em}{4\pi\varepsilon_0 \lambda}}$

Answer: B

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76. A large plane sheet of charge having surface charge density $5 \times 10^{-16} Cm^{-2}$ lies in XY plane. Find electric flux through a circular area of radius $1cm$. Given normal to the circular area makes an angle of 60° with Z-axis.

A. $3.44 \times 10^{-5} Nm^2 / C$

B. $4.44 \times 10^{-5} Nm^2 / C$

C. $5.44 \times 10^{-5} Nm^2/C$

D. zero

Answer: B

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77. Two large, thin metal plates are parallel and close to each other. On their faces, the plates have surfaces charge densities of opposite sign and of magnitude $.177 \times 10^{-11}$ coulomb per square metre. What is electric field

(i) to the left of the plates ?

(ii) to the right of the plates ?

(iii) in between the plates ?

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78. A thin spherical shell of metal has a radius of $0.25m$ and carries charge of $0.2\mu C$. Calculate the electric intensity at $3.0m$ from the centre of the shell.

A. $2000N/C$

B. $20N/C$

C. 0

D. $200N/C$

Answer: D

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79. At a point $20cm$ from the centre of a uniformly charged dielectric sphere of radius $10cm$, the electric field is $100V/m$. The electric field at $3cm$ from the centre of the sphere will be

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80. Two non-conducting sphere of radius R have charge Q uniformly distributed. The centres of sphere are $x = 0$ and $x = 3R$. Find the magnitude and direction of the net electric field on the X-axis

(i) $x = 0$

(ii) $x = \frac{R}{2}$

(iii) $x = \frac{3R}{2}$

(iv) $x = 4R$

A. $0, k\frac{q}{18R^2}$

B. $0, k\frac{q}{18\left(R^3\right)}$

C. $0, k\frac{q}{9}\left(R^2\right)$

D. $0, k2\frac{q}{18}\left(R^2\right)$

Answer: A

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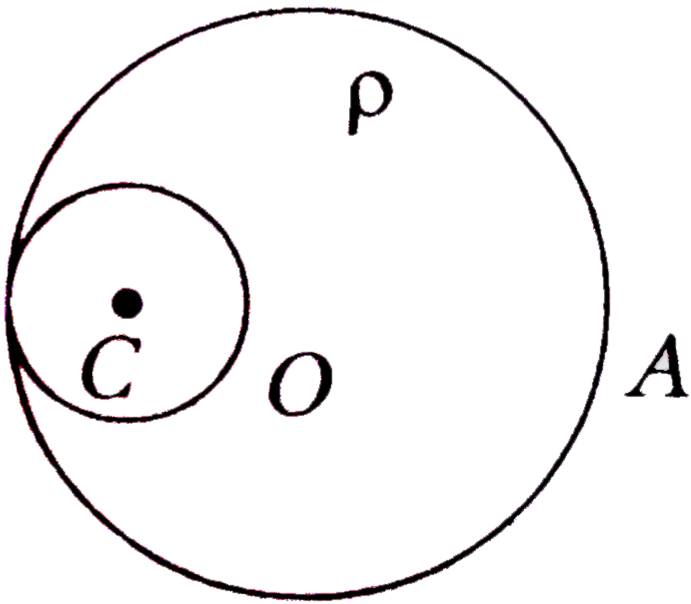
81. A non-conducting sphere of radius R has a spherical cavity of radius $R/2$ as shown. The solid part of the sphere has a uniform volume charge density ρ. Find the magnitude and direction of electric field at point (a) O and (b) A.



A. $\frac{-\rho R}{6\varepsilon_0}, \frac{-\rho R}{6\varepsilon_0}$

B. $\frac{-\rho R}{6\varepsilon_0}, 0$

C. $0, \frac{-\rho R}{6\varepsilon_0}$

D. $0, 0$

Answer: A

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Example Type 5

1. Equipotential spheres are drawn round a point charge. As we move away from charge will the spacing between two spheres having a constant potential difference decrease, increase or remain constant.

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2. Draw electric lines of forces due to an electic dipole.

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3. Along the axis of a dipole, direction of electric field is always in the direction of electric dipole moment p. Is this statement true of false?

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4. At a far away distance r along the axis from a electric dipole electric field is E. Find the electric field at distance $2r$ along the perpendicular bisector.

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5. An electric dipole is placed at the centre of a sphere. Find the electric flux passing through the sphere.

A. 0

B. 1

C. 2

D. None of the above

Answer: A

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Example Type 6

1. A point charge q is placed at the centre of a cube. What is the flux linked.

a with all the faces of the cube?

b. with each face of the cube?

c. if charge is not at the centre, then what will be the answer of parts a and b ?

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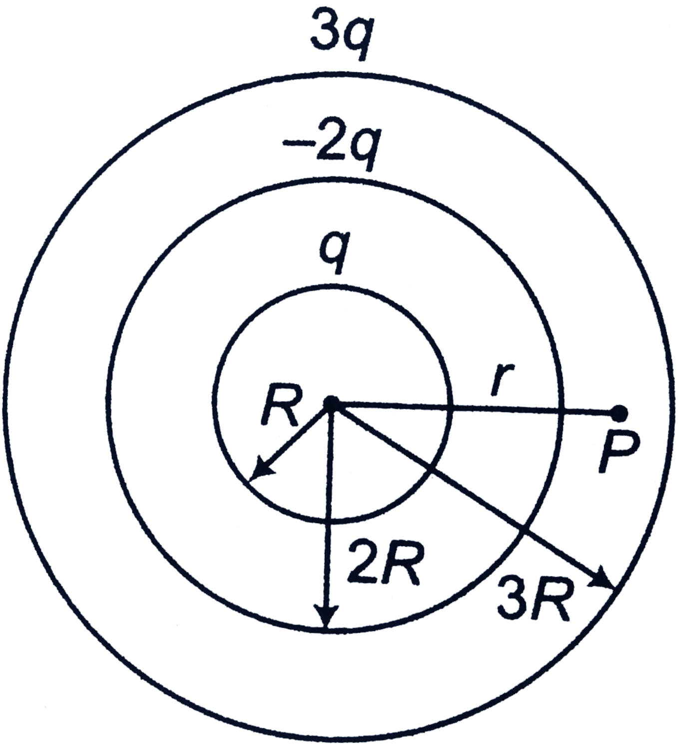
2. Three conducting spherical shells have charges $q, -2q$ and $3q$ as shown in figure. Find electric Potential at point P as shown in figure.



A. $kq\left(\frac{1}{2}r - \frac{1}{r}\right)$

B. $kq\left(\frac{1}{R} - \frac{1}{r}\right)$

C. $kq\left(\frac{1}{2R} - \frac{1}{r}\right)$

D. $\frac{kq}{r} - \frac{k(2q)}{r} + \frac{k_{3q}}{R}$

Here $= kq\left(\frac{1}{R} - \frac{1}{r}\right)$

Answer: B

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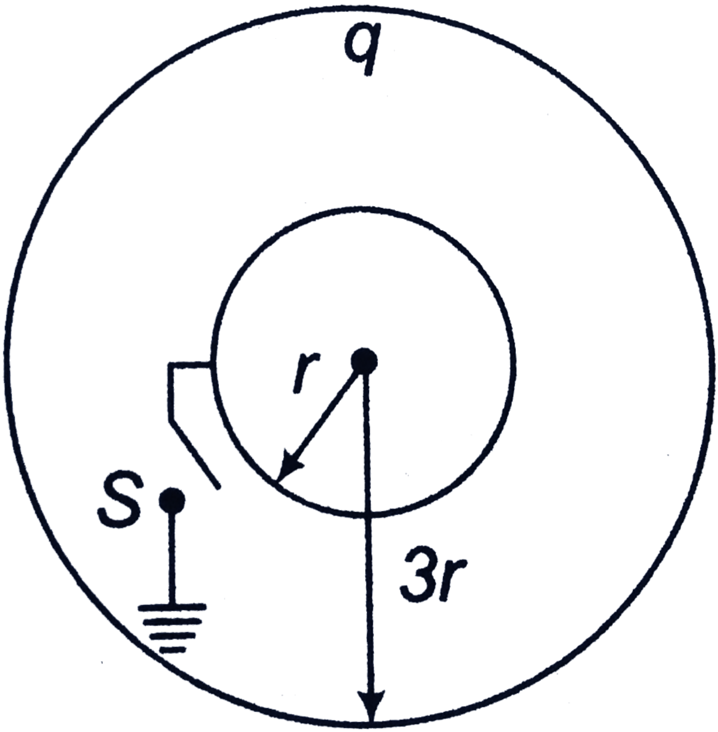
3. Figure shows two conducting thin concentric shells of radi r and $3r$. The outer shell carries a charge q. Inner shell in neutral. Find the charge that wilL flow from inner shell to earth the switch S is closed.



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

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

C. q

D. $-q$

Answer: A

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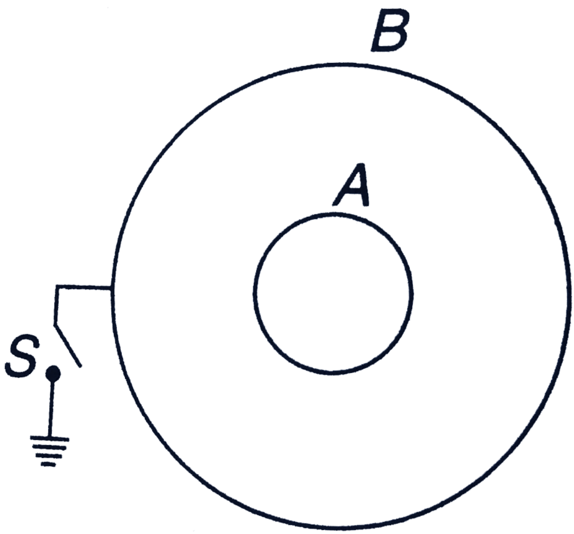
4. Initially the spheres A and B are at potentials V_A and V_B. Find the potential of A when sphere B is earthed.



A. V_A

B. 0

C. $V_A + V_B$

D. $V_A - V_B$

Answer: D

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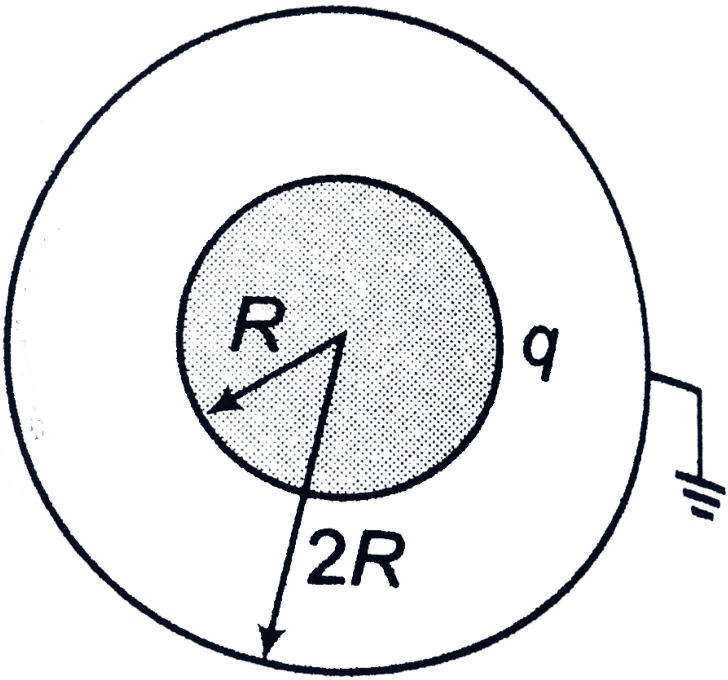
Example Type 8

1. A charge q is distributed uniformly on the surface of a sold sphere of radius R. It covered by a concentric hollow conduction sphere of radius $2R$. Find the charges inner and outer surface of hollow sphere if it is earthed.



A. $-q, 0$

B. $-q, q$

C. $0, 0$

D. $0, q$

Answer: A

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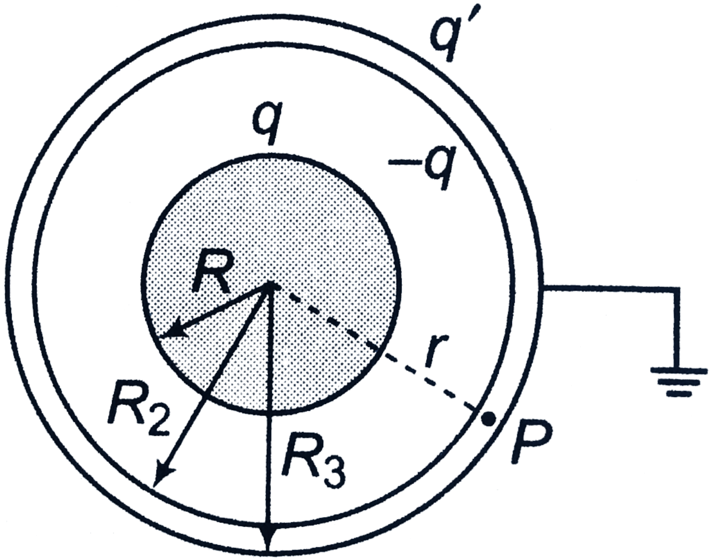
2. Solve the above problem if thickness of the hollow sphere is considerable.



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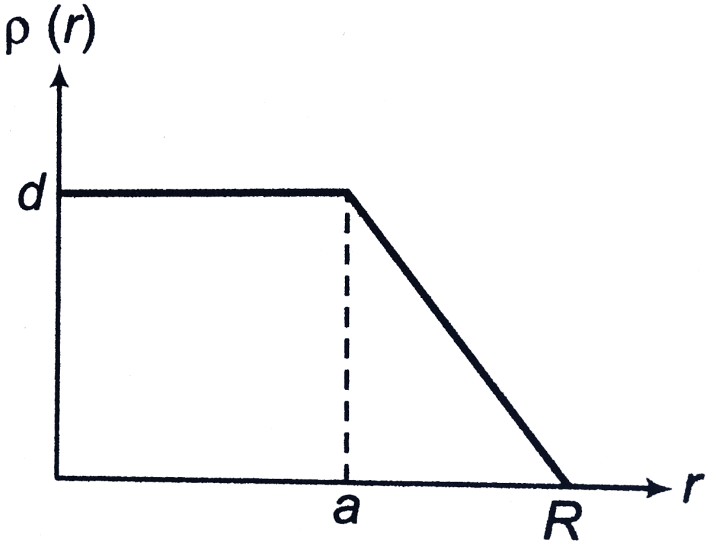
3. The nuclear charge (Ze) is non uniformlly distribute with in a nucleus of radius r. The charge density $\rho(r)$ (charge per unit volume) is dependent only on the radial distance r form the centre of the nucleus s shown in figure. The electric field is only along the radial direction.



The electric field at $r = R$ is

A. independent of a

B. directly proportional to a

C. directly proportional to a^2

D. inversely proportional to a

Answer: A

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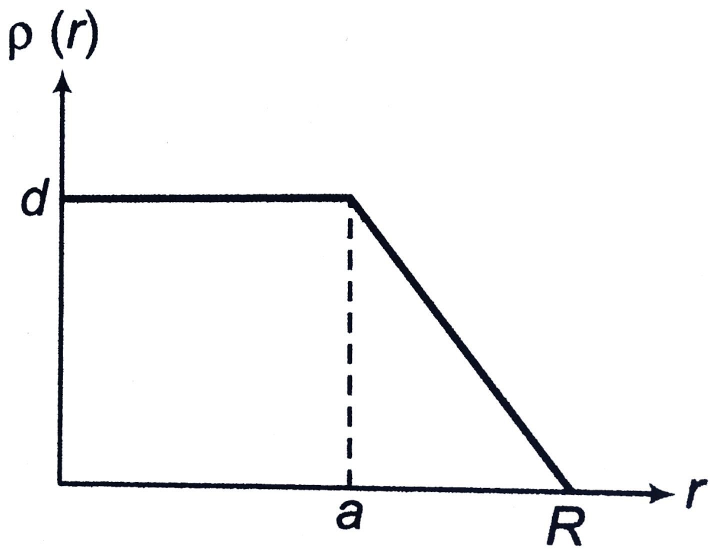
Level 2 Single Correct

1. The nuclear charge (Ze) is non uniformly distributed within a nucleus of radius r. The charge density $\rho(r)$ (charge per unit volume) is dependent only on the radial distance r form the centre of the nucleus as shown in figure. The electric field is only along the radial direction. For a=0 the value of d (maximum value of ρ as shown in the figure) is



A. $\frac{3Ze}{4\pi R^3}$

B. $\frac{3Ze}{\pi R^3}$

C. $\frac{4Ze}{3\pi R^3}$

D. $\frac{Ze}{3\pi R^3}$

Answer: B

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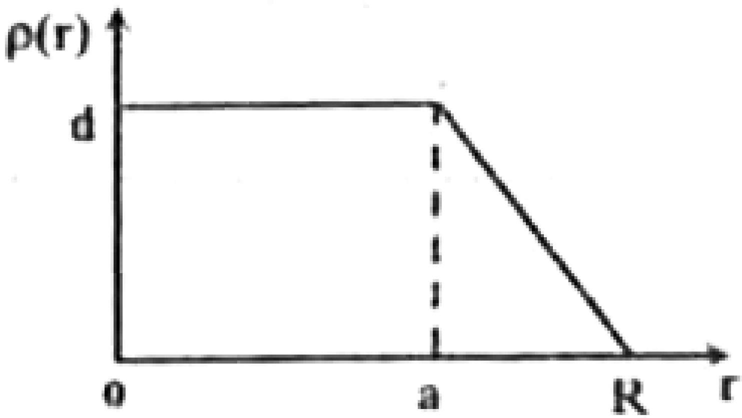
2. 

The electric field within the nucleus is generally observed to be linearly dependent on r. This implies.

A. $a = 0$

B. $a = \frac{R}{2}$

C. $a = R$

D. $a = \frac{2R}{3}$

Answer: C

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3. The electric field in a region is given by $E = a\hat{i} + b\hat{j}$. Hence as and b are constants. Find the net flux passing through a square area of side l parallel to y-z plane.

A. al^3

B. al^2

C. al^4

D. al

Answer: B

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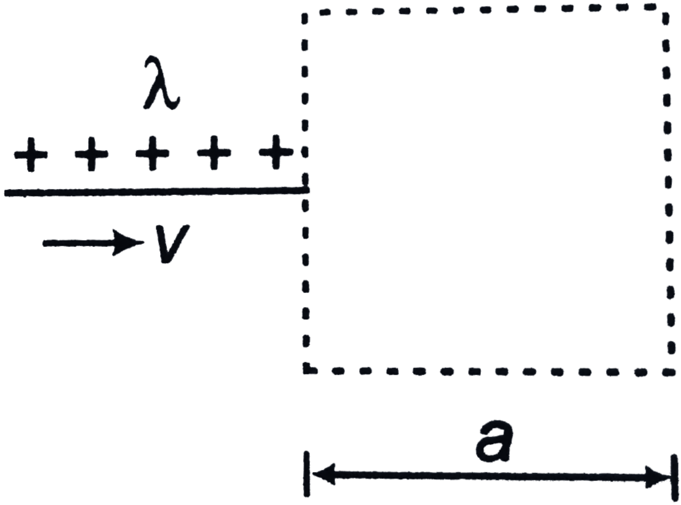
4. Figure shows an imaginary cube of side a. A uniformly charged rod of length a moves towards right at a constant speed v. At $t = 0$ the right end of the just touches the left face of the cube. Plot a graph between electric flux passing through the cube versus time.



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5. The electric field in a region is given by $E = \alpha x\hat{i}$. Here α is a constant of proper dimensions. Find

a. the total flux passing throug a cube bounded by the surface

$x = l, x = 2l, y = 0, y = l, z = 0, z = l.$

b. the charge contained inside in above cube.

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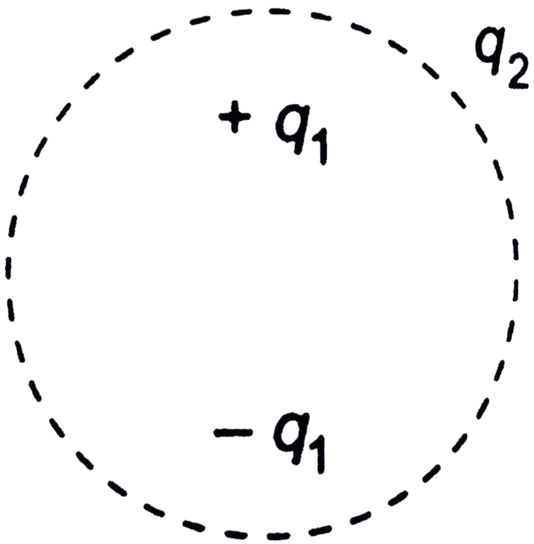
6. Consider the charge configuration and a spherical Gaussian surface as shown in the figure. When calculating the flux of the electric field over the spherical surface, the electric field will be due to.



A. q_2

B. only the positive charges

C. all the charges

D. $+q_1$ and $-q_1$

Answer: C

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7. A point charge q is placed on the apex of a cone of semi-vertex angle θ. Show that the electric flux through the base of the cone is $q(1-\cos\theta)/2\varepsilon_0$.

.

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8. Draw $E-r$ and $V-r$ graphs due to two point charges $+q$ and $-2q$ kept at some along the line joining these two charges.

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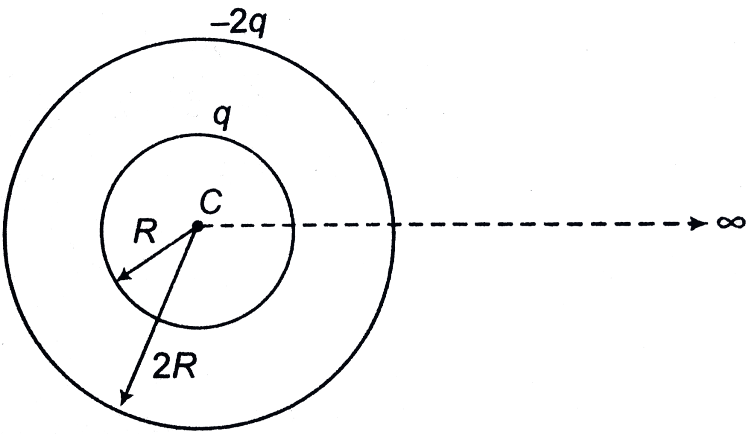
9. Draw E-r and V-r graphs due to two charged spherical shells as shown in figure (along the line between C and $\propto$)



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10. An electron with a speed 5.00×10^6 m/s enters an electric field of magnitude 10^3 N/C, travelling along the field lies in the direction that retards its motion.

a. How far will the electron travel in the field before stopping momentarily?

b. How much time will have elapsed?

c. If the regin with the electric field is only 8.00 mm long (too short from the electronn to stop with in it), what fraction of the elctron's initial kinetic energy wil be lost in that region.

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11. A charged particle of mass $m = 1$ kg and charge $q = 2\mu C$ is thrown for a horizotal ground at an angle $\theta = 45^\circ$ with speed $20m/s$. In space a horizontal electric field $E = 2 \times 10^7$ V/m exist. Find the range on horizontal ground of the projectile thrown.

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12. Find the potential difference V_{AB} between $A(2m, 1m, 0)$ and $B(0, 2m, 4m)$ in an electric field,

$$E = \left(x\hat{i} - 2y\hat{j} + z\hat{k}\right)\frac{V}{m}$$

A. $2V$

B. $5V$

C. $3V$

D. $4V$

Answer: C

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13. Find potential difference V_{AB} between $A(0, 0, 0)$ and B(1m,1m,1m)

$\in ane \leq ctricfielda$. E-yhati+xhatj$b$. E=3x^2yhati+x^3hatj`

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14. An electric dipole of dipole moment p is placed in a uniform electric field E in stable equilibrium position. Its moment of inertia about the centroidal axis is I . If it is displaced slightly from its mean position, find the period of small oscillations.

A. $\pi\sqrt{\frac{I}{pE}}$

B. $2\pi\sqrt{\frac{I}{pE}}$

C. $\pi\sqrt{\frac{2I}{pE}}$

D. $2\pi\sqrt{\frac{2I}{pE}}$

Answer: B

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15. Two identical thin ring, each of radius R meters, are coaxially placed a distance R metres apart. If Q_1 coulomb, and Q_2 coulomb, are repectively the charges uniformly spread on the two rings, the work done in moving a charge q from the centre of one ring to that of the other is

A. zero

B. $\frac{q(Q_1 - Q_2)(\sqrt{2} - 1)}{\sqrt{2}(4\pi\varepsilon_0 R)}$

C. $\frac{q\sqrt{2}(Q_1 + Q_2)}{(4\pi\varepsilon_0 R)}$

D. $q\left(\frac{Q_1}{Q_2}\right)(\sqrt{2}+1)\sqrt{2}\left(4\pi\varepsilon_0 R\right)$

Answer: B

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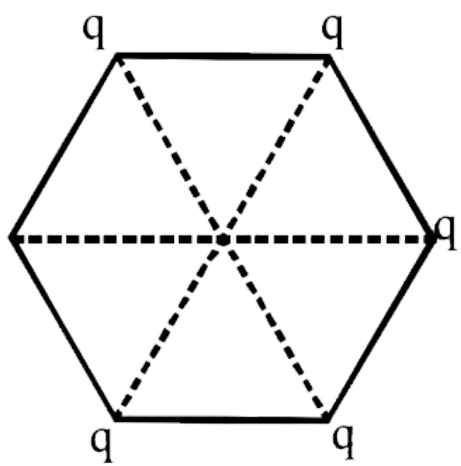
16. Five point charges, each of value +q coul, are placed on five vertices of a regular hexagon of isde L meters. The magnitude of the force on the point charge of value -q coul, placed at the centre of the hexagen is................



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17. A point charge $q_1 = 9.1\mu C$ is held fixed at origin. A second point charge $q_2 = -0.42\mu C$ and a mass $3.2 \times 10^{-4} kg$ is placed on the x-axis, $0.96m$ from the origin. The second point charge is released at rest. What is its speed when it is $0.24m$ from the origin?

A. $26m/s$

B. $2.6m/s$

C. $46m/s$

D. $4.6m/s$

Answer: A

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18. A point charge $q_1 = -5.8\mu C$ is held stationary at the origin. A second point charge $q_2 = +4.3\mu C$ moves from the pont $(0.26m0, 0)$ to $(0.38m, 0, 0)$. How much work is doen the electric force on q_2?

A. $0.172J$

B. $0.272J$

C. $0.372J$

D. $0.472J$

Answer: B

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19. A uniformly charged thin ring has radius $10.0cm$ and total charge $+12.0\mu C$. An electron is placed on the ring's axis a distance $25.0cm$ from the centre of the ring and is constrained to stay on the axis of the ring. The electron is then released from rest.

a. describe the subsequent motion of the electron

b. find the speed of the electron when it reaches the centre of the ring

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20. Two points A and B are 2 cm apart and a uniform electric field E acts along the straight line AB directed A to B with $E = 200N/C$. A particle of charge $+10^{-6}C$ is taken from A to B along AB, Calculate

a. the force on the charge

b. the potential difference $V_A - V_B$ and

c.the work done on the charge by E

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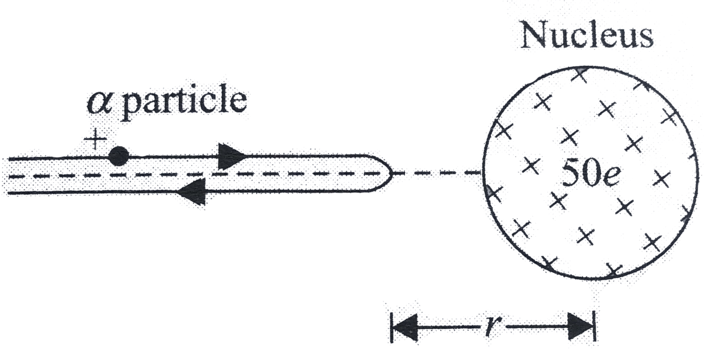
21. An alpha particle with kinetic energy $10MeV$ is heading toward a stationary tin nuclcus of atomic number 50. Calculate the distance of closest approach (Fig . 3.23).



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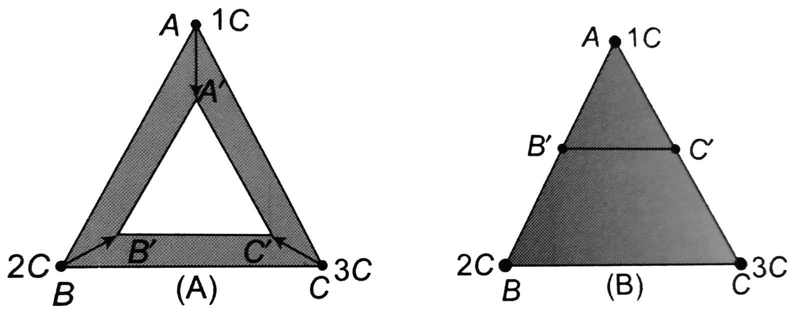
22. Three point charges $1C, 2C$ and $3C$ are placed at the corners of an equilaternal triangle of side $1m$. The work required to move these charges to the corners of a smaller equilaternal triangle of side $0.5m$ in two different ways as in fig. (A) and fig. (B) are W_a and W_b then:



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23. Consider a spherical surface of radius 4 m cenred at the origin. Point charges +q and - 2q are fixed at points A(2 m, 0,0) and B(8 m, 0, 0), respectively. Show that every point on the shperical surface is at zero potential.

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

$E = \frac{a(x\hat{i} + y\hat{j})}{x^2 + y^2}$ where, a is constant and $\hat{i}$ and $\hat{j}$ are the unit vectors of the x and y axes. Find the charges within a sphere of radius R with the centre at the origin.

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25. Find the electric field caused by a disc of radius a with a uniform surfce charge density σ (charge per unit area) at a point along the axis of the disc a distance x from its centre.

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26. A non-conducting disc of radius a and uniform positive surface charge density σ is placed on the ground, with its axis vertical. A particle of mass m and positive charge q is dropped, along the axis of the disc, from a height H with zero initial velocity. The particle has $q/m = 4 \in_0 g/\sigma$

(a) Find the value of H if the particle just reaches the disc.

(b) Sketch the potential energy of the particle as a function of its height and find its equilibrium position.

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27. Four point charges $+8\mu C, -1\mu C, -1\mu C$ and , $+8\mu C$ are fixed at the points $-\sqrt{27/2}m, -\sqrt{3/2}m, +\sqrt{3/2}m$ and $+\sqrt{27/2}m$ respectively on the y-axis. A particle of mass $6 \times 10^{-4}kg$ and $+0.1\mu C$ moves along the x-direction. Its speed at $x = +\infty$ is v_0. find the least value of v_0 for which the particle will cross the origin. find also the kinetic energy of the particle at the origin in tyhis case. Assume that there is no force part from electrostatic force.

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

A. $\frac{\rho R^2}{6\varepsilon_0}$

B. $\frac{\rho R^2}{4\varepsilon_0}$

C. $\frac{\rho R^2}{3\varepsilon_0}$

D. $\frac{\rho R^2}{2\varepsilon_0}$

Answer: A

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29. A positively charged disc is placed on a horizontal plane. A charged particle is released from a certain height on its axis. The particle just reaches the centre of the disc. Select the correct alternative.

A. particle has negative charge on it

B. total potential energy (gravitationl+electrostatic) of the particle first increases, then decreases

C. total potential energy of the particle first decreases, then increases

D. total potential energy of the particle contilnously decreses

Answer: C

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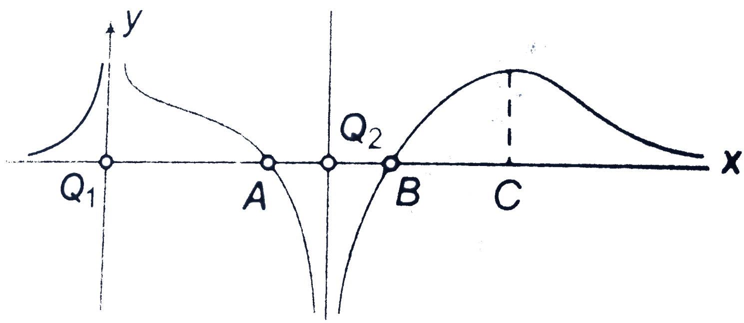
30. The curve represents the distribution of potential along the staight line joining the two charges Q_1 and Q_2 (separated by a distance r) then which of the following statements are correct?



1. $|Q_1| > |Q_2|$

2. Q_1 is positive in nature

3. A and B are equilibrium points

4. C is a point of unstable equilibrium

A. 1 and 2

B. 1,2,and 3

C. 1,2 and 4

D. 1,2,3 and 4

Answer: A

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31. A point charge $q_1 = q$ is placed at point P. Another point charge $q_2 = -q$ is placed at point Q. At some point $R(R \neq P, R \neq Q)$, electric potential due to $q - 1 is V_1$ and electric potential due to q_2 is V_2. Which of the following is correct

A. only for some points $V_1 > V_2$

B. only fro some points $V_2 > V_1$

C. for all points $V_1 > V_2$

D. for all points $V_2 > V_1$

Answer: C

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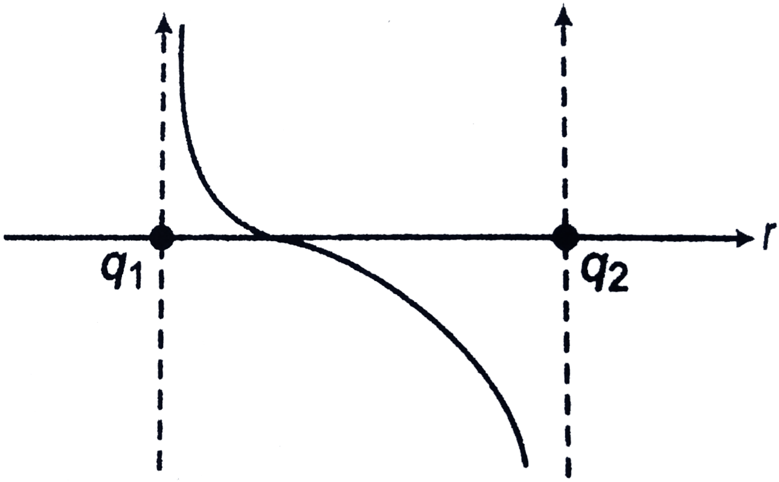
32. The variation of electric field between two charge q_1 and q_2 along the line joining the charges is plotted against distance from q_1 (taking rightward direction of electric field as positive) as shown in the figure.

Then the correct statement is



A. q_1 and q_2 are positive and $q_1 < q_2$

B. q_1 and q_2 are positive and $q_1 > q_2$

C. q_1 is positive and q_2 is negative $q_1 < |q_2|$

D. q_1 and q_2 are negative and $|q_1| < |q_2|$

Answer: A

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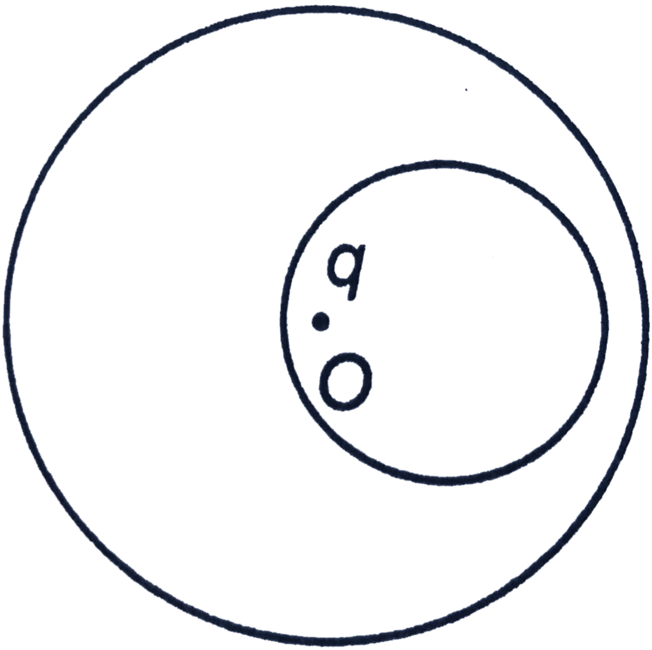
33. A charge q is placed at O in the cavity in a spherical uncharged conductor. Points S is outside the conductor. If q is displaced from O towards S (still remaining within the cavity)



A. electric field at S will increase

B. electric field at S will decrease

C. electric field at S will first increase and then decrease

D. electric field t S will not change

Answer: D

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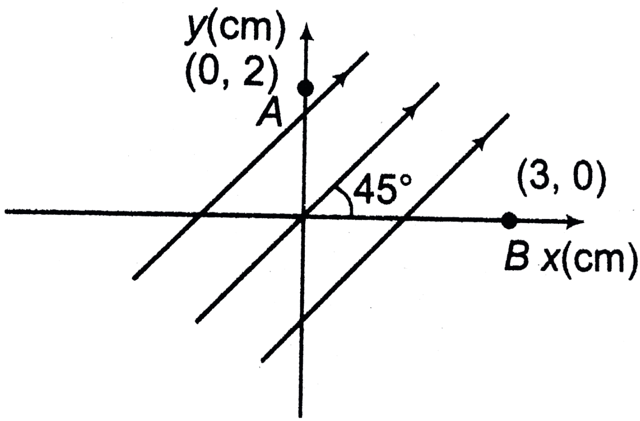
34. A uniform electric field of $400\frac{V}{m}$ is directed at 45° above the x-axis as shown in the figure. The potential difference $V_A - V_B$ is given by



A. 0

B. $4V$

C. $6.4V$

D. $2.8V$

Answer: D

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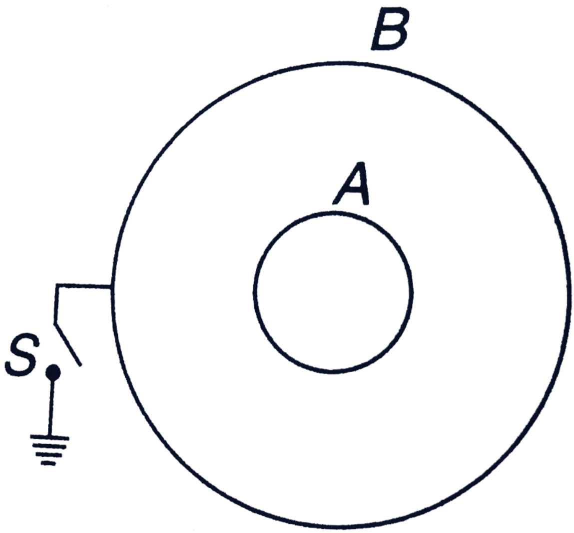
35. Initially the spheres A and B are at potentials V_A and V_B. Find the potential of A when sphere B is earthed.



A. 0

B. V_A

C. V_A - V_B

D. V_B

Answer: C

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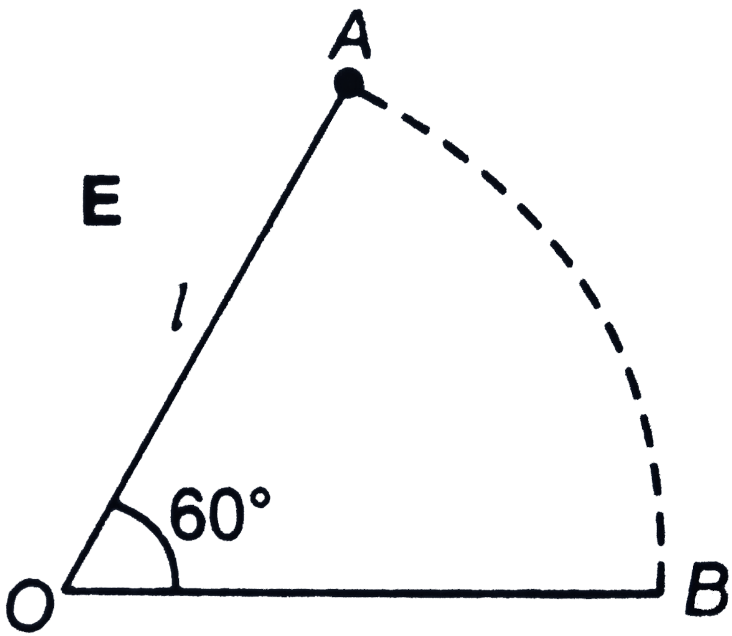
36. A particle of mass m and charge q is fastened to one end of a string of length. The other end of the string is fixed to the point O. The whole sytem liles on as frictionless horizontal plane. Initially, the mass is at rest at A. A uniform electric field in the direction shown in then switfched on. Then



A. the speed o fthe particle when it reaches B is $\sqrt{\frac{2qEl}{m}}$

B. the speed of the particle when it reaches B is $\sqrt{\frac{qEl}{m}}$

C. the tension in the string when the particle reaches at B is qE

D. the tension in the string when the particle reaches at B is zero

Answer: B

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37. A charged particle of mass m and charge q is released from rest the position $\left(x_0, 0\right)$ in a uniform electric field $E_0\hat{j}$. The angular momentum of the particle about origin.

A. is zero

B. is constant

C. increases with time

D. decreases with time

Answer: C

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38. A charge $+Q$ is uniformly distributed in a spherical volume of radius R. A particle of charge $+q$ and mass m projected with velocity v_0 the surface of the sherical volume to its centre inside a smooth tunnel dug across the sphere. The minimum value of v_0 such tht it just reaches the centre (assume that thee is no resistance on the particle except electrostatic force) of he sphericle volume is

A. $\sqrt{\dfrac{Qq}{2\pi\varepsilon_0 mR}}$

B. $\sqrt{\dfrac{Qq}{\pi\varepsilon_0 mR}}$

C. $\sqrt{\dfrac{2Qq}{\pi\varepsilon_0 mR}}$

D. $\sqrt{\dfrac{Qq}{4\pi\varepsilon_0 mR}}$

Answer: D

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39. Two identical coaxial rings each of radius R are separated by a distance of $\sqrt{3}R$. They are uniformly charged with charges $+Q$ and -Q respectively. The minimum kinetic energy with which a charged particle (charge $+q$) should be projected from the centre of the negatively charged ring along the axis of the rings such that it reaches the centre of the positively charged ring is

A. $\dfrac{Qq}{4\pi\varepsilon_0 R}$

B. $\dfrac{Qq}{2}\pi\varepsilon_0 R\Big)$

C. $\dfrac{Qq}{8\pi\varepsilon_0 R}$

D. $\dfrac{3Qq}{4\pi\varepsilon_0 R}$

Answer: A

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40. A uniform electric field exists in x-y plane. The potential of points $A(2m, 2m), B(-2m, 2m)$ and $C(2m, 3m)$ are $4V, 16V$ and $12V$ respectively. The electric field is

A. $\left(4\hat{i} + 5\hat{j}\right)V/m$

B. $\left(3\hat{i} + 4\hat{j}\right)V/m$

C. $-\left(3\hat{i} + 4\hat{j}\right)V/m$

D. $\left(3\hat{i} - 4\hat{j}\right)V/m$

Answer: D

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41. Two fixed charges $-2Q$ and $+Q$ are located at points $(-3a, 0)$ and $(+3a, 0)$ respectively. Then which of the following statement is correct?

A. Points where the electric potential due to the two charges is zero in x-y plane, lie on a circle radius 4a and centre (5a,0)

B. potential is zero at $x = a$ and $x = 9a$

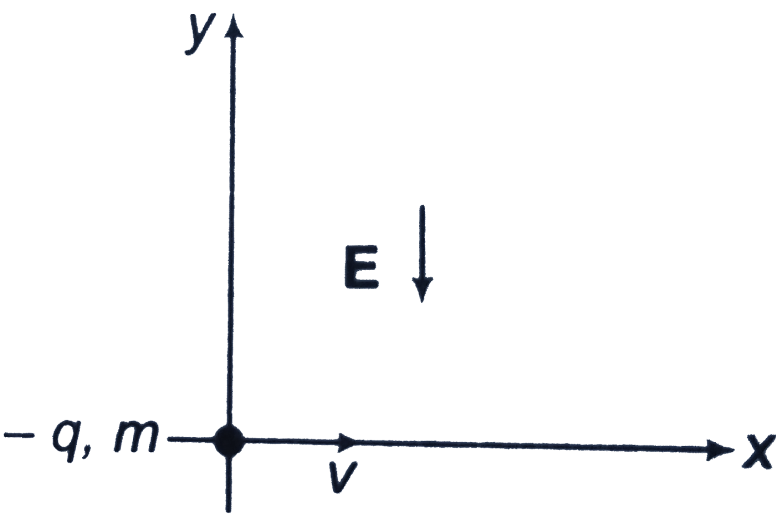
C. both a and b are wrong

D. both a and b are correct

Answer: D

Watch Video Solution

42. A particle of mass m and charge -q is projected from the origin with a horizontal speed v into an electric field of intensity E directed downward. Choose the wrong statement. Neglect gravity



A. The kinetic energy after a displacement y is qEy

B. The horizontal and vertical components of acceleration of

$a_x = 0, a_y = \frac{qE}{m}$

C. the equation of trajectory is $y = \frac{1}{2}\left(\frac{qEx^2}{mv^2}\right)$

D. The horizontall and verticasl displacements x and y after a time t

x=vt and $y = \frac{1}{2}a_y t^2$

Answer: A

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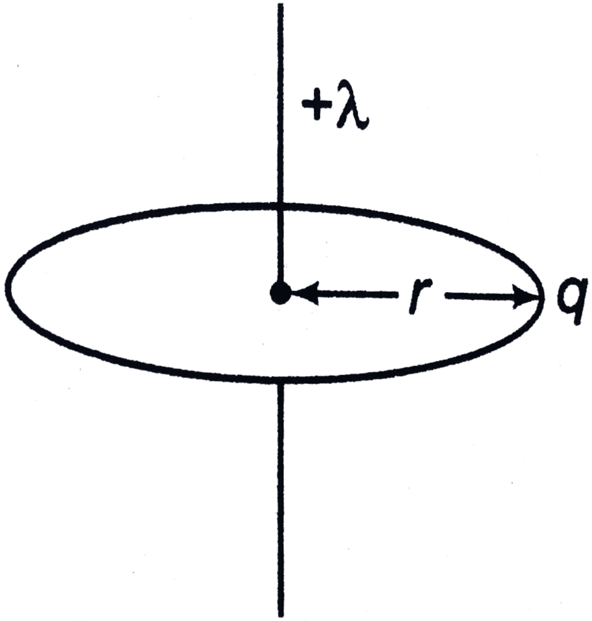
43. A particle of charge -q and mass m moves in a circle of radius r around an infinitely long line charge of linear charge density $+\lambda$. Then, time period will be



where ,

$k = \frac{1}{4}\pi\varepsilon_0\Big)$

A. $T = 2\pi r\sqrt{\left(\frac{m}{2k\lambda q}\right.}$

B. $T^2 = \frac{4\pi^2 m}{2k\lambda q}r^3$

C. $T = \frac{1}{2\pi r}\sqrt{\frac{2k\lambda w}{m}}$

D. $T = \frac{1}{2\pi r}\sqrt{\frac{m}{2k\lambda q}}$

Answer: A

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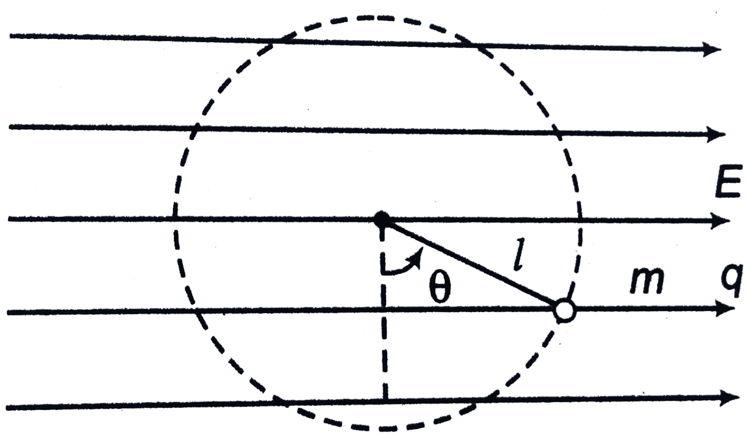
44. A small ball of masss m and charge +q tied with a string of length l, rotating in a veticle circle under gravity and a uniform horizontal electric field E as shown. The tension in the string will be minimum for



A. $\theta = \tan^{-1}\left(\frac{qE}{mg}\right)$

B. $\theta = \pi$

C. $\theta = 0^\circ$

D. $\theta = \pi + \tan^{-1}\left(\frac{qE}{mg}\right)$

Answer: D

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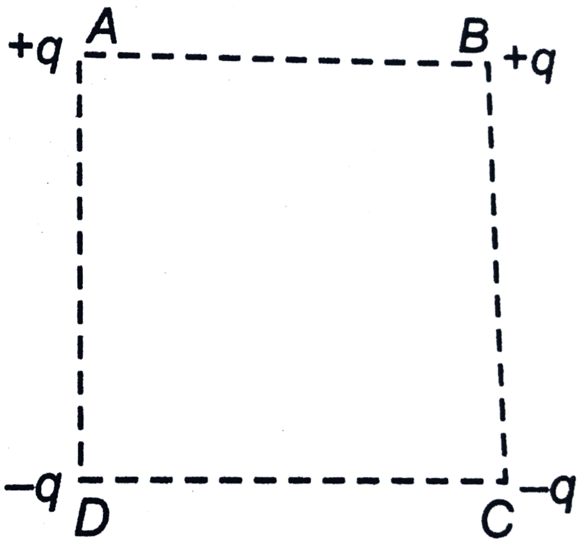
45. For charges A,B,C and D are plasced at the four corners of a squre of a side a. The energy required to take the charges C and D to infinity (they are also infinitely separated from each other)is



A. $\dfrac{q^2}{4\pi\varepsilon_0 a}$

B. $\dfrac{2q^2}{\pi\varepsilon_0 a}$

C. $\dfrac{q^2}{4\pi\varepsilon_0 a}\left(\sqrt{2}+1\right)$

D. $\dfrac{q^2}{4\pi\varepsilon_0 a}\left(\sqrt{2}-1\right)$

Answer: C

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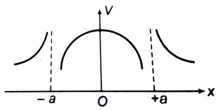
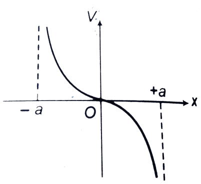
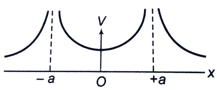
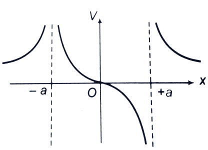
46. Two identical positive charges are placed at $x = -a$ and $x = a$. The correct variation of potential V along the x-axis is given by

A. (a)


B. (b)


C. (c)


D. (d)


Answer: C

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47. Two identical charges are placed at the two corners of an equilateral triangle. The potential energy of the system is U. The work done in bringing an identical charge from infinity to the third vertex is

A. U

B. $2U$

C. $3U$

D. $4U$

Answer: B

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48. A charged particle q is shot from a large distance towards another charged particle Q which is fixed, with speed v. It approaches Q up to as closed distance r and then returns. If q were given a speed 2v, the distance of approach would be

A. r

B. $2r$

C. $r/2$

D. $r/4$

Answer: D

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49. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30° with each other. When suspended in a liquid of density $0.8 gcm^{-3}$, the angle remains the same. If density of the material of the sphere is $1.6 gcm^{-3}$, the dielectric constant of the liquid is

A. 2

B. 4

C. 2.5

D. 3.5

Answer: A

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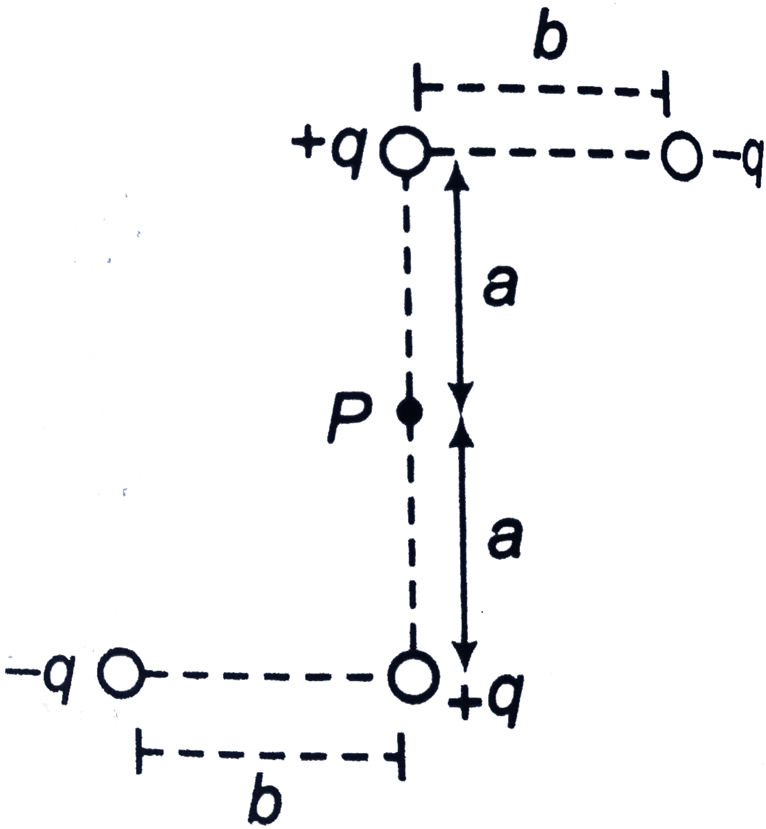
50. The electrostatic potential due to the charge configuration at point P as shown in figure for bltlta is



A. $\frac{2q}{4\pi\varepsilon_0 a}$

B. $\frac{2qb^2}{4\pi\varepsilon_0 a^3}$

C. $\frac{qb^2}{4\pi\varepsilon_0 a^3}$

D. zero

Answer: C

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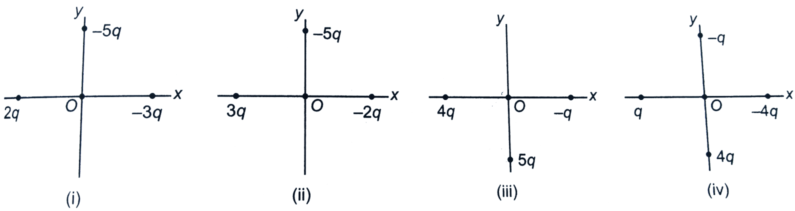
51. The figure show four situations in which charged particles are at equal distances from the origin. If E_1, E_2, E_3 and E_4 be the magnitude of the net electic field at the origin in four situations i, ii, iii and iv respectively then



A. $E_1 = E_2 = E_3 = E_{+}4$

B. $E_1 = E_2 > E_3 > E_4$

C. $E_1 < E_2 < E_3 = E_4$

D. $E_1 > E_2 = E_3 > E_4$

Answer: A

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52. An isolated conduction sphere sphere whose radius $R = 1$ m has a charge $q = \frac{1}{9}nC$. The energy density at the surface of the sphere is

A. $\frac{\varepsilon_0}{2}J/m^3$

B. $\varepsilon_0 J/m^3$

C. $2\varepsilon_0 J/m^3$

D. $\varepsilon_0/3Jm^3$

Answer: A

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53. Two conducting concentric, hollow spheres A and B have radii a and b respectively, with A inside B. Their common potentials is V. A is now given some charge such that its potential becomes zero. The potential of B will now be

A. 0

B. $V(1 - a/b)$

C. Va/b

D. Vb/a

Answer: B

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54. In a uniform electric field, the potential is $10V$ at the origin of coordinates , and $8V$ 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. $4V$

C. $8V$

D. $10V$

Answer: B

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55. There are two uncharged identicasl metallic spheres 1 and 2 of radius r separated by a distance $d(d > > r)$. A charged metalllic sphere of same radius having charge q is touched with one of the sphere. After some time it is moved away fom the system. Now, the uncharged sphere is earthed. Charge on earthed sphere is

A. $+\frac{q}{2}$

B. - $\frac{q}{2}$

C. - $\frac{qr}{2d}$

D. - $\frac{qd}{2r}$

Answer: C

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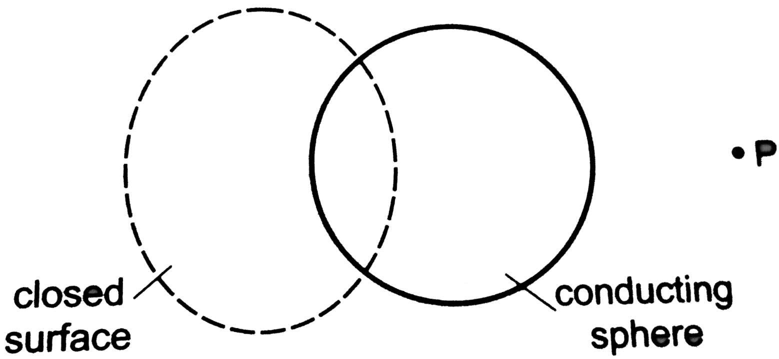
56. Figure shown a closed surface which intersects a conducting sphere. If a positive charge is placed at the point P, the flux of the electric field through the closed surface



A. will remain zero

B. will become positive

C. will become negative

D. data insufficient

Answer: B

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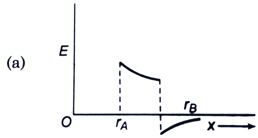
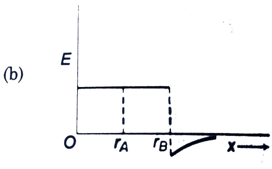
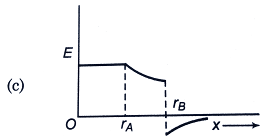
57. Two concentric coducting thin spherical shells A and B having radii r_A and $r_B\left(r_B > r_A\right)$ are charged to Q_A and -$Q_B\left(\left|Q_B\right| > \left|Q_A\right|\right)$. The electrical field along a line passing through the centre is

A. 

B. 

C. 

D. none of these

Answer: A

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58. The electric potential at a point (x, y) in the x-y plane is given by $V = -kxy$. The field intentisy at a distance r in this plane, from the origin is proportional to

A. r^2

B. r

C. $1/r$

D. $1/r^2$

Answer: B

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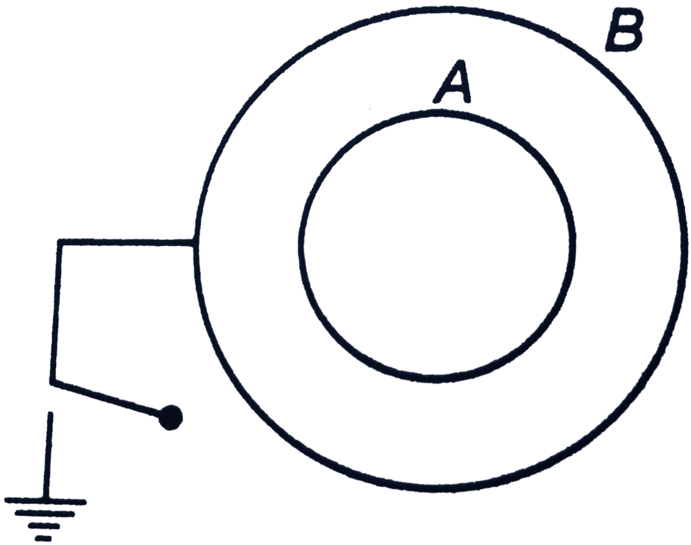
59. Two concentric shells have radii R and $2R$ charges q_A and q_B and potentials $2V$ and $\left(\frac{3}{2}\right)V$ respectively. Now, shell B is earthed and let charges on them become q_A' and q_B'. Then,



A. $q_A / q_B = \frac{1}{2}$

B. $q_A' / q_B' = 1$

C. potential of AS after earhing becomes $\left(\frac{3}{2}\right)V$

D. potential difference between A and B after earting becomes $V/2$

Answer: A::D

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60. A particle of mass 2 kg chrge 1 mC is projected vertially with velocity k $10ms^{-1}$. There is as uniform horizontal electric field of $10^4 N/C$, then

A. the horizontal range of the particle is $10m$

B. the time of flight of the particle is $2s$

C. the maximum heighty reached is $5m$

D. the horizontal range of the particle is $5m$

Answer: A::B::C

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61. At a distance of $5cm$ and $10cm$ outward from the surface of a uniformly charged solid sphere, the potentials are $100V$ and $75V$, repectively. Then.

A. potential at its surface is $150V$

B. the charge on the shre is $\frac{50}{3} \times 10^{-10} C$

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

D. the electric potential at its centre is $25V$

Answer: A::B::C

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62. Three charged particle sare in equilibrium under their electrostatic forces only. Then

A. the particle smust be collinear

B. all the charges cannot have the same magnitude

C. all the charges cannot have the same sign

D. the equilibrium is unstable

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

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63. Charges Q_1 and Q_2 lie inside and outside, respectively, of a closed surface S. Let E be the field at any point on S and ϕ be the flux of E over S.

A. If Q_1 changes both E and ϕ will change

B. If Q_2 changes, will changes but ϕ will not change

C. If $Q_1 = 0$ and $Q_2 \neq 0$, then $E \neq 0$ but $\phi = 0$

D. If $Q_1 \neq 0$ and $Q_2 = 0$, the $E = 0$ but $\phi \neq 0$

Answer: A::B::C

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

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

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

C. the electric field is not at any where on the sphere

D. the electric field is zero on a circle on the sphere

Answer: A::C

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65. Mark correct options

A. Gauss's law is valild 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 al tlhe charges

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

Answer: C::D

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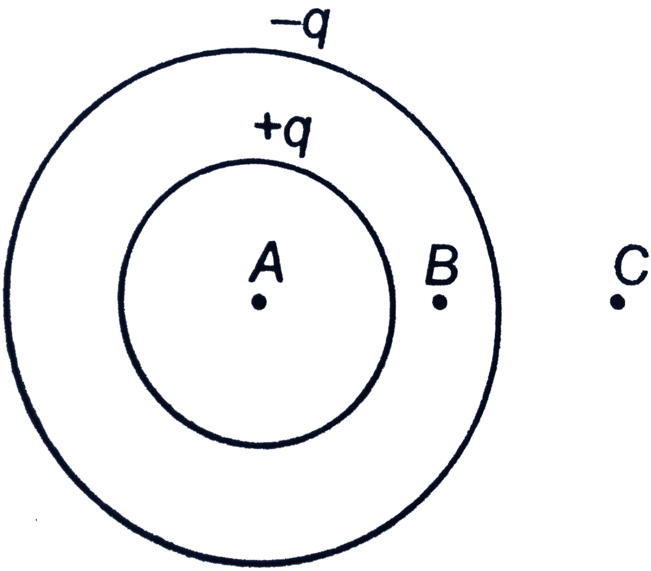
66. Two concentric spherical shells have charges $+q$ and $-q$ as shown in figure. Choose the correct options.



A. At a electric field is zero but electric potentiasl in non zero

B. At B electic feid and electric potential both are non zero

C. At C electric field is Zero but electric potential is non zero

D. At C electrilc fiedl and electric potential both are zero

Answer: A::B::D

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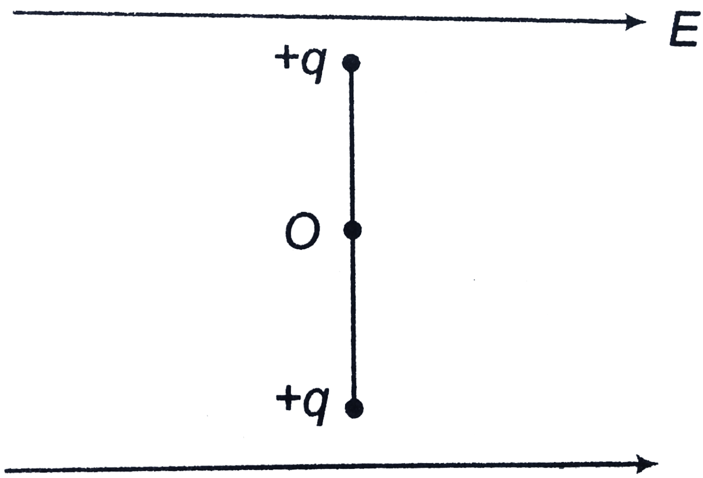
67. A rod is hinged (free to rotate) ast its centre O as shown in figue. Two point charge $+q$ and $+q$ are kept at its two ends. Rod is placed in uniform electric field E as shown. Space is gravity free. Choose the correct options.



A. net force from the hinge on the rod is zerr

B. net force from he hinge onn the rod is leftwards

C. Equilibrium of rod is neutral

D. Equilibrium of rod is stable

Answer: B::C

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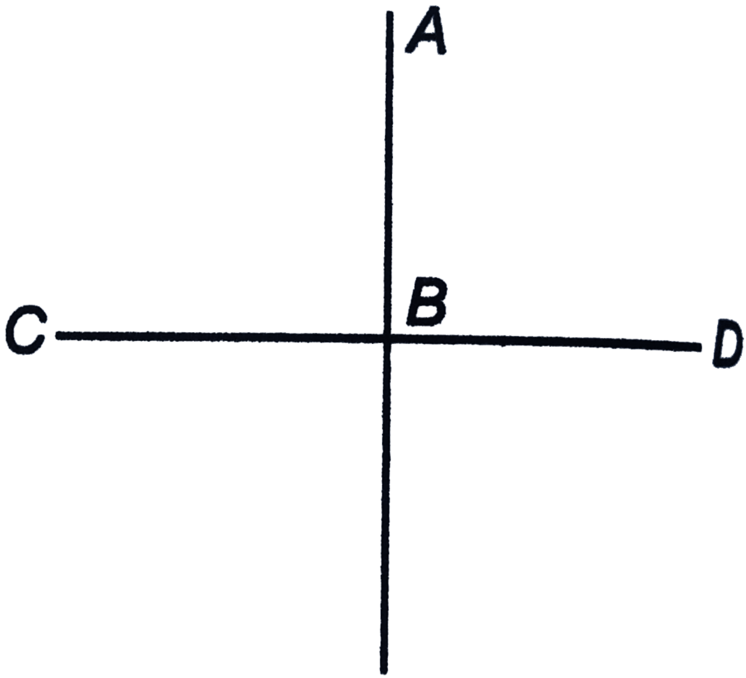
68. Two charges $+Q$ each are fixed at points C and D. Line AB is the bisector line of CD. A third charge $+q$ is moves from A to B, then from B to C



A. From A to B electrostatic potential energy wil decrese

B. from A to B electrostastic potential ennergy wil increase

C. From B to C electrostatic potential energy will increase

D. From B to C electrostatic potential energy will decrease

Answer: B::C

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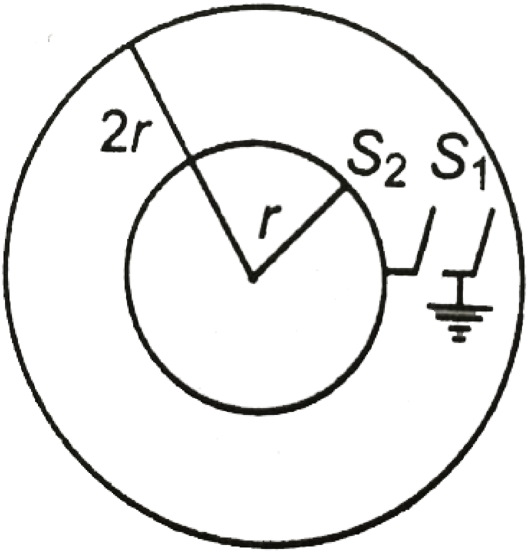
69. There are two concentric spherical shell of radii r and $2r$. Initially, a charge Q is given to the inner shell and both the switches are open.



If switch S_1 is closed and then opened, charge on the outer shell will be

A. Q

B. $Q/2$

C. -Q

D. -$Q/2$

Answer: C

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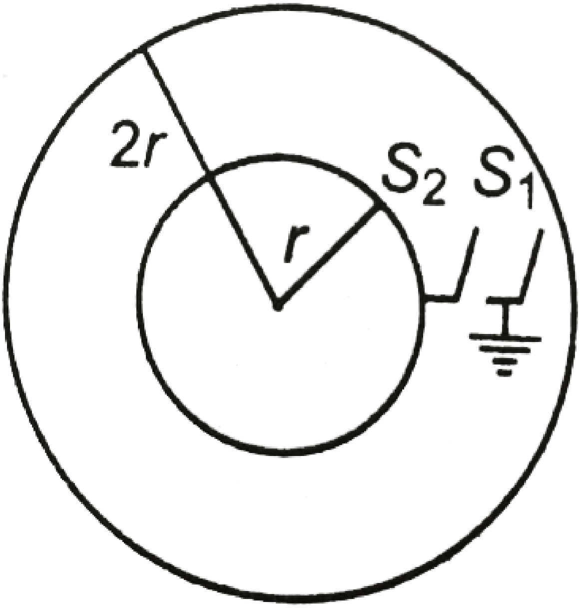
70. There are two concentric spherical shell of radii r and $2r$. Initially, a charge Q is given to the inner shell and both the switches are open.



Now, S_2 is closed and opened. The charge flowing through the swithc S_2 in the process is

A. Q

B. $Q/4$

C. $Q/2$

D. $2Q/3$

Answer: C

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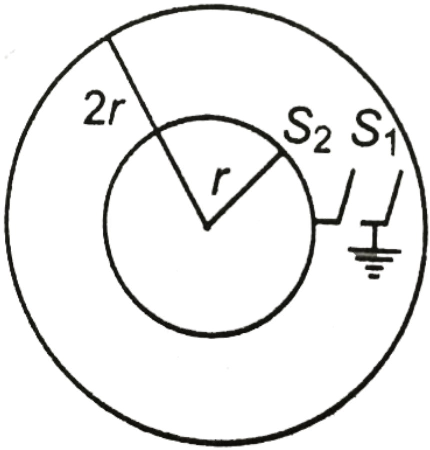
71. There are two concentric spherical shell of radii r and $2r$. Initially, a charge Q is given to the inner shell and both the switches are open.



The twio steps of the above two problems are repeated b times, the potential differences between the shells will be

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

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

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

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

Answer: A

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72. A sphere of charges of radius R carries a positive charge whose volume charge density depends only on the distance r from the ball's centre as $\rho = \rho_0\left(1 - \frac{r}{R}\right)$, where ρ_0 is constant. Assume epsilon as the permittivity of space.

The magnitude of electric field as a function of the distance r inside the sphere is given by

A. $E = \frac{\rho_0}{\varepsilon}\left[\frac{r}{3} - \frac{r^3}{4R}\right]$

B. $E = \frac{\rho_0}{\varepsilon}\left[\frac{r}{4} - \frac{r^3}{3R}\right]$

C. $E = \frac{\rho_0}{\varepsilon}\left[\frac{r}{3} + r^2(4R)\right]$

D. $E = \frac{\rho_0}{\varepsilon}\left[\frac{r}{4} + \frac{r^2}{3R}\right]$

Answer: A

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73. A sphere of charges of radius R carries a positive charge whose volume chasrge density depends only on the distance r from the ball's centre as $\rho = \rho_0\left(1 - \frac{r}{R}\right)$, where$\rho_0$ is constant. Assume epsilon as theh permittivity of space.

The magnitude of the electric field as a functiion of the distance r outside the balll is given by

A. $E = \frac{\rho_0 R^3}{8\varepsilon r^2}$

B. $E = \frac{\rho_0 r^3}{12\varepsilon r^2}$

C. $E = \frac{\rho_0 R^2}{8\varepsilon r^3}$

D. $E = \frac{\rho_0 R^2}{12\varepsilon r^3}$

Answer: B

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74. A sphere of charges of radius R carries a positive charge whose volume chasrge density depends only on the distance r from the ball's centre as $\rho = \rho_0\left(1 - \frac{r}{R}\right)$, where ρ_0 is constant. Assume epsilon as theh permittivity of space.

The value of distance r_m at which electric field intensity is maximum is given by

A. $r_m = \frac{R}{3}$

B. $r_m = \frac{3R}{2}$

C. $r_m = \frac{2R}{3}$

D. $r_m = \frac{4R}{3}$

Answer: C

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75. A sphere of charges of radius R carries a positive charge whose volume chasrge density depends only on the distance r from the ball's centre as $\rho = \rho_0\left(1 - \frac{r}{R}\right)$, where ρ_0 is constant. Assume epsilon as theh permittivity of space.

the maximum electric field intensity is

A. $E_m = \frac{\rho_0 R}{9\varepsilon}$

B. $E_m = \frac{\rho_0 \varepsilon}{9R}$

C. `E_m=(rhoR)/(3epsilon)

D. $E_m = \frac{\rho_0 R}{6\varepsilon}$

Answer: A

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76. A solid metallic sphere of radius a is surrounded by a conducting spherical shell of radius $b(b > a)$. The solid sphere is given a charge Q. A student measures the potential at the surface of the solid sphere as V and the potential at the surface of spherical shell as V_b. After taking these readings, he decides . to put charge of -$4Q$ on the shell. He then noted the readings of the potential of solid sphere and the shell and found that the potential difference is $\triangle V$.

He then connected the outer spherical shell to the earth by a conducting wire and found that the charge on the outer surface of the shell as He then decides to remove the earthing connection from the shell and earthed the inner solid sphere. Connecting the inner sphere with the earth he observes the charge on the solid sphere as q_2. He then wanted to check what happens if the two are connected by the conducting wire. So he removed the earthing connection and connected a conducting wire between the solid sphere and the spherical shelll. After the connections were made he found the charge on the outer shell as q_3.

Potential difference ($\triangle CV$) measured by the student between the inner solid shere and outer shell after putting a charge -$4Q$ is

A. $V_a - 3V_b$

B. $3\left(V_a - V_b\right)$

C. V_a

D. $V_a - V_b$

Answer: D

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77. A solid metallic sphere of radius a is surrounded by a conducting spherical shell of radius $b(b > a)$. The solid sphere is given a charge Q. A student measures the potential at the surface of the solid sphere as V and the potential at the surface of spherical shell as V_b. After taking these readings, he decides . to put charge of $-4Q$ on the shell. He then noted the readings of the potential of solid sphere and the shell and found that the potential difference is $\triangle V$.

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q_2 is

A. Q

B. $Q\left(\frac{a}{b}\right)$

C. $-4Q$

D. zero

Answer: B

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78. A solid metallic sphere of radius a is surrounded by a conducting spherical shell of radius $b(b > a)$. The solid sphere is given a charge Q. A student measures the potential at the surface of the solid sphere as V and the potential at the surface of spherical shell as V_b. After taking these readings, he decides . to put charge of $-4Q$ on the shell. He then noted the readings of the potential of solid sphere and the shell and found that the potential difference is $\triangle V$.

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q_3 is

A. $\dfrac{Q(a+b)}{a-b}$

B. $\frac{Qa^2}{b}$

C. $\frac{Q(a - b)}{b}$

D. $-\frac{Qb}{a}$

Answer: C

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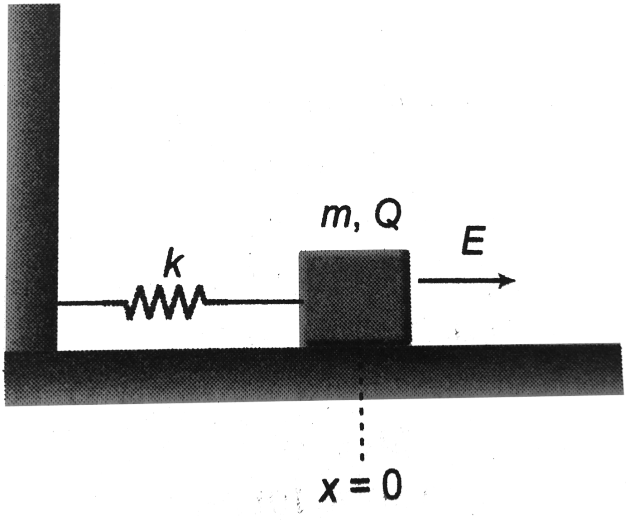
79. A $4.00kg$ block carrying a charge $Q = 50.0\mu C$ is connected to a spring for which k = 100 N/ m. The block lies on a frictionless horizontal track, and the system is immersed in a uniform electric field of magnitude $E = 5.00 \times 10^5 \frac{V}{m}$, directed as shown in figure. If the block is released from rest when the spring is unstretched (at x = 0).



(a) By what maximum amount does the spring expand?

(b) What is the equilibrium position of the block?

(c) Show that the block's motion is simple harmonic and determine its period.

(d) Repeat part (a) if the coefficient of kinetic friction between block and surface is 0.2.

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80. A particle of mass m and charge $-Q$ is constrained to move along the axis of a ring of radius a. The ring carries a uniform charge density $+\lambda$ along its length. Initially, the particle is in the centre of the ring where the force on it is zero. Show that the period of oscillation of the particle when it is displaced slightly from its equilibrium position is given by

$$T = 2\pi sq\sqrt{\frac{2\varepsilon_0 ma^2}{\lambda Q}}$$

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81. Three identical conducting plain parallel plates, each of area A are held with equal (/ between successive surfaces. Charges $2Q$, and $3Q$ are placed on them. Neglecting edge effects, find the Charge on the left face of the middle plate

A. 0

B. 2Q

C. 3Q

D. None of the Above

Answer: B

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82. A long non-conducting, massless rod of length L pivoted at its centre and balanced with a weight w at a distance x from the lefrt end. At the left and right ends fo the rod are attached small conducting sphers with positive charfges q and $2q$ respectively. A distance h directly beneath each of these spheres is a fixed sphere with positive charge Q.

(a) Find the distance x where the rod is horizontal and balanced.b. What valueshold h have so that the rod exerts no vertical force on the bearing when the rod is horizontal and balanced?

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83. The electric potential varies in space according to the relation $V = 3x + 4y$. A particle of mass 10 kg starts from rest from point $(2, 3.2)$ m under the influence of this field. Find the velocityr,f the particle when it crosses the x-axis. The charge on the particle is $+1\mu C$. Assume V (x, y)are in SI units.

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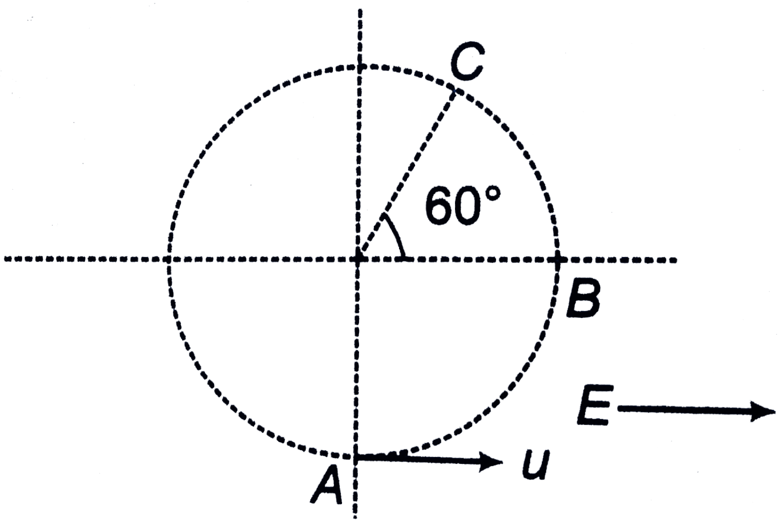
84. A simple pendulum with a bob of mass $m = 1$ kg, charge $q = 5\mu C$ and string length imis given a horizontal velocity a in a uniform electric field $E = 2 \times 10^6 \frac{V}{m}$ at its bottommost point A, as shown in figure. It is given that the speed a is such that the particle leaves the circle at point C. Find the speed a (Take $g = 10\frac{m}{s^2}$)



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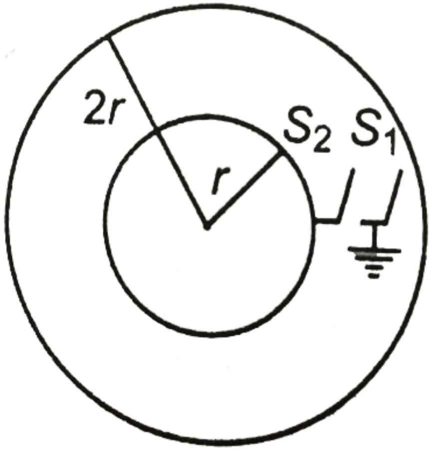
85. There are two concentric spherical shell of radii r and $2r$. Initially, a charge Q is given to the inner shell and both the switches are open.



The twio steps of the above two problems are repeated b times, the potential differences between the shells will be

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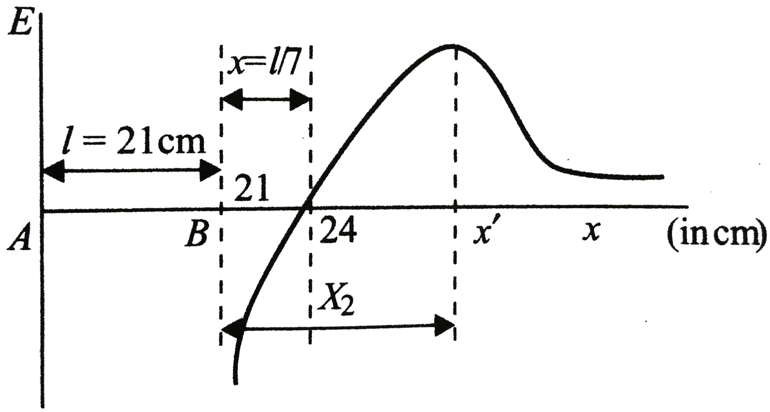
86. Two point charge Q_a and Q_b are positional at point A and B. The field strength to the right of charge Q_b on the line that passes through the two charges varies according to a law represented schematically in fig. (without employing a definite scale). The field strength is assumed to be positive 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 ration 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.

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87. A conducting sphere S_1 of radius r is attached to an insulating handle. Another conduction sphere S_2 of radius R is mounted on an insulating stand. S_2 is initially uncharged. S_1 is given a charge Q brought into contact with S_2 and removed. S_1 is recharge such that the charge on it is again Q and it is again brought into contact with S_2 and removed. This procedure is repeated n times.

a. Find the electrostatic energy of S_2 after n such contacts with S_1.

b. What is the limiting value of this energy as $n \to \infty$?

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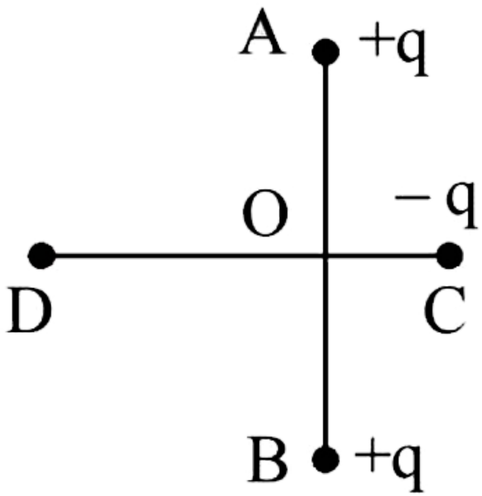
88. Two fixed, equal, positive charges, each of magnitude 5×10^{-5} coul are located at points A and B separated by a distance of 6m. An equal and opposite charge moves towards them along the line COD, the perpendicular bisector of the line AB.

The moving charge, when it reaches the point C at a distance of 4m from O, has a kinetic energy of 4 joules. Calculate the distance of the farthest point D which the negative charge will reach before returning towards C.



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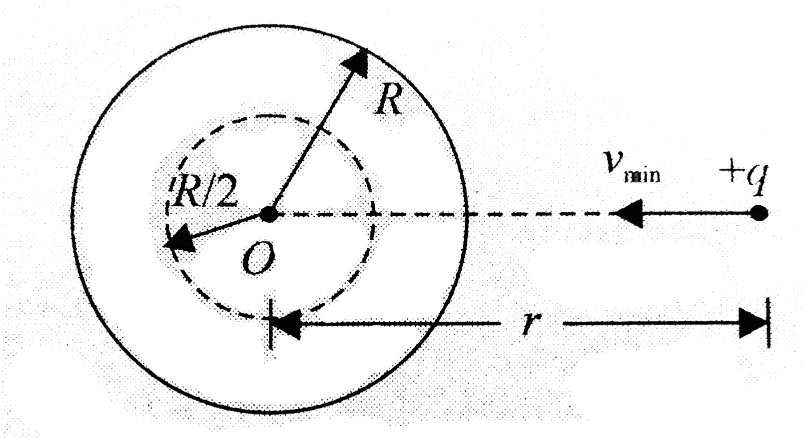
89. A positive charge Q is uniformly distributed throughout the volume of a dielectric sphere of radius R. A point mass having charge +q and mass m is fired toward the center of the sphere with velocity v from a point at distance $r(r > R)$ from the center of the sphere. Find the minimum velocity v so that it can penetrate $(R/2)$ distance of the sphere. Neglect any resistance other than electric interaction. Charge on the small mass

remains constant throughout the motion.



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90. A point charge $-q$ revolves around a fixed charge $+Q$ in elliptical orbit. The minimum ar.d maximum distance of q from Q are r_1 and r_2, respectively. The mass of revolving particle is $Q > q$ and assume no gravitational effects. Find the velocity of q at positions when it is at r_1 and r_2 distance from Q.

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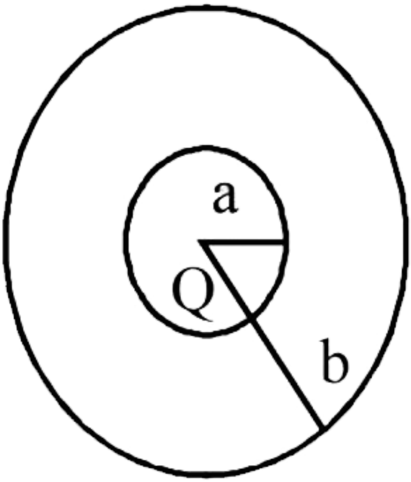
91. The region between two concentric spheres of radii 'a' and 'b', respectively (see figure), have volume charge density $\rho = \frac{A}{r}$, where A is a constant and r is the distance from the centre. At the centre of the spheres is a point charge Q. The value of A such that the electric field in the region between the spheres will be constant, is:



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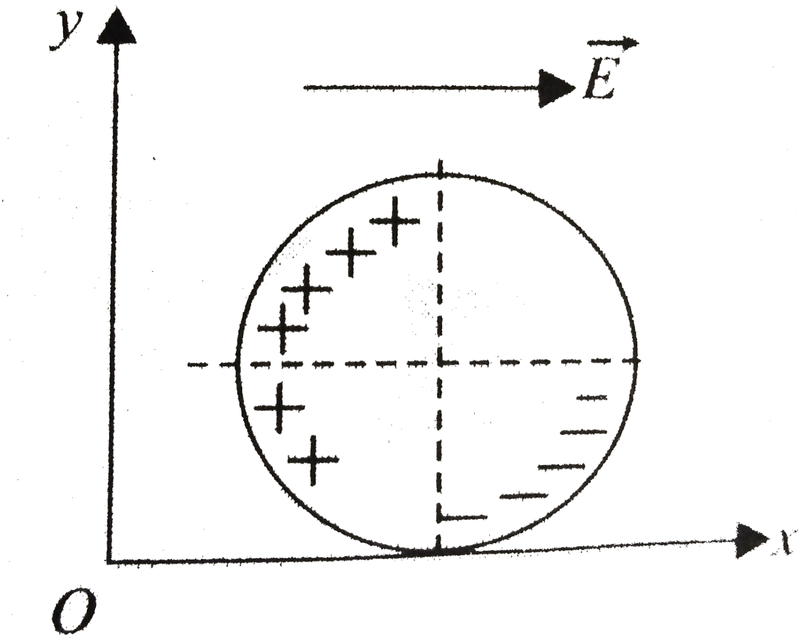
92. A nonconducting ring of mass m and radius R, with charge per unit length λ is shown in fig. It is then placed on a rough nonconducting horizontal plane. At time t=0, a uniform electric field $\vec{E} = E_0\hat{i}$ is switched on and the ring starts rolling without sliding. Determine the friction force (magnitude and direction) acting on the ring.



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93. A rectangular tank of mass m_0 and charge Q is placed over a smooth horizontal floor. A horizontal electric field£ exist in the region. Rain drops are falling vertically in the tank at the constant rate of n drops per second. Mass of each drop is m. Find velocityoftank as function of time.

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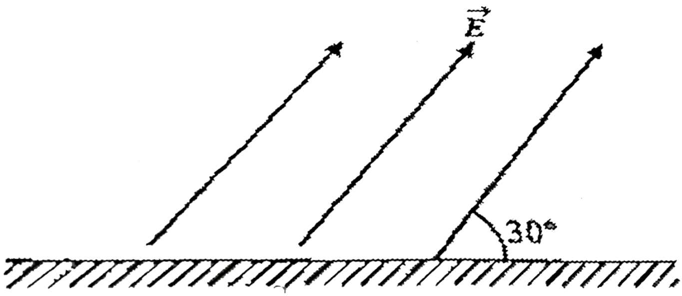
94. In a region an electric field is setu!l with its strength $E = 15 N/C$ and it makes an angle of $30°$ with the horizontal plane as shown in figure. A ball having a charge 2C, mass 3kg and coefficient of restitution with ground 0.5 is projected at an angle of $30°$ with the horizontal along the direction of electric field with speed 20 m/s. Find the horizontal distance travelled by ball from first hit with the ground to the second time when it hits the ground. $\left[70\sqrt{3}m\right]$



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Exercise 24.1

1. Is attraction a true test of electrification?

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2. Is repulsion a true test of electrification?

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3. Why does a phonograph record attract dust particles just after it is cleaned?

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4. What is the total charge, in coulombs, of all the electrons in three gram mole o' hydrogen atom?

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Exercise 24.2

1. The mass of an electron is $9.11x10^{-31}$ kg, that of a proton is $1.67x10^{-27}$ kg. Find the ratio F_e/F_g of the electric force and the gravitational force exerted by the proton on the electron.-

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2. Find the dimensions and units of ε_0

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3. Three point charges q are placed at three vertices of an equilateral triangle of side a. Find magnitude of electric force on any charge due to the other two.

A. $\left(\frac{\sqrt{3}}{4\pi\varepsilon_0}\right)\left(\frac{q}{a}\right)^2$

B. $\left(\frac{\sqrt{2}}{4\pi\varepsilon_0}\right)\left(\frac{q}{a}\right)^2$

C. $\left(\frac{\sqrt{3}}{4\pi\varepsilon_0}\right)\left(\frac{q}{2a}\right)^2$

D. $\left(\frac{\sqrt{2}}{4\pi\varepsilon_0}\right)\left(\frac{2q}{a}\right)^2$

Answer: A

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4. Three point charges each of value $+q$ are placed on three vertices of a square of side a metre. What is the magnitude of the force on a point charge of value $-q$ coulomb placed at the centre of the square?

A. $\left(\frac{1}{4\pi\varepsilon_0}\right)\left(\frac{q}{a}\right)^2$

B. $\left(\frac{1}{2\pi\varepsilon_0}\right)\left(\frac{2q}{a}\right)^2$

C. $\left(\frac{1}{2\pi\varepsilon_0}\right)\left(\frac{q}{a}\right)^2$

D. $\left(\frac{1}{4\pi\varepsilon_0}\right)\left(\frac{2q}{a}\right)^2$

Answer: C

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5. Coulomb's law states that the electric force becomes weaker with increasing distance. Suppose that instead, the electric force between two charged particles were independent of distance. In this case, would a neutral insulator still be attracted towards the comb.

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6. A metal sphere is suspended from a nylon thread. Initially, the metal sphere is uncharged. When a positively charged glass rod is brought close to the metal sphere, the sphere is drawn towards the rod. But if the sphere touches the rod, it suddenly flies away from the rod. Explain, why the sphere is first attracted then repelled?

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7. What is the lower limit of the electric force between two particles placed at a certain distance?

A. $\frac{1}{4\pi\varepsilon_0}\frac{2e^2}{r}$

B. $\frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2}$

C. $\frac{1}{2\pi\varepsilon_0}\frac{e}{r^2}$

D. None of these

Answer: B

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8. Does the force on a charge due to another charge depend on the charges present nearby?

A. No

B. Yes

C. Sometimes

D. Depends upon the charge present nearby

Answer: A

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9. The electric force on a charge q_1 due to q_2 is $\left(4\hat{i} - 3\hat{j}\right)N$. What is the force on q_2 due to q_1?

A. $\left(4\hat{i} - 3\hat{j}\right)N$

B. $\left(4\hat{i} + 3\hat{j}\right)N$

C. $\left(-4\hat{i} - 3\hat{j}\right)N$

D. $\left(-4\hat{i} + 3\hat{j}\right)N$

Answer: D

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Exercise 24.3

1. The electric field of a point charge is uniform. Is it true or false?

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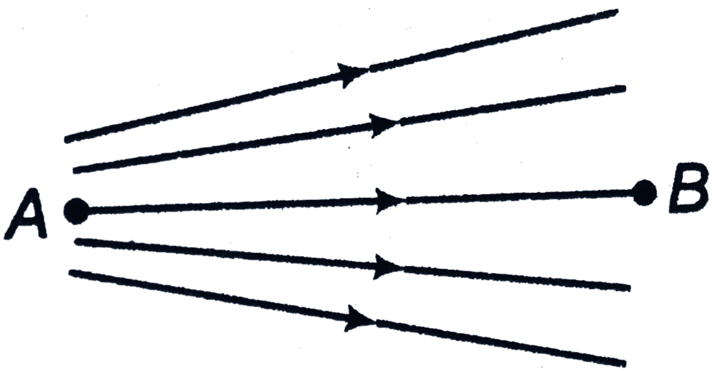
2. Electric field lines are shown inf figure. State whether the electric potential is greater at A or B.



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3. A charged particle always move in the direction of electric field. Is this statement true or false?

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4. The trajectory of a charged particle is the same as a field line. Is this statement true or false?

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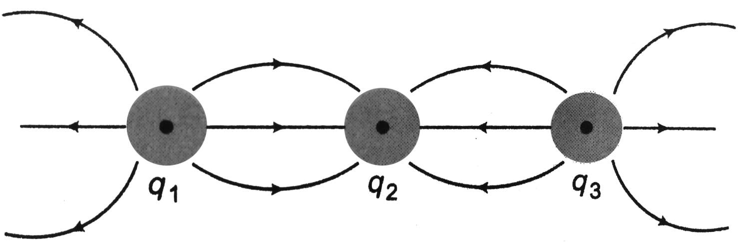
5. Figure shows some of the electric field lines due to three point charges $q_{,}q_2$ and q_3 of equal magnitude. What are the signs of each of the three charges?



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Exercise 24.4

1. Four particles each having a charge q are placed on the four vertices of a regular pentagon. The distance of each comer from !be centre is 'a'. Find the electric field at the centre of pentagon.

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2. A charge $q = -2.0\mu C$ is placed at origin. Find the electric field at $(3m, 4m, 0)$.

A. $-\left(4.32\hat{i} + 5.76\hat{j}\right) \times 10^2 N/C$

B. $-\left(4.32\hat{i} - 5.76\hat{j}\right) \times 10^2 N/C$

C. $-\left(5.76\hat{i} + 4.32\hat{j}\right) \times 10^2 N/C$

D. $\left(4.32\hat{i} + 5.76\hat{j}\right) \times 10^2 N/C$

Answer: A

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3. A point charge $q_1 = 1.0 \mu C$ is held fixed at origin. A second point charge $q_2 = -2.0 \mu C$ and a mass 10^{-4} kg is placed on the x-axis, 1.0 m from the origin. The second point charge is released from rest. What is its speed when it is 0.5 m from the origin?

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4. A point charge $q_1 = -1.0 \mu C$ is held stationary at the origin. A second point charge $q_2 = +2.0 \mu C$ moves from the point $(1.0m, 0, 0)$ to $(2.0m, 0, 0)$. How much work is done by the electric force on q_2?

A. $9mJ$

B. $-9mJ$

C. $-18mJ$

D. $18mJ$

Answer: B

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Exercise 24.5

1. A point charge q_1 is held stationary at the origin. A second charge q_2 is placed at a point a, and the electric potential energy of the pair of charges is $-6.4 \times 10^{-8} J$. When the second charge is moved to point b, the electric force on the charge does $4.2 \times 10^{-8} J$ of work. What is the electric potential energy of the pair of charges when the second charge is at point b?

A. $-10.6 \times 10^{-8} J$

B. $-1.06 \times 10^{-8} J$

C. $-100.6 \times 10^{-8} J$

D. $-1.006 \times 10^{-8} J$

Answer: A

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2. Is it possible to have an arrangement of two point charges separated by finite distances such that the electric potential energy of the arrangement is the same as if the two charges were infinitely far apart? What if there are three charges?

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3. Find V_{ba}, if $12J$ of work has to be done against an electric field to take a charge of 10^{-2} C from a to b.

A. $120V$

B. $-250V$

C. $1200V$

D. $-120V$

Answer: C

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Exercise 24.6

1. A rod of length L lies along the x-axis with its left end at the origin. It has a non-uniform charge density $\lambda = \alpha x$, where a is a positive constant.

(a) What are the units of α?

(b) Calculate the electric potential at point A where $x = -d$.

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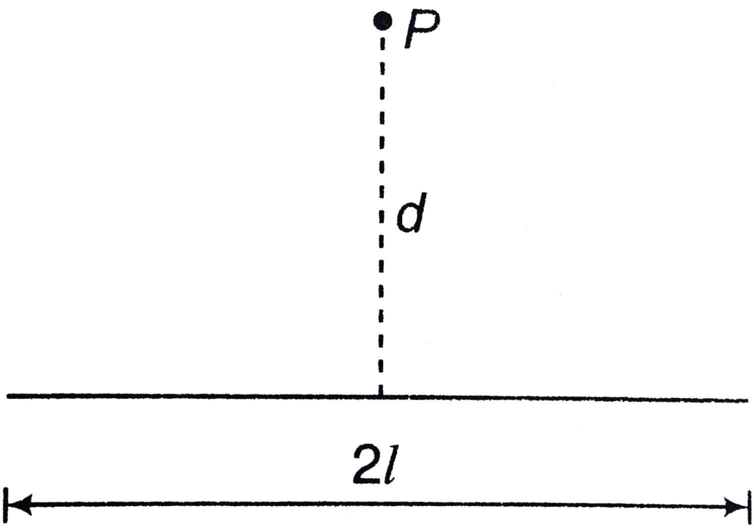
2. A charge q is uniformly distributed along an insulating straight wire of length 21 as shown in Fig. Find an expression for the electric potential at a point located a distance d from the distribution along its perpendicular bisector.



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Exercise 24.7

1. A cone made of insulating material has a total charge Q spread uniformly over its sloping surface. Calculate the work done in bringing a small test charge q from infinity to the apex of the cone. The cone has a slope length L.

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2. Determine the electric field strength vector if the potential of this field depends on x, coordinates as

(a) $V = a\left(x^2 — y^2\right)$ (b) $V = axy$

where, a is a constant.

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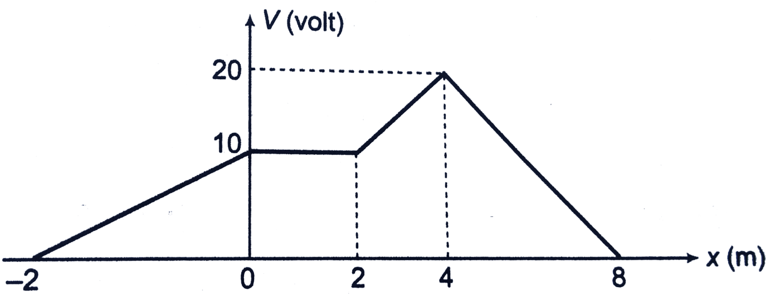
Level 1 Assertion And Reason

1. The electrical potential function for an electrical field directed parallel to the x-axis is shown in the given graph.



Draw the graph of electric field strength.

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2. The electric potential decreases uniformly from $100V$ to $50V$ as one moves along the x-axis from $x = 0$ to $x = 5m$. The electric field at $x = 2m$ must be equal to $10V/m$. Is this statement true or false.

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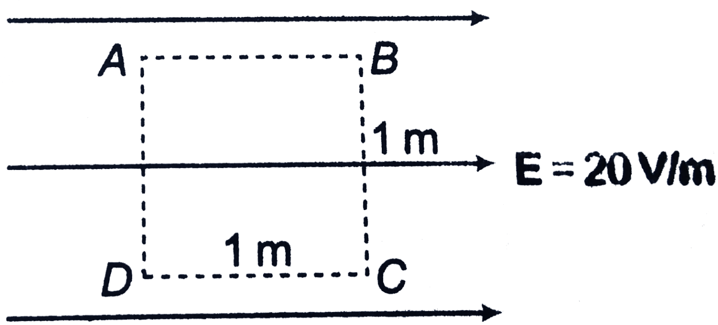
3. In the uniform electric field shown in figure, find :

a. $V_A - V_D$

b. $V_A - V_C$

c. $V_B - V_D$

d. $V_C - V_D$



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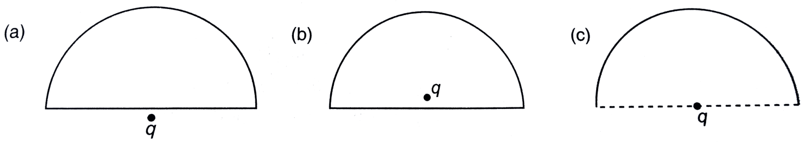
4. In figure (a), a charge q is placed just outside the centre of a closed hemisphere. In figure (b), the same charge q is placed just inside the centre of the closed hemisphere and in figure (c), the charge is placed at the centre of hemisphere open from the base. Find the electric flux passing through the hemisphere in all the three cases.



A. $0, \frac{q}{\varepsilon_0} \frac{q}{2}\varepsilon_0$

B. $0, 0 \frac{q}{2}\varepsilon_0$

C. $0, \frac{q}{\varepsilon_0} 0$

D. $0, 0\ 0$

Answer: A

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5. Net charge within an imaginary cube drawn in a uniform electric field is always zero. Is this statement true or false?

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6. A hemispherical body of radius R is placed in a uniform electric field E. What is the flux linked with the curved surface if, the field is (a) parallel to the base, (b) perpendicular to the base.

A. $\phi = (E(\pi R)$

B. $\phi = \left(ES = E\left(\pi R^3\right)\right.$

C. $\phi = E\left(\pi R^2\right)$

D. $\phi = \left(ES = E\left(\pi R^4\right)\right.$

Answer: C

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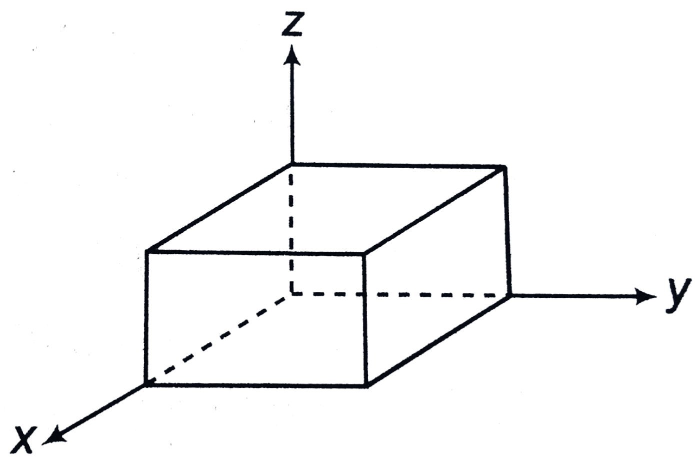
7. A cube has sides of length $L = 0.2\text{m}$. It is placed with one corner at the origin as shown in figure. The electric field is uniform and given by $E = (2.5N/C)\hat{i}$ - $(4.2N/C)\hat{j}$. Find the electric flux through the entire cube.



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8. Assertion: An independnt negative charge moves itself from point A to point B. then, potential at A should be less than potential at B.

Reason: While moving from A to B kinetic energy of electron will increase

A. If both Assertion and Reason are true but Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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9. Assertion: When two unlike charges are brought nearer, their electrostatic potential energy decreases.

Reason: All conservative forces act in the direction of decreasing potential energy.

A. If both Assertion and Reason are true but Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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10. Assertion: At a point electric potential is decreasing along x-axis at a rate of $10V/m$. Therefore, x-component of electric field at this point should be $10V/m$ along x-axis.

Reason: Magnitude of $E_x = \frac{\partial V}{\partial x}$

A. If both Assertion and Reason are true but Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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11. Assertion: Electric potential on the surface of a charged sphere of radius R is V. Then electric field at distance $r = \frac{R}{2}$ from centre is $\frac{V}{2R}$. Charge is distributed uniformly over the volume.

Reason: From centre to surface, electric field varies linearly with r. Here r is distance from centre.

A. If both Assertion and Reason are true but Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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12. Assertion: Gauss's theroem can be applied only for a closed surface.

Reason: Electric flux can be obtained passing from an open surface also.

A. If both Assertion and Reason are true but Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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13. Assertion: In the electric field $E = \left(4eci + 4\hat{j}\right)N/C$ electric potential at A (4m, 0) is more than the electric portential at $B(0, 4m)$

Reason: Electric lines of forces always travel from higher potential to lower potential.

A. If both Assertion and Reason are true but Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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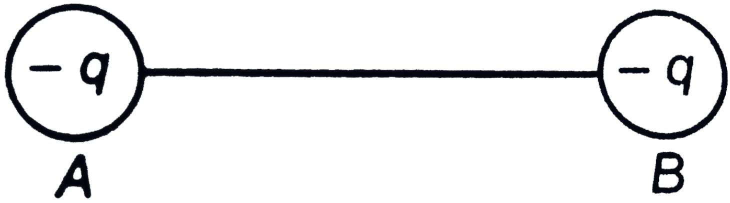
14. Assertion: Two charges $-q$ each are fixed points A and B. When a third chrge $-q$ is moves from A to B, electrical potential energy first decreases than increases,



Reason: Along the line joining A and B, third charge is stable equilibrium position at centre.

A. If both Assertion and Reason are true but Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: A::B

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15. Assertion: A small electric dipole is moved translatonally from higher potential to lower potential in uniform electric field. Work done by electric is positive.

Reason: When a positive charge is moved from higher potential to lower potential, work done by electric field positive.

A. If both Assertion and Reason are true but Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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16. Assertion: In case of charged spherical shells, E-r graph is discontinuous while V-r graph is continuous

Reason: According to Gauss's theorem only the charge inside a closed surface ca produce electric field at some point.

A. If both Assertion and Reason are true but Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: C

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17. Assertion: If we see along the axis of a chaged ring, the magnitudeof electric field is minimum at centre and magnitude of electridc potential is maximum.

Reason: Electric field is a vector quantity while electric potential is scalar.

A. If both Assertion and Reason are true but Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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18. Units of electric flux is

A. $\frac{N - m^2}{C^2}$

B. $\frac{N}{C^2 - m^2}$

C. volt-m

D. volt-m^3

Answer: C

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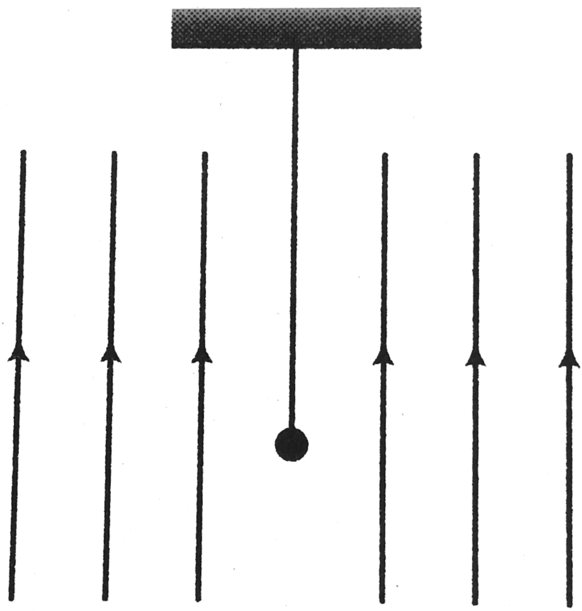
19. A neutral pendulum oscillates in a uniform electric field as shown in figure. If a positive charge is given to the pendulum, then its time period



A. will increase

B. will decrease

C. will remain constant

D. will first increase then decrease

Answer: A

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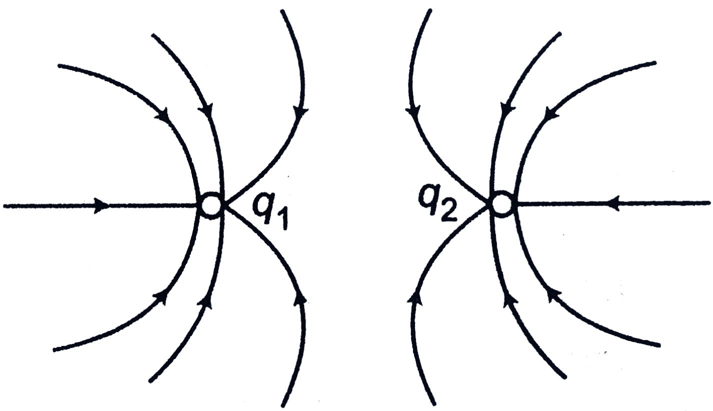
Level 1 Objective

1. Identify the correct statement about the charges q_1 and q_2 then



A. q_1 and q_2 both are positive

B. q_1 and q_2 both are negative

C. q_1 is positive q_2 negative

D. q_2 is positive and q_1 is negative

Answer: B

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2. Three identical charges are placed at corners of a equilateral triangel of side l. If force between any two charges is F, the work required to double the dimensiions of triangle is

A. $-3Fl$

B. $3Fl$

C. $(-3/2)Fl$

D. $(3/2)Fl$

Answer: C

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3. A proton a deutron and an α particle are accelerated through potentials of V, $2V$ and $4V$ respectively. Their velocity will bear a ratio

A. $1:1:1$

B. $1:\sqrt{2}:1$

C. $\sqrt{2}:1:1$

D. $1:1:\sqrt{2}$

Answer: D

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4. Electric potential at a point P, r distance away due to a point charge q kept at point A is V. If twice of this charge is distributed uniformly on the

surface of a hollow sphere of radius 4r with centre at point A the potential at P now is

A. V

B. $V/2$

C. $V/4$

D. $V/8$

Answer: B

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5. Four charges $+q$, -1, $+q$ and $-q$ are placed in order on the four consecutive corners of a square of side a. The work done in interchanging the positions of any two neighbouring charges of the opposite sign is

A. $\frac{q^2}{4\pi\varepsilon_0 a}\left(-4+\sqrt{2}\right)$

B. $\frac{q^2}{4\pi\varepsilon_0 a}\left(4+2\sqrt{2}\right)$

C. $\frac{q^2}{4\pi\varepsilon_0 a}\left(4 - 2\sqrt{2}\right)$

D. $\frac{q^2}{4\pi\varepsilon_0 a}\left(4 + \sqrt{2}\right)$

Answer: C

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6. Two concentric spheres of radii R and $2R$ are charged. The inner sphere has a charge if $1\mu C$ and the outer sphere has a charge of $2\mu C$ of the same sigh. The potential is $9000V$ at a distance $3R$ from the common centre. The value of R is

A. $1m$

B. $2m$

C. $3m$

D. $4m$

Answer: A

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7. A ring of radius R is having two charges q and $2q$ distributed on its two half parts. The electric potentiasl at a point on its axis at a distance of $2\sqrt{2}R$ from its centre is $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$

A. $\frac{3kq}{R}$

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

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

D. $\frac{kq}{\sqrt{3}R}$

Answer: C

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8. A particle A having charge of $2.0 \times 10^{-6}C$ and a mass of 100 g is fixed at the bottomk of a smooth inclined plane of inclination 30°. Where should another particle B having same charge and mass, be placed o the inclined plane so that B may remain in equilibrium?

A. 8 cm from the bottom

B. 13 cm from the bottomk

C. 21 cm from the bottom

D. 27 cm from the bottom

Answer: D

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9. Four positive charges $\left(2\sqrt{2}-1\right)Q$ are arranged at the four corners of a square. Another charge q is placed at the center of the square. Resulting force acting on each corner charge is zero if q is

A. $-\frac{7Q}{4}$

B. $-\frac{4Q}{7}$

C. $-Q$

D. $-\left(\sqrt{2}+1\right)Q$

Answer: A

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10. A proton is released from rest, 10 cm from a charged sheet carrying charged density of $-2.21 \times 10^{-9} C/m^2$. It will strike the sheet after the time (approximately)

A. $4\mu s$

B. $2\mu s$

C. $\sqrt{2}\mu s$

D. $4\sqrt{2}\mu s$

Answer: A

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11. Two point charges $+q$ and $-q$ are placed a distance x apart. A third charge is so placed that al the three charges are in equilibrium. Then

A. uknknown charge is $-4q/9$

B. unknown charge is $-9q/4$

C. it should be at $(x/3)$from smaller chargge between them

D. none of these

Answer: D

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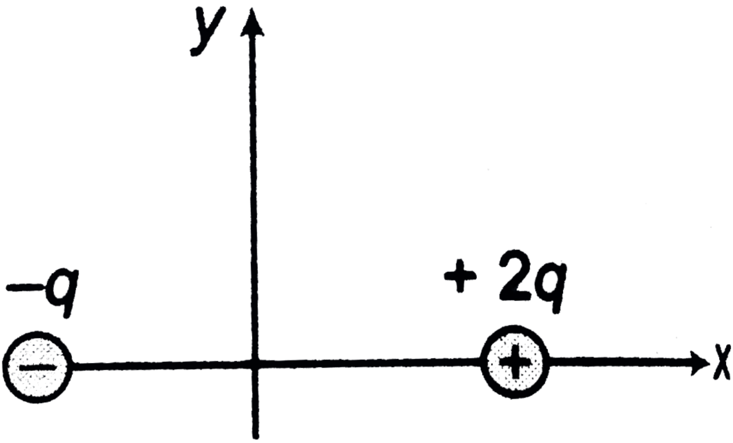
12. Charge $2q$ and $-q$ are placed at $(a, 0)$ and $(-a, 0)$ as shown in the figure. The coordinates of the point at which electric field intensity is zero will be $(x, 0)$ where



A. $-a < x < a$

B. $x < -a$

C. $x > -a$

D. $0 < x < a$

Answer: B

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13. Five point charge ($+q$ each) are placed at the five vertices of a regular hexagon of side $2a$.what is the magnitude of the net electric field at the centre of the hexazon?

A. $\frac{1}{4\pi\varepsilon_0}\frac{q}{a^2}$

B. $\frac{q}{16\pi\varepsilon_0 a^2}$

C. $\frac{\sqrt{2}q}{4\pi\varepsilon_0 a^2}$

D. $\frac{5q}{16\pi\varepsilon_0 a^2}$

Answer: B

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14. Two identical small conducting spheres having unequal positive charges q_1 and q_2 are separated by a distance r. If they are now made to touch each other and then separated again to the same distance, the electrostatic force between them in this case will be

A. less than before

B. same as before

C. more than before

D. zero

Answer: C

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15. Three concentric conducting spherical shells carry charges $+4Q$ on the inner shell $-2Q$ on the middle shell and $+6Q$ on the outer shell. The charge on the inner surface of the outer shell is

A. 0

B. $4Q$

C. $-Q$

D. $-2Q$

Answer: D

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16. 1000 drops of same size are charged to a potential of 1 V each. If they coalesce to form in single drop, its potential would be

A. V

B. $10V$

C. $100V$

D. $1000V$

Answer: C

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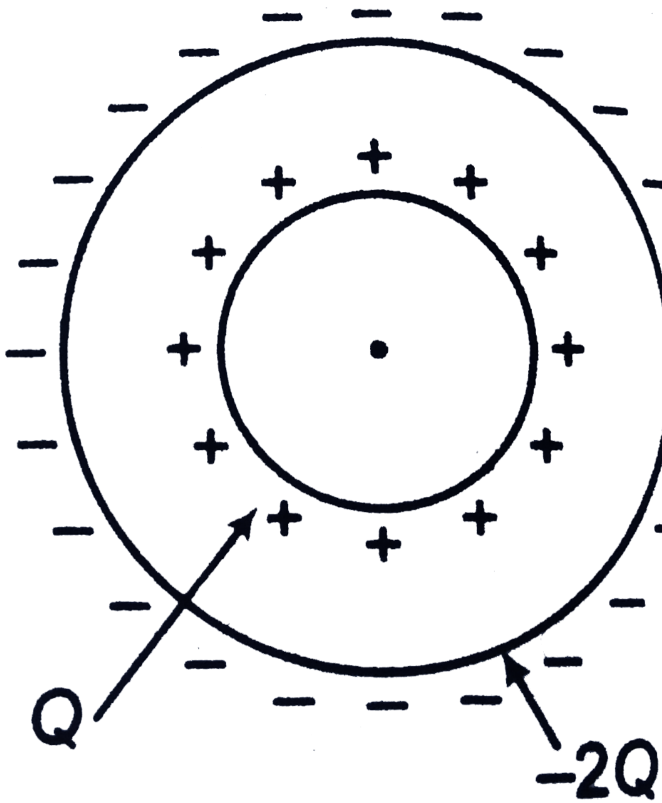
17. Two concentric conducting spheres of radii R and $2R$ are crrying charges Q and $-2Q$, respectively. If the charge on inner sphere is doubled, the potetial differece between the two spheres will



A. becomes two times

B. become four times

C. be halved

D. remain same

Answer: A

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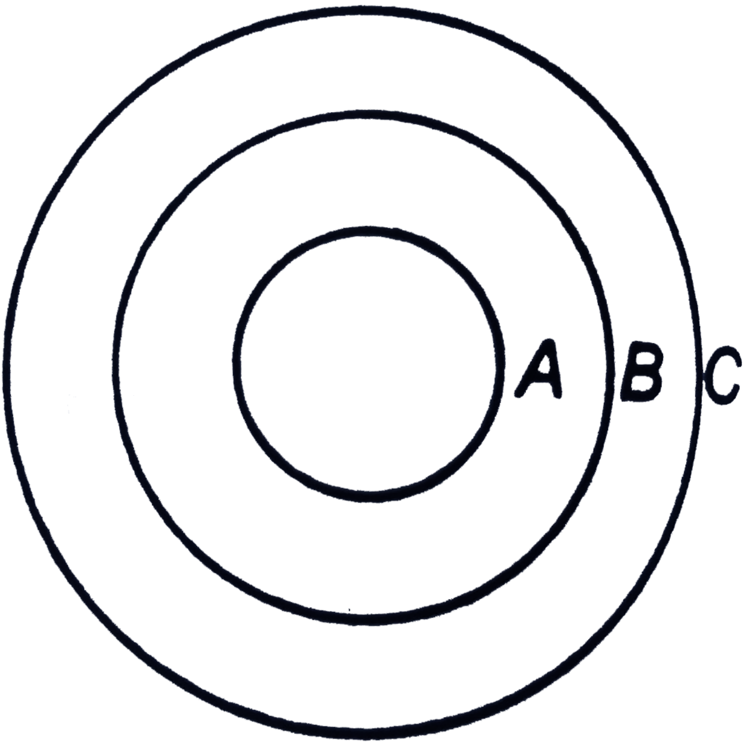
18. Charges $Q, 2Q$, and $-Q$ are given to three concentric conducting spherical shells A, B and C respectively as shown in figure. The ratio of charge on the inner and outer surface of shell C will be



A. $+\frac{3}{4}$

B. $\frac{-3}{4}$

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

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

Answer: D

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19. The electric field in a region of space is given by $E = 5\hat{i} + 2\hat{j}N/C$. The flux of E due ot this field through an area $1m^2$lying in the y-z plane, in SI units is

A. 5

B. 10

C. 2

D. $5\sqrt{29}$

Answer: A

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20. A charges Q is placed at each of the two opposite corners of a square. A charge q is placed to each of the other two corners. If the resultant force on each charge q is zero, then

A. $q = \sqrt{2}Q$

B. $q = -\sqrt{2}Q$

C. $q = 2\sqrt{2}Q$

D. $q = -2\sqrt{2}Q$

Answer: D

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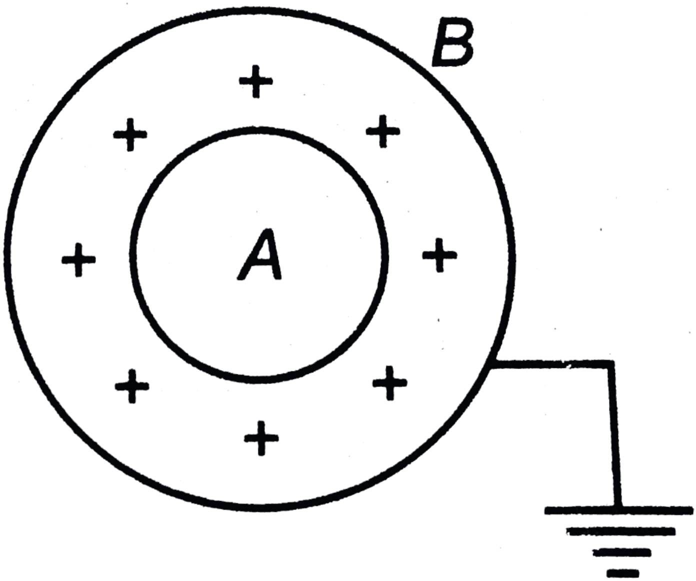
21. A and B are two concentric spherical shells. If A is given a charge $+q$ while B is earthed as shown in figure then



A. charge on the outer surface of shell B is zero

B. the charge on B is equal and opposite to that of A

C. the field inside A and outside B is zero

D. All of the above

Answer: D

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22. A solid sphere of radius R has charge q uniformly distributed over its volume. The distance from it surfce at which the electrostatic potential is equal to half of the potential at the centre is

A. R

B. 2R

C. $\frac{R}{3}$

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

Answer: C

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23. Four dipoles each of magnitudes of charges $\pm e$ are placed inside a sphere. The total flux of E coming out of the sphere is

A. zero

B. $\frac{4e}{\varepsilon_0}$

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

D. none of these

Answer: A

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24. A pendulum bob of mass m charge q is at rest with its string making an angle θ with the vertical in a uniform horizontal electric field E. The tension in the string in

A. $\frac{mg}{\sin\theta}$

B. mg

C. $\frac{qE}{\sin\theta}$

D. $\frac{qE}{\cos\theta}$

Answer: C

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25. Two isolated charged conducting spheres of radii a and b produce the same electric field near their surface. The ratio of electric potentials on their surfaces is

A. $\frac{a}{b}$

B. $\frac{b}{a}$

C. $\frac{a^2}{b^2}$

D. $\frac{b^2}{a^2}$

Answer: A

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26. Two point charges+q nd -q are held fixed at $(-a, 0)$ and $(a, 0)$ respectively of a x-y coordinate system then

A. the electric field E at all point on the axis has the same direction.

B. E at all points on the y-axis is along $\hat{i}$

C. positive work is done in bringing a test charge from infinity to the origin

D. All of the above

Answer: B

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27. A conducting shell S_1 having a charge Q is surrounded by an uncharged concentric conducting spherical shell S_2. Let the potential difference between S_1 and that S_2 be V. If the shell S_2 is now given a charge $-3Q$, the new potential difference between the same two shells is

A. V

B. $2V$

C. $4V$

D. $-2V$

Answer: A

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28. At a certain distance from a point charge, the field intensity is $500V/m$ and the potentil is $-3000V$. The distance to the charge and the magnitude of the charge respectively are

A. $6m$ and $6\mu C$

B. $4m$ and $2\mu C$

C. $6m$ and $4\mu C$

D. $6m$ and $2\mu C$

Answer: D

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29. Two points charges q_1 and q_2 are placed at a distance of 50 m from each each other in air, and interact with a certain force. The same charges are now put in oil whose relative permittivity is 5. If the interacting force between them is still the same, their separation now is

A. $16.6m$

B. $22.3m$

C. $28.4m$

D. $25.0m$

Answer: B

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30. An infinite line of charge λ per unit length is placed along the y-axis. The work done in moving a charge q from $A(a, 0)$ to $B(2a, 0)$ is

A. $\frac{q\lambda}{2\pi\varepsilon_0}$"In" 2`

B. $\frac{q\lambda}{2\pi\varepsilon_0}\ln\left(\frac{1}{2}\right)$

C. $\frac{q\lambda}{4}\pi\varepsilon_0\Big)\ln\sqrt{2}$

D. $\frac{q\lambda}{4\pi\varepsilon_0}\ln 2$

Answer: B

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31. An electric dipole is placed perpendicular to an infinite line of charge at same distance as shown in figure. Identify the correct statement.

A. the dipole is attracted towards the line charge

B. the dipole is repelled away from the line charge

C. the diple does not experience a force

D. the dipole experienes a force as wel as a torque

Answer: A

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32. An electrical charge 2×10^{-8} C is placed at the point $(1, 2, 4)$ m. At the point $(4, 2, 0)$m, the electric

A. potential will be 36 V

B. field will along y-axis

C. field will increase if the space between the points is filled with a dielectric

D. All of the above

Answer: A

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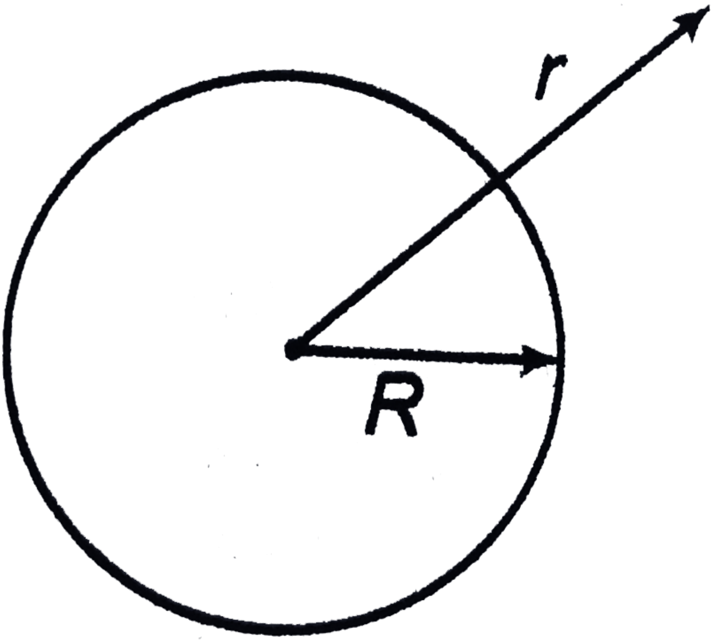
33. If the potential at the centre of a uniformly charged hollow sphere of radus R is V, then electric field at a distance r from the centre of sphere will be ($r > R$).



A. $\frac{VR}{r^2}$

B. $\frac{Vr}{R}$

C. $\frac{VR}{r}$

D. $\frac{VR}{R^2 + r^2}$

Answer: A

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

A. $\sqrt{3}N/C$

B. $4N/C$

C. $5N/C$

D. $20N/C$

Answer: D

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35. Two thin wire rings each having radius R are placed at distance d apart with their axes coinciding. The charges on the two are $+Q$ and $-Q$. The potential difference between the centre so the two rings is

A. zero

B. $\frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{R} - \frac{1}{\sqrt{R^2 + d^2}}\right]$

C. $\frac{Q}{4}\pi\varepsilon_0 d^2\Big)$

D. $\frac{Q}{2\pi\varepsilon_0}\left[\frac{1}{R} - \frac{1}{\sqrt{R^2 + d^2}}\right]$

Answer: D

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36. The electric field at a distance 2 cm from the center of a hollow spherical conducting shell of radius 4 cm having a charge of 2×10^{-3} on its surface is

A. $1.1 \times 10^{10} V/m$

B. $4.5 \times 10^{-10} V/m$

C. $4.5 \times 10^{10} V/m$

D. zero

Answer: D

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37. Charge Q is given a displacement $r = a\hat{i} + b\hat{j}$ in electric field $E = E_1\hat{i} + E_2\hat{j}$. The work done is

A. $Q(E_1 a + E_2 b)$

B. $Q\sqrt{(E_1 a)^2 + (E_2 b)^2}$

C. $Q(E_1 + E_2)\sqrt{a^2 + b^2}$

D. $Q\sqrt{E_1^2 + E_2^2}\sqrt{a^2 + b^2}$

Answer: A

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38. A certain charge Q is divided into two parts q and $Q - q$, wheich are then separated by a cetain distance. What must q be in terms of Q to maximum the electrostatic repulsion between the two charges?

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39. An α- particle is the nucleus of a helium atom. It has a mas $m = 6.64 \times 10^{-27}$ kg and as charge $1 = +2e = 3.2 \times 10^{-19}$c. compare the force of the electric repulsion between two α-particles with the force of gravitational attraction between them.

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40. What is the charge per unit area in C/m^2 of an infinite plane sheet of charge if the electric field produced by the sheet of charge has magnitude $3.0N/C$?

A. $4.85 \times 10^{-11} C/m^2$

B. $5.31 \times 10^{-11} C/m^2$

C. $2.13 \times 10^{-11} C/m^2$

D. None of these

Answer: B

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41. A circular wire loop of radius R carries a total charge q distributed uniformly over its length. A small length $x(< < R)$ of the wire is cut off. Find the electric field at the centre due to the remaining wire.

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42. Two identical conducting spheres, fixed in space, attract each other with an electrostatic force of $0.108N$ when separated by $50.0cm$, centre-to-centre. A thin conducting wire then connects the spheres. When the wire is removed, the spheres repel each other with an electrostatic force of $0.0360N$. What were the initial charges on the spheres?

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43. Show that the torque on an electric dipole placed in a uniform electric field is $\tau = p \times E$ independent of the origin about which torque is calculated.

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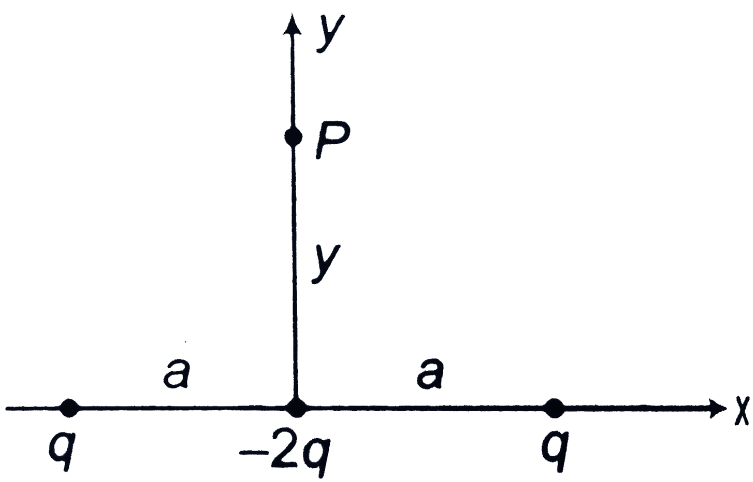
44. Three point charges q, $-2q$ and q are located along the x-axis a s shown in figure. Show that the electric field at $P(y > > a)$ along the y-axis is,

$$E = -\frac{1}{4\pi\varepsilon_0}\frac{3qa^2}{y^4}\hat{j}$$



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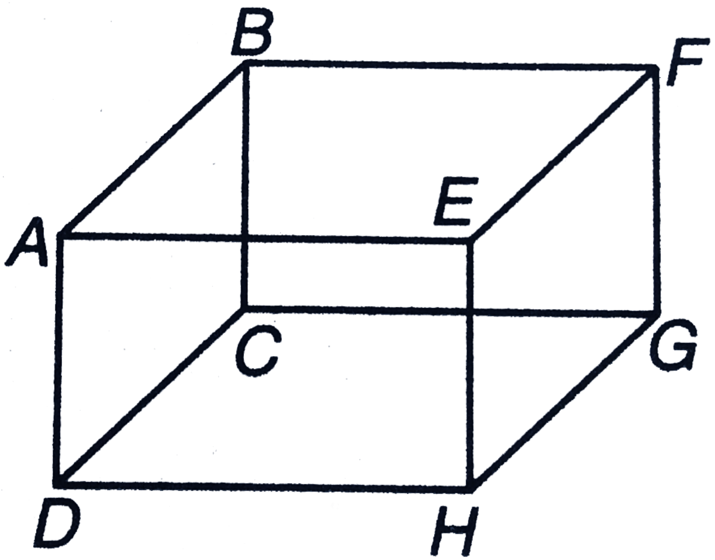
45. A charge q is placed at point D of the cube. Find the electric flux passing through the $EFGH$ and face $AEHD$.



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46. Point charges q_1 and q_2 lie o the x-axis at points $x = -a$ and $x = +a$ respectively.

a. How must q_1 and q_2 be related for the net electrostatic force on point charge $+Q$, placed at $x = +\frac{a}{2}$, to be zero?

b. With the same point charge $+Q$ now placed ate $x = +3a/2$

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47. Two particles (free to move) with charges $+q$ and $+4q$ are a distance L apart. A third charge is placed so that the entire system is in equilibrium.

(a) Find the location, magnitude and sign of the third charge.

(b) Show that the equilibrium is unstable.

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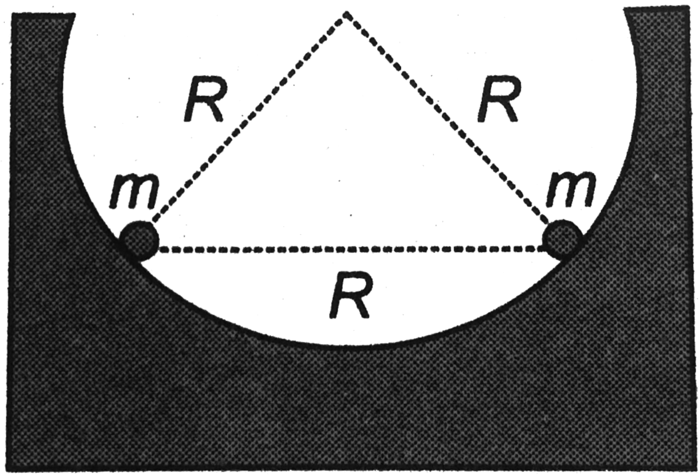
48. Two identical beads each have a mass m and charge q. When placed in a hemispherical bowl of radius R with frictionless, non-conducting walls, the beads move, and at equilibrium they area distance R apart (figure).

Determine the charge on each bead.



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49. Three identical small balls, each of mass 0.1 g, are suspended at one point on silk thread having a length of $l = 20cm$. What charges should be imparted to the balls for each thread to form an angle of $\alpha = 30^\circ$ with the vertical?

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50. Three charges, each equal to q, are placed at the three. corners of a square of side a . Find the electric field at. the fourth corner.

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51. A point charge $q = -8.0nC$ is located at the origin. Find the electric field vector at the point $x = 1.2m, y = -1.6m$.

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52. Find the electric field at the centre of a uniformly charged semicircular ring of radius R. Linear charge density is λ

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53. Find the electric field at a point P on the perpendicular bisector of a uniformly charged rod. The lengthof the rod is L, the charge on it is Q and the distance of P from the centre of the rod is a.

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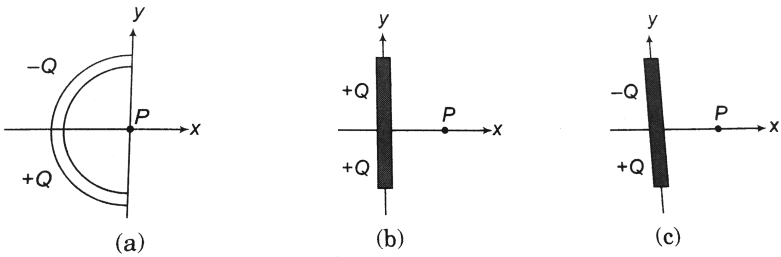
54. Find the direction of electric field at P for the charge distribution as shown infigure.



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55. A clock face has charges $-q, -2q, , ... -12q$ 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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56. A charged particle of mass $m = 1$ kg and charge $q = 2\mu C$ is thrown from a horizontal ground at an angle $\theta = 45^\circ$ with the speed $25 m/s$. In space, a horizontal electric field $E = 2 \times 10^7$ V/m exists in the direction of motion. Find the range on horizontal ground of the projectile thrown. Take $g = 10 m/s^2$.

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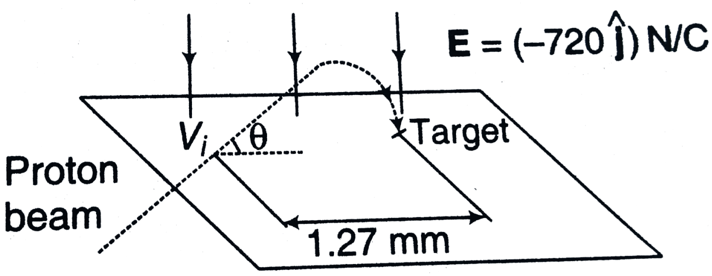
57. Protons are projected with an initial speed $v_i = 9.55 \times 10^3 m/s$ into a region where a uniform electric field $E = \left(-720\hat{j}\right)$ N/C is present, as shown in figure. The protons are to hit a target that lies at a horizontal distance of 1.27 mm from the point where the protons are launched. Find

(a) the two projection angles 0 that result in a hit and

(b) the total time of flight for each trajectory.



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58. At some instant the velocity components of an electron moving between two charged parallel plates are $v_x = 1.5 \times 10^5 m/s$ and $v_y = 3.0 \times 10^6 m/s$.Suppose that the electric field between the plates is given by $E = (120N/C)\hat{j}$

. (a) What is the acceleration of the electron?

(b) What will be the velocity of the electron after its x-coordinate has changed by 2.0 cm?

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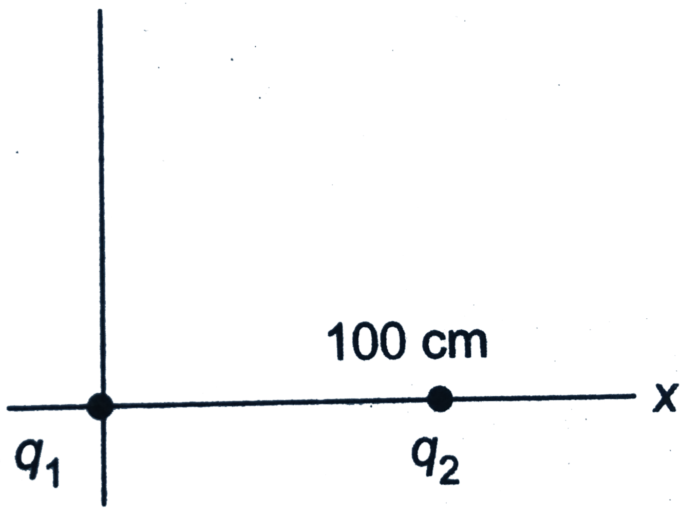
59. A point charge $q_1 = +2\mu C$ is placed at the origin of coordinates. A second charge, $q_2 = -3\mu C$, is placed on the x-axis at $x = 100cm$. At what

point (or points) on the x-axis will the absolute potential be zero?



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60. A charge Q is spread uniformly in the form of a line charge density $\lambda = \frac{Q}{3a}$ on the sides of an 3a equilateral triangle of perimeter 3a. Calculate the potential at the centroid C of the triangle.

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61. A uniform electric field of magnitude $250V/m$ is directed in the positive x-direction. $A + 12\mu C$ charge moves from the origin to the point $(x, y) = (20.0cm, 5.0cm)$.

(a) What was the change in the potential energy of this charge?

(b) Through what potential difference did the charge move?

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62. A small particle has charge $-5.00\mu C$ and mass $2.00 \times 10 - 4$ kg. It moves from point A where the electric potential is $V_A = +200V$. to point B, where the electric potential is $V_B = +800V$. The electric force is the only force acting on the particle. The particle has speed $5.00\frac{m}{s}$ at point A. What is its speed at point B? is it moving faster or slower at B than at A. Explain,

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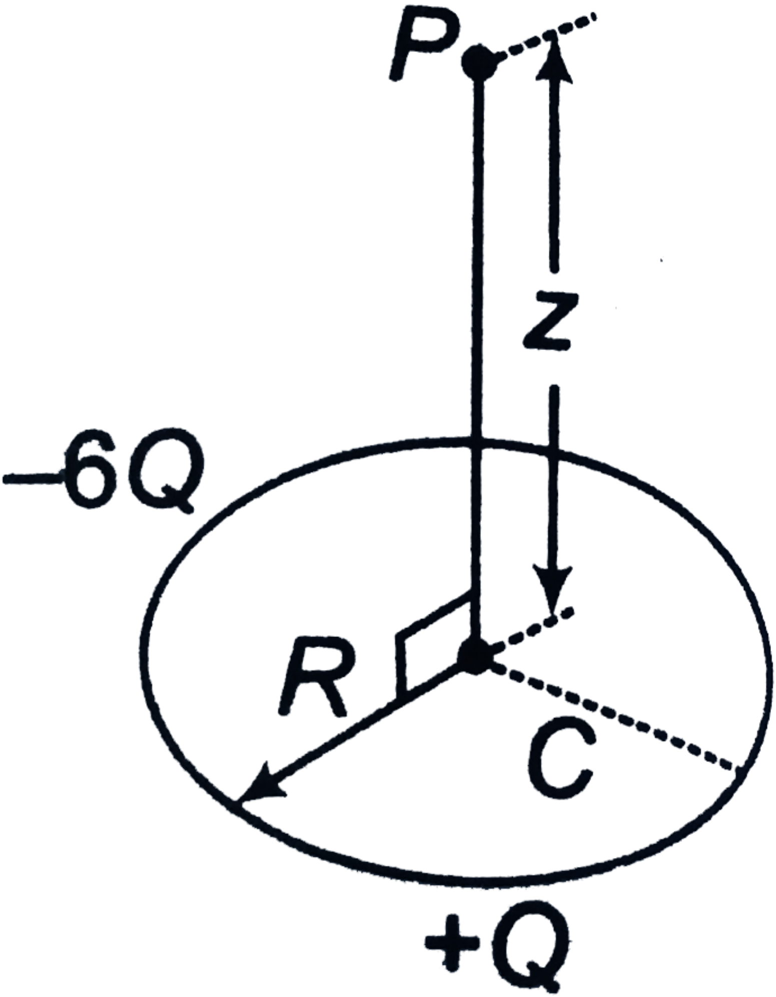
63. A plastic rod has been formed into a circle of radius R. It has a positive charge $+Q$ uniformly distributed along one-quarter of its circumference and a negative charge of $-6Q$ uniformly distributed along the rest of the circumference (figure). With V = 0 at infinity, what is the electric potential

$-6Q$

(a) at the centre C of the circle and

(b) at point P, which is on the central axis of the circle at distance z from the centre?



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64. A point charge $q_1 = +2.40\mu C$ is held stationary at the origin. A second point charge $q_2 = -4.30\mu C$ moves from the point x=0.150 m, y=0 to the point x=0 0.250 m, y=0.250 m. How much work is done by the electric force on q_2?

A. $-0.56J$

B. $-0.256J$

C. $-0.356J$

D. $-0.45J$

Answer: C

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65. A point charge $q_1 = 4.00nC$ is placed at the origin, and a second point charge $q_2 = -3.00nC$, placed on the x-axis at x = + 20.0 cm. A third point charge $q_3 = 2.00nC$ is placed on the X-axis between q_1, and q_2. (Take as zero the potential energy of the three charges when they are infinitely far apart).

(a) What is the potential energy of the system of the three charges if q_3 is placed at x= + 10.0 cm?

(b) Where should q_3 be placed to make the potential energy of the system equal to zero?

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66. Three point charges, which initially are infinitely far apart, are placed at the corners of an equilateral triangle with sides d. Two of the point charges are identical and have charge q.If zero net work is required to place the three charges at the corners of the triangles, what must the value of the third charge be?

A. -$q/4$

B. -$q/2$

C. $q/2$

D. $q/4$

Answer: B

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67. The electric field in a certain region is given by $E = \left(5\hat{i} - 3\hat{j}\right)kV/m$. Find the difference in potential $V_B - V_A$. If A is at the origin and point B is at a. (0,0,5)m, b. (4,0,3) m.`

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68. In a certain region of space, the electric field is along $+y$-direction and has a magnitude of 400 V/m . What is the potential difference from the coordinate origin to the following points?

$a. x = 0, y = 20cm, z = 0$

b. $x = 0, y = -30cm, z = 0$

$c. x = 0, y = 0, z = 15cm$

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69. An electric field of $20N/C$ exists along the x-axis in space. Calculate the potential difference V_B - V_A where the points A and B are given by

a. $A = (0, 0), B = (4m, 2m)$

b. $A = (4m, 2m), B = (6m, 5m)$

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70. The electric potential existing in space is $V(x, y, z)A(xy + yz + zx)$

(a) Write the dimensional formula of A.

(b) Find the expression for the electric field.

(c) If A is 10 SI units, find the magnitude of the electric field at $(1m, 1m, 1m)$

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71. An electric field $E = \left(20\hat{i} + 30\hat{j}\right)$ N/C exists in the space. If thepotential at the origin is taken be zero, find the potential at $(2m, 2m)$.

A. $-100V$

B. $-200V$

C. $-300V$

D. $-400V$

Answer: A

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72. In a certain region of space, the electric potential is $V(x, y, z) = Axy - Bx^2 + Cy$, where A, B and C are positive constants.

(a) Calculate the x, y and z- components of the electric field.

(b) At which points is the electric field equal to zero?

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73. A sphere centered at the origin has radius $0.200m$. $A - 500\mu C$ point charge is on the x-axis at $x = 0.300m$. The net flux through the sphere is

$360N - m^2/C$. What is the total charge inside the sphere?

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74. A closed surface encloses a net charge of $-3.60\mu C$. What is the net electric flux through the surface?

(b) The electric flux through a closed surface is found to be $780N - m^2/C$. What quantity of charge is enclosed by the surface?

(c) The closed surface in part (b) is a cube with sides of length 2.50 cm. From the information given in part (b), is it possible to tell where within the cube the charge is located? Explain.

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75. The electric field in a region is given by $E = \frac{3}{5}E_0\hat{i} + \frac{4}{5}E_0 j$ with $E_0 = 2.0x10^3 N/C$. Find the flux of this field through a rectangular surface of area $0.2m^2$ parallel to the y-z plane.

A. $24Nm^2/C$

B. $240Nm^2/C$

C. $440Nm^2/C$

D. $44Nm^2/C$

Answer: B

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76. The electric field in a region is given by $E = \frac{E_0 x}{l}\hat{i}$. Find the charge contained inside a cubical 1 volume bounded by the surfaces $x = 0, x = a, y = 0, yh = , z = 0$ and z=a. Take $E_0 = 5 \times 10^3 N/C$ l=2cm and a=1m.

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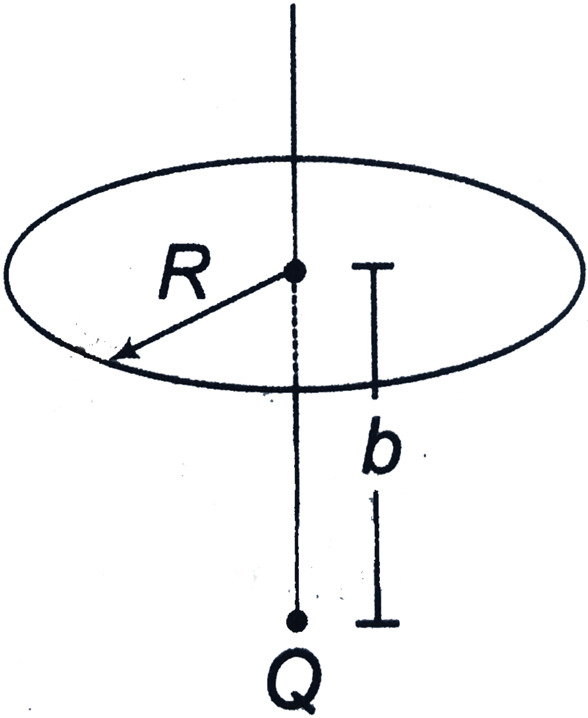
77. A point charge Q is located on the axis of a disc of radius R at a distance b from the plane of the disc (figure). Show that if one-fourth of the electric flux from the charge passes through the disc, then $R = \sqrt{3}b$.



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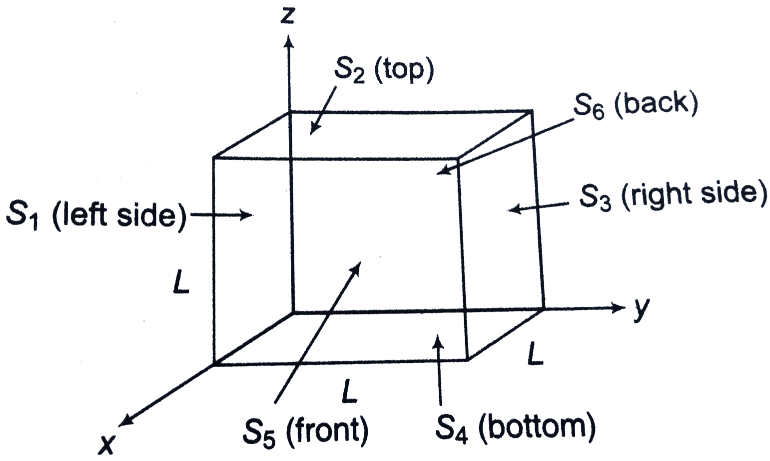
78. A cube has sides of length L. It is placed with one corner atAthe origin as shown in figure. The electric field is uniform and given by $E = -B\hat{i} + C\hat{j} - D\hat{k}$, where B, C and D are positive constants.



(a) Find the electric flux through each of the six cube faces S_1, S_2, S_3, S_4 and S_5 and S_6.

(b) Find the electric flux through the entire cube.

A. 0

B. EL^2

C. E^2L^2

D. EL

Answer: A

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79. Two point charges q and $-q$ are separated by a distance $2l$. Find the flux strength vector across the circle of radius R placed with its centre coinciding with the of line joining the two charges in the perpendicular plane.

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80. A point charge q is placed at the origin. Calculate the electric flux through the open hemispherical surface $(x - a)^2 + y^2 + z^2 = a^2, x \geq a$

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81. A charge Q is distributed over two concentric hollow spheres of radii r and $R(> r)$ such that the surface charge densities are equal. Find the potential at the common centre.

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82. A charge q_0 is distributed uniformly on a ring of radius R. A sphere of equal radius R constructed with its centre on the circumference of the ring. Find the electric flux through the surface of the sphere.

A. $\frac{q_0}{4\varepsilon_0}$

B. $\frac{q_0}{2\varepsilon_0}$

C. $\frac{q_0}{3\varepsilon_0}$

D. $\frac{q_0}{\varepsilon_0}$

Answer: C

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Level 1 Subjective

1. Two concentric conducting shells A and B are of radii R and $2R$. A charge $+q$ is placed at the centre of the shells. Shell B is earthed and a charge q is given to shell A. Find the charge on outer surface of A and B.

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

`(i) Find the potential of the three shells A, B and C.

(ii) If the shells A and C are at the same potential, obtain the relation between the radii a, b and c.

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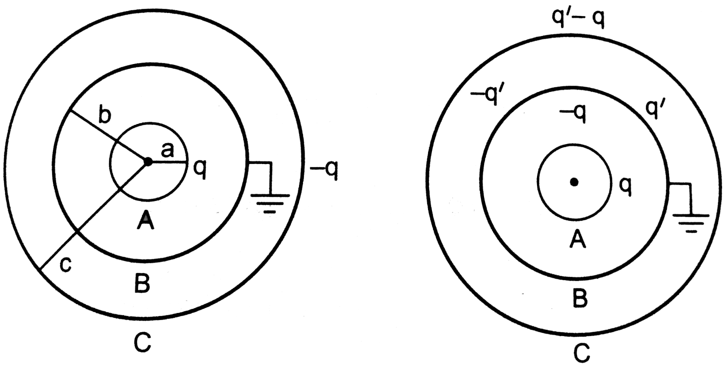
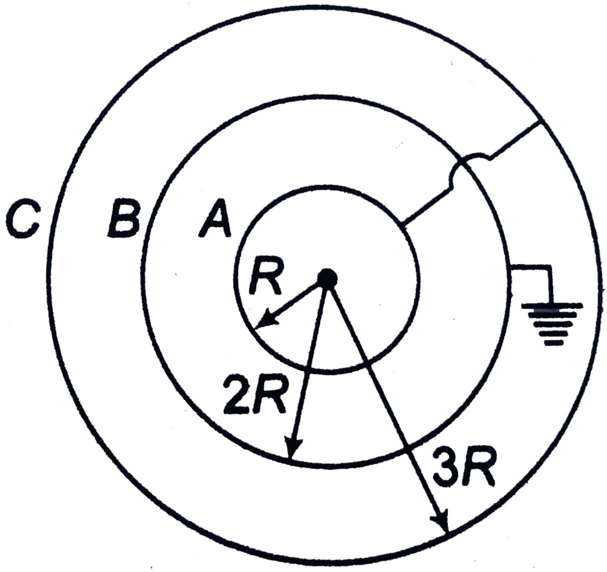
3. A charge Q is placed at the centre of an uncharged, hollow metallic sphere of radius a. (a) Find the surface charge density on the inner surface and on the outer surface. (b) If a charge q is put on the sphere, what would be the surface charge densities on the inner and the outer surface? (c) Find the electric field inside the sphere at a distance x from the centre in the situations (a) and (b).

4. Figure shows three concentric thin spherical shells A, B and C of radii a, b and c respectively. The shells A and C are given charges q and -q respectively and the shell B is earthed. Find the charges appearing on the surfaces of B and C.



5. Three spherical shells have radii R, $2R$ and $3R$ respectively. Total charge on A and C is $3q$. Find the charges on different surface of A, B and C. The connecting wire does not touch the shell B.



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6. In the above problem, the charges on different surfaces if a charge q is placed at the centre of the shell with all other conditions remaining the same.

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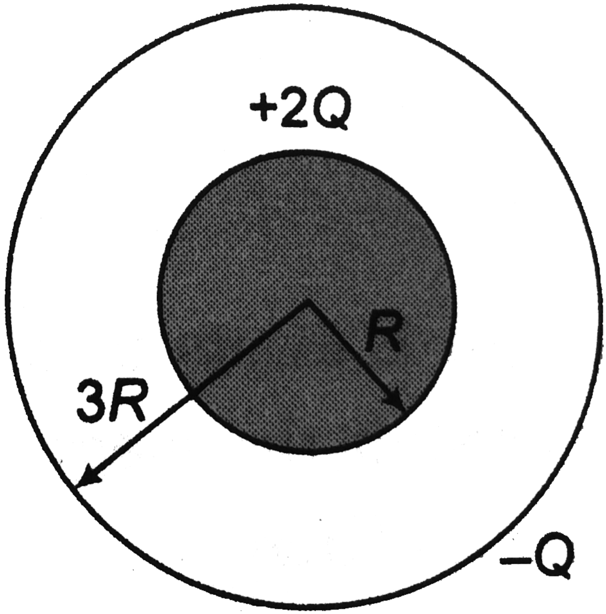
7. A solid sphere of radius R has a charge $+2Q$. A hollow spherical concentric with the first sphere that has net charge -Q.



(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?

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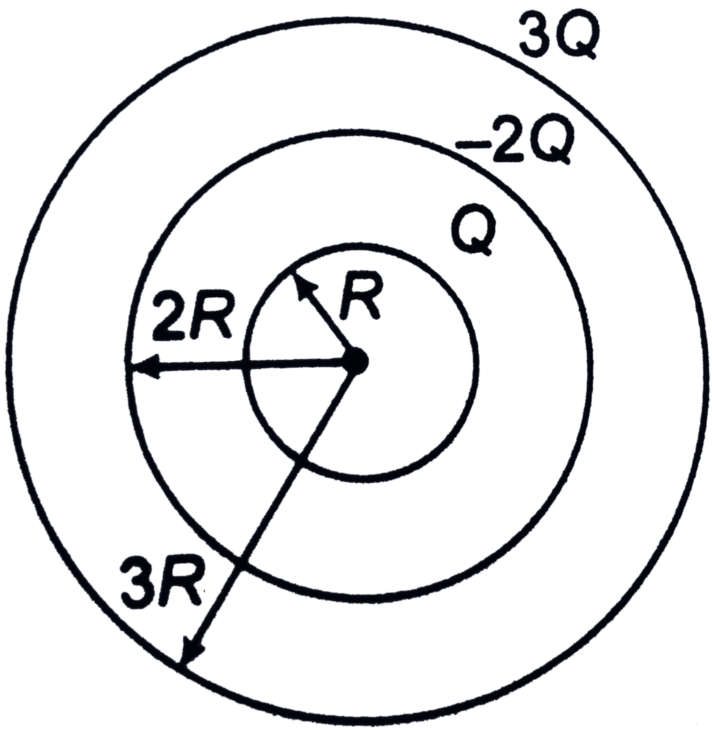
8. Three concentric conducting spherical shells of radii R, $2R$ and $3R$ carry charges Q, $-2Q$ and $3Q$, respectively.



a. Find the electric potential at $r = R$ and $r = 3R$ where r is the radial distance from the centre. ltbr. b. Compute the electric field at $r = \frac{5}{2}R$

$c. computethe \rightarrow tale \le ctrostatice \ne rgys \rightarrow red \in thesystem. The \in \ne rshellis$

3R. $e. Computethee \le ctricfieldat$r=5/2R`.

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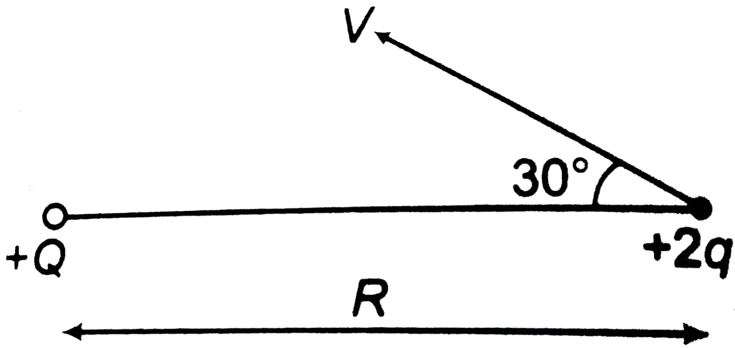
9. In the diagram shown the charge $+Q$ is fixed. Another charge $+2q$ and mass M is projected from a distance R from the fixed charge. Minimum separtion between the two charge if the velocity becomes $\frac{1}{\sqrt{3}}$ time of the projected velocity, at this moment is (Assume gravity to be absent)



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

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

C. $\frac{1}{2}R$

D. none of these

Answer: A

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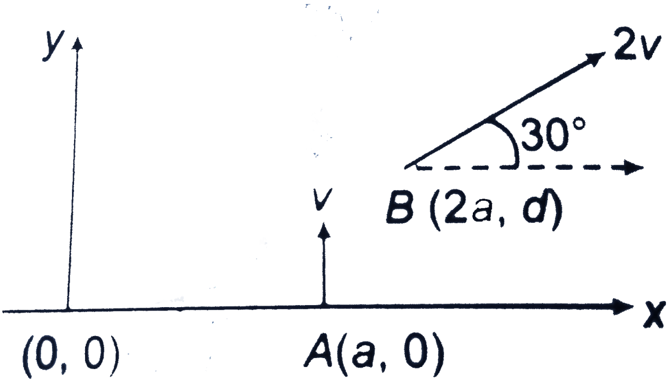
10. A uniform electric field of strength E exists in region. A electron enters a point A with velocity v as shown. It moves through the electric field and reaches at point B. Velocity particle at B is $2v$ at 30° with x-axis .

Then



A. electric field $E = \frac{3mv^2}{2ea}\hat{i}$

B. rate of doing work doen by electric field ast B is $\frac{3mv^2}{2ea}$

C. Bota a and b are correct

D. both a and b are wrong

Answer: A

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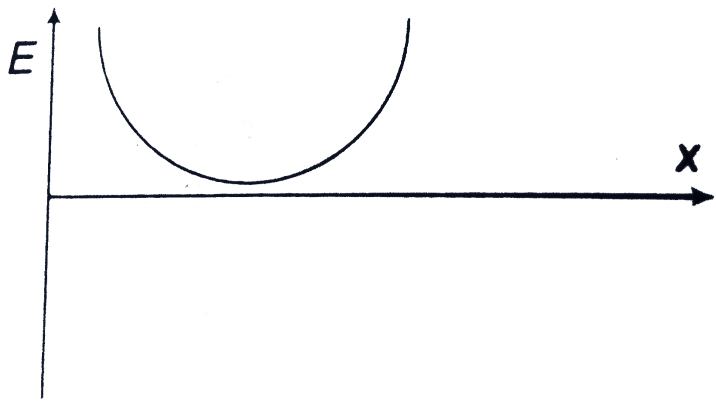
11. Two point charges a and b whose magnitude are same, positioned at a certain distance along the positive x-axis from each other a is at origin. Graph is drawn between electrical field strength and distance x from a. E is taken positive if it is along the line joining from a to b From the graph it can be decided that



A. a is positive b is negative

B. a and b both are positive

C. a and b both are negative

D. a is negative, b is positive

Answer: A

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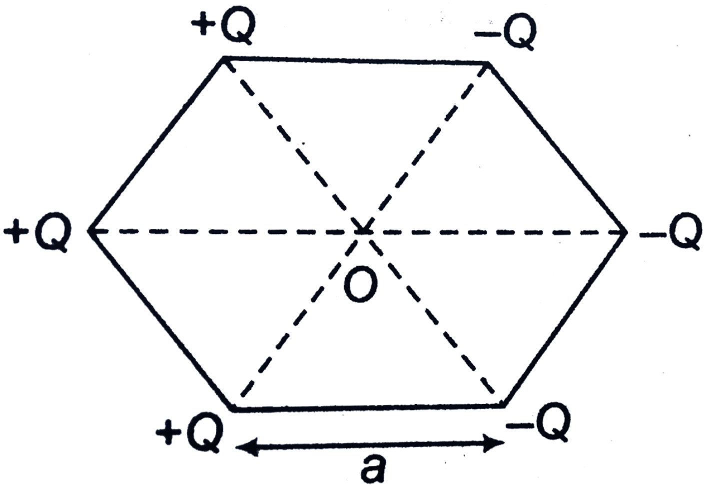
12. Six charges are placed at the vertices of a rectangular hexagon as shown in the figure. The electric field on the line passing through point O and perpendicular to the plane of the figure as a function of distance x from point O is $(x > \ > a)$



A. 0

B. $\frac{Qa}{\pi\varepsilon_0 x^3}$

C. $\frac{2Qa}{\pi}\varepsilon_0 x^3$

D. $\frac{\sqrt{3}Qa}{\pi\varepsilon_0 x^3}$

Answer: B

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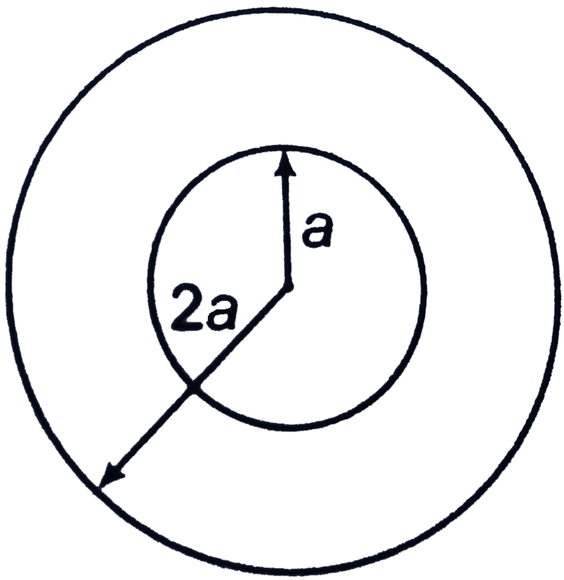
13. If the electric potential of the inner shell is $10V$ and that of the outer shel is $5V$, then the potential at the centre will be



A. $10V$

B. $5V$

C. $15V$

D. zero

Answer: A

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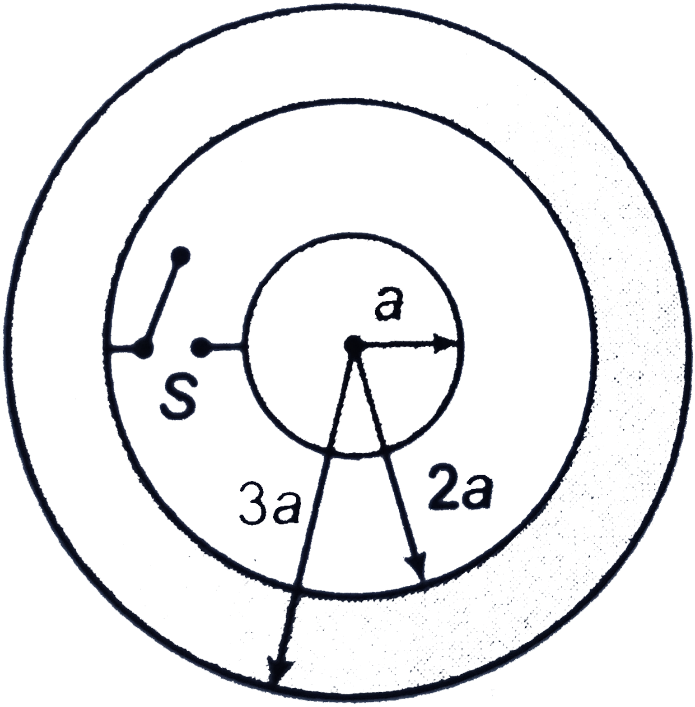
14. A solid conducting sphere of radius a having a charge q is surrounded by a concentric conducting spherical shell of inner radius $2a$ and outer radius $3a$ as shown in figure. Find the amount of heat porduced when switch is closed $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$



A. $\frac{kq^2}{2a}$

B. $\frac{kq^2}{3a}$

C. $\frac{kq^2}{4a}$

D. $\frac{kq^2}{6a}$

Answer: C

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15. There are four concentric shells A,B, C and D of radii $a, 2a, 3a$ and $4a$ respectively. Shells B and D are given charges $+q$ and $-q$ respectively. Shell C is now earthed. The potential difference $V_A - V_C$ is $k = \left(\frac{1}{4\pi\varepsilon_0}\right)$

A. $\frac{kq}{2a}$

B. $\frac{kq}{4a}$

C. $\frac{kq}{3a}$

D. $\frac{kq}{6a}$

Answer: D

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SUBJECTIVE_TYPE

1. Eight point charges of magnitude Q are arranged to form the corners of a cube of side L. The arrangement is made in manner such that the nearest neighbour of any charge has the opposite sign. Initially, the charges are held at rest. If the system is let free to move, what happens to the arrangement? Does the cube-shape shrink or expand? Calculate the velocity ct each charge when the side-length of the cube formation changes from L to nL. Assume that the mass of each point charge is m.

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2. A proton of mass m and accelerated by a potential difference Vgets into a uniform electric field of a parallel plate capacitor parallel to plates of length 1 at mid-point of its separation between plates. The field strength in it varies with time as E = at, where a is a positive constant. Find the angle of deviation of the proton as it comes out of the capacitor. (Assume that it does not collide with any of the plates.)

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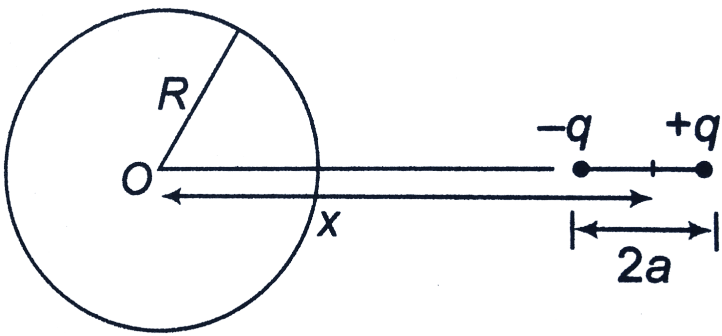
3. Two concentric rings placed in a gravity free region in yz-plane one of radius R carries $a+Q$ and second of radius $4R$ and charge $-8Q$ distributed uniformly over it. Find the velocity with which a point charge of mass m and charge $+q$ should be projected from a a distance $3R$ from the centre of rings on its axis so that it will reach to the centre of the rings.

View Text Solution

4. An electric dipole is placed at a distance x from centre O on the axis of a charged ring of R and charge Q uniformly distributed over it.



(a) Find the net force acting on the dipole.

(b) What is the work done in rotating the dipole through 180°?

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5. Three concentric, thin, spherical, metallic shells have radii 1, 2, and 4 cm and they are held at potentials $10, 0$ and $40V$ respectively. Taking the origin at the common centre, calculate the following:

(a) Potential at r = 1.25 cm

(b) Potential at r = 2.5 cm

(c) Electric field at r =1.25 cm

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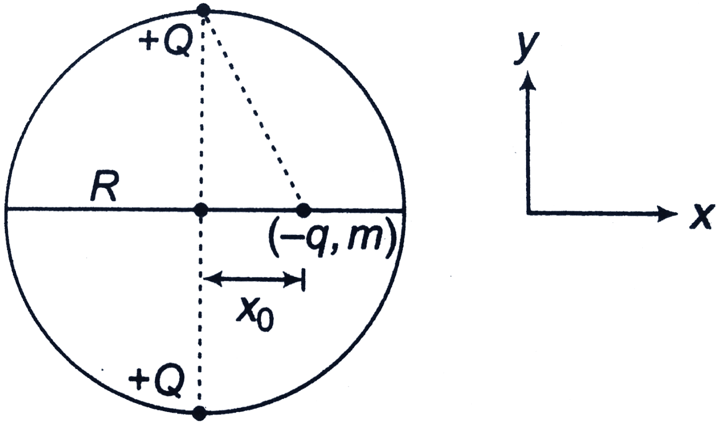
6. A thin insulating wire is stretched along the diameter of an insulated circular hoop of radius E. A small bead of mass m and charge –q is threaded onto the wire. Two small identical charge= are tied to the hoop at points opposite to each other, so that the diameter passing throughtheL-is perpendicular to the thread (see figure). The bead is released at a point which is a distance-, from the centre of the hoop. Assume that $x_0 < \; < R$.



a. What is the resultant acting on the charged bead?

b. Describe (qualitatively) the motion of the bead after it is released.

c. Use the assumption that $x/R < \ < 1$ to obtain an approximate equation of motinand find the dislacemet ad velocity of the bead as functuions of time.

d. When will the velocity of the bead will become zero for the first time?

View Text Solution

Check point 1.1

1. Which of the following is correct regarding electric charge ?

(i) If a body is having positive charge i.e. shortage of electrons.

(ii) If a body is having negative charge i.e. excess of electrons.

(iii) Minimum possible charge $= \pm 1.6 \times 10^{-19} C$.

(iv) Charge is quantised i.e. $Q = \pm ne$,

where $n = 1, 2, 3, 4....$

A. both (i) and (ii)

B. Both (ii) and (iii)

C. (i), (ii), (iii)

D. All of these

Answer: D

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2. One metallic sphere A is given positive charge whereas another identical metallic sphere B of exactly same mass as of A is given equal amount of negative charge. Then

A. mass of A and mass of B still remain equal

B. mass of A increase

C. mass of B decrease

D. mass of B increase

Answer: D

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3. When 10^{14} electrons are removed from a neutral metal sphere , the charge on it becomes

A. $16\mu C$

B. - $16\mu C$

C. $32\mu C$

D. - $32\mu C$

Answer: A

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4. A conductor has 14.4×10^{-19} coulombs positive charge. The conductor has : (Charge on electron $= 1.6 \times 10^{-19}$ coulombs

A. 9 electrons in excess

B. 27 electrons in short

C. 27 electrons in excess

D. 9 electrons in short

Answer: D

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5. Charge on α - particle is

A. $4.8 \times 10^{-19} C$

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

C. $3.2 \times 10^{-19} C$

D. $6.4 \times 100^{-19} C$

Answer: C

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6. A body has -80 micro coulomb of charge. Number of additional electrons in it will be

A. 8×10^{-5}

B. 80×10^{-17}

C. 5×10^{14}

D. 1.28×10^{-17}

Answer: C

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7. When a glass rod is rubbed with silk, it

A. gains electrons from silk

B. gives electrons to silk

C. gains protons from silk

D. given protons to silk

Answer: B

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8. If we comb our hair on a dry day and bring the comb near small pieces of paper, the comb attracts the pieces, why?

A. comb is a good conductor

B. paper is a good conductor

C. the atoms in the paper get polarised by the charged comb

D. the comb possesses magnetic propterties

Answer: C

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9. When a body is earth connected, electrons from the earth flow into the body. This means the body is ....

A. uncharged

B. charged positively

C. charged negatively

D. an insulator

Answer: A

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10. Conisder a neutral conducting sphere. A poistive point charge is placed outisde the sphere. The net charge on the sphere is then

A. Negative and distributed uniformly over the surface of the sphere

B. Negative and appears only at the point on the sphere closed to the point charge

C. Negative and distributed non-uniformly over the entire surface of the sphere

D. zero

Answer: D

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Check point 1.2

1. There are two charge $+1\mu c$ and $+2\mu c$ kept at certain separation ,the ratio of electrostatic forces acting on them will be in the ratio

A. $1:5$

B. $1:1$

C. $5:1$

D. $1:25$

Answer: B

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2. The force between two charges $0.06m$ apart is $5N$. If each charge is moved towards the other by $0.04m$, then the force between them will become

A. 7.20 N

B. 11.25 N

C. 22.50 N

D. 45.00 N

Answer: B

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3. Write down the value of obsolute permittivity of free space.

A. $9 \times 10^9 NC^2 / m^2$

B. $8.85 \times 10^{-12} N - m^2 / C^2 s$

C. $8.85 \times 10^{-12} C^2 / N - m^2$

D. $9 \times 10^9 C^2 / N - m^2$

Answer: C

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4. Two charges each equal to $2\mu C$ are 0.5 m apart. If both of them exist inside vacuum, then the force between them is

A. 1.89 N

B. 2.44 N

C. 0.144 N

D. 3.144 N

Answer: C

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5. The charges on two spheres are $+7\mu C$ and $-5\mu C$ respectively. They experience a force F. If each of them is given an additional charge of $-2\mu C$, the new force of attraction will be

A. F

B. $F/2$

C. $F/\sqrt{3}$

D. $2F$

Answer: A

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6. 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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7. A metallic particle having no net charge is placed near a finite metal plate carrying a positive charge. The electric force on the particle will be

A. towards the plate

B. away from the plate

C. parallel to the plate

D. zero

Answer: A

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8. Two charge spheres separated at a distance d exert a force F on each other. If they are immersed in a liquid of dielectric constant K=2, then the force (if all conditions are same) is

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

B. F

C. $2F$

D. $4F$

Answer: A

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9. Two charges placed in air repel each other by a force of $10^{-4}N$. When oil is introduced between the charges, then the force becomes $2.5 \times 10^{-5}N$. The dielectric constant of oil is

A. 2.5

B. 0.25

C. 2

D. 4

Answer: D

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10. Two point charges placed at a distance r in air experience a certain force. Then the distance at which they will experience the same force in a medium of dielectric constant K is

A. r

B. r/K

C. $r/\sqrt{K}$

D. $r\sqrt{K}$

Answer: C

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11. F_g and F_e represent gravitational and electrostatic force respectively between electrons situated at a distance 10 cm. The ratio of F_g/F_e is of the order of

A. 10^{42}

B. 10^{-21}

C. 10^{24}

D. 10^{-43}

Answer: D

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12. Two protons are a distance of $1 \times 10^{-10} cm$ from each other. The force acting on them are

A. nuclear force and gravitational force

B. nuclear force and coulomb force

C. coulomb force and gravitational force

D. nuclear, coulomb and gravitational force

Answer: C

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13. Two particle of equal mass m and charge q are placed at a distance of 16 cm. They do not experience any force. The value of $\frac{q}{m}$ is

A. l

B. $\sqrt{\frac{\pi\varepsilon_0}{G}}$

C. $\sqrt{\frac{G}{4\pi\varepsilon_0}}$

D. $\sqrt{4\pi\varepsilon_0 G}$

Answer: D

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14. A charge q_1 exerts some force on a second charge q_2 If a third charge q_3 is brought near q_2, then the force exterted by q_1 on q_2

A. decrease

B. increase

C. remains the same

D. increase, if q_3 is of same sign as q_1 and decrease, if q_3 is of opposite sign as q_1

Answer: C

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15. Electric charge of $1\mu C$, - $1\mu C$ and $2\mu C$ are placed in air at the corners A, B and C respectively of an equilateral triangle ABC having length of each side 10 cm. The resultant force on the charge at C is

A. 0.9 N

B. 1. 8N

C. 2.7 N

D. 3.6 N

Answer: B

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Check point 1.3

1. The SI unit of electric field intensity is

A. netweon/coulomb

B. joule/coulomb

C. volt-metre

D. newton/metre

Answer: A

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2. Which of the following is deflected by electric field ?

A. X-rays

B. γ - rays

C. Neutrons

D. α - particles

Answer: D

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3. A charged particle of mass $5 \times 10^{-5} kg$ is held stationary in space by placing it in an electric field of strength $10^{7} NC^{-1}$ directed vertically downwards. The charge on the particle is

A. $-20 \times 10^{-5} \mu C$

B. $-5 \times 10^{-5} \mu C$

C. $5 \times 10^{-5} \mu C$

D. $20 \times 10^{-5} \mu C$

Answer: B

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4. find the electric field strength due to a point charge of $5\mu C$ at a distance of 80 cm from the charge.

A. $8 \times 10^4 NC^{-1}$

B. $7 \times 10^4 NC^{-1}$

C. $5 \times 10^4 NC^{-1}$

D. $4 \times 10^4 NC^{-1}$

Answer: B

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5. The electric field due to a charge at a distance of 3 m from it is $500 NC^{-1}$. The magnitude of the charge is

$$\left[\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 N - m^2/C^2\right]$$

A. $2.5\mu C$

B. $2.0\mu C$

C. $1.0\mu C$

D. $0.5\mu C$

Answer: D

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6. Two charges $+5\mu C$ and $+10\mu C$ are placed $20cm$ apart. The net electric field at the mid-point between the two charges is

A. $4.5 \times 10^6 NC^{-1}$ directed towards $+5\mu C$

B. $4.5 \times 10^6 NC^{-1}$ directed towards $+10\mu C$

C. $13.5 \times 10^6 NC^{-1}$ directed towards $+5\mu C$

D. $13.5 \times 10^6 NC^{-1}$ directed towards $+10\mu C$

Answer: A

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7. Two point charges $+8q$ and $-2q$ are located at $x = 0$ and $x = L$ respectively. The location of a point on the x axis at which the net electric field due to these two point charges is zero is

A. 8 L

B. 4 L

C. 2 L

D. $L/4$

Answer: C

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8. A cube of side b has a charge q at each of its vertices. Determine the potential and electric field due to this charge array at the center of the cube.

A. q/b^2

B. $q/2b^2$

C. $32q/b^2$

D. zero

Answer: D

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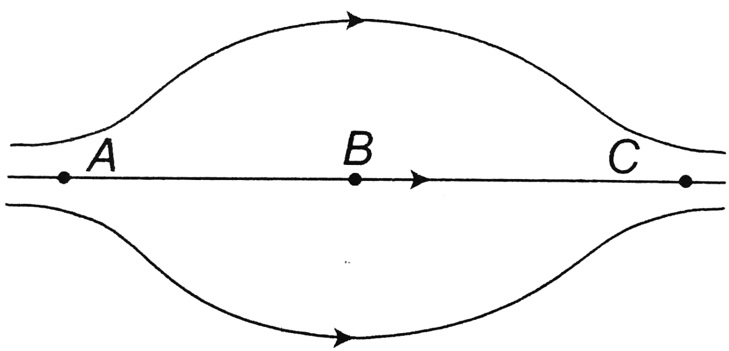
9. The figure shows some of the electric field lines corresponding to an electric field. The figure suggests



A. $E_A > E_B > E_C$

B. $E_A = E_B = E_C$

C. $E_A = E_C > E_B$

D. $E_A = E_C < E_B$

Answer: C

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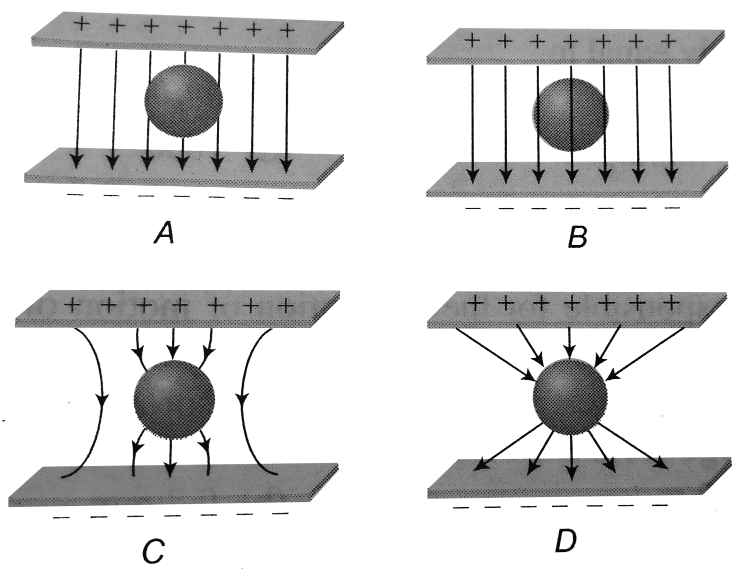
10. An uncharged sphere of metal is placed in between two charged plates as shown. The lines of force look like



A. A

B. B

C. C

D. D

Answer: C

Watch Video Solution

Check point 1.4

1. The electric dipole moment of an electron and a proton 4.3 nm apart, is

A. $6.8 \times 10^{-28} C - m$

B. $2.56 \times 10^{-29} C^2 / m$

C. $3.72 \times 10^{-14} C / m$

D. $11 \times 10^{-46} C^2 / m$

Answer: A

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2. If E_a be the electric field strength of a short dipole at a point on its axial line and E_e that on the equatorial line at the same distance, then

A. $E_e = 2E_a$

B. $E_a = 2E_e$

C. $E_a = E_e$

D. IN COMPLETE INFO

Answer: B

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3. Electric field on the axis of a small electric dipole at a distance r is $\vec{E}_1$ and $\vec{E}_2$ at a distance of $2r$ on a line of perpendicular bisector is

A. $\frac{E_0}{16}$

B. $\frac{E_0}{16}$

C. $\frac{E_0}{8}$

D. - $\frac{E_0}{8}$

Answer: D

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4. The electric field due to an electric dipole at a distance r from its centre in axial position is E. If the dipole is rotated through an angle of 90° about its perpendicular axis, the electric field at the same point will be

A. E

B. $E/4$

C. E/2

D. 2E

Answer: C

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5. The torque acting on an electric dipole of moment p held at an angle θ with an electric field E is ....

A. p.E

B. $p \times E$

C. zero

D. $E \times p$

Answer: B

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6. When an electric dipole P $\vec{v}$ is placed in a uniform electric field $\vec{E}$ then at what angle between $\vec{P}$ and $\vec{E}$ the value of torque will be maxima

A. 90°

B. 0°

C. 180°

D. 45°

Answer: A

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7. An electric dipole is kept in non-unifrom electric field. It experiences

A. a force and a torque

B. a force but not a torque

C. a torque but not a force

D. Neither a force nor a torque

Answer: A

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8. An electric dipole of moment $\vec{p}$ is placed normal to the lines of force of electric intensity $\vec{E}$, then the work done in deflecting it through an angle of 180° is

A. pE

B. $+2pE$

C. $-2pE$

D. zero

Answer: D

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9. A molecule with a dipole moment p is placed in an electric field of strength E. Initially the dipole is aligned parallel to the field. If the dipole is to be rotated to be anti-parallel to the field, the work required to be done by an external agency is

A. $-2pE$

B. $-pE$

C. pE

D. $2pE$

Answer: D

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10. Two opposite and equal chrages 4×10^{-8} coulomb when placed $2 \times 10^{-2} cm$ away, from a dipole. If dipole is placed in an ecternal electric field 4×10^{8} newton//coulomb, the value of maximum torque and the work done in rotating it through 180° will be

A. $64 \times 10^{-4} N - m$ and $64 \times 10^{-4} J$

B. $32 \times 10^{-4} N - m$ and $32 \times 10^{-4} J$

C. $64 \times 10^{-4} N - m$ and $32 \times 10^{-4} J$

D. $32 \times 10^{-4} N - m$ and $64 \times 10^{-4} J$

Answer: D

Watch Video Solution

Check point 1.5

1. The law goverening electrostatics is coulomb's law.In priciple coulomb's law can be used to compute electric field due to any charge configuation .In pracitce however it is a formidable task to compute electric field due to uniform charge distributions .For such cases Gauss proposed a theorem which states that

$$\oint \bar{E}.\,\overline{ds} = \frac{q}{\varepsilon_0}$$

where ds is an element of area directed across the outward normal for the surface at every point .The integral is called electric flux.Any convenient surface that we choose to evalute the surface integral is called the Gaussian surface.

The SI unit of electric flux is

A. weber

B. newton coulomb $^{-1}$

C. Volt $\times$ metre

D. joule coulomb $^{-1}$

Answer: C

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2. A surface element $\overrightarrow{ds} = 5\hat{i}$ is placed in an electric field $\vec{E} = 4\hat{i} + 4\hat{j} + 4\hat{k}$. What is the electric flux emanting from the surface ?

A. 40 unit

B. 50 unit

C. 30 unit

D. 20 unit

Answer: D

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3. A cube of side a is placed in a uniform electric field $E = E_0\hat{i} + E_0\hat{j} + E_0\hat{k}$.

Total electric flux passing through the cube would be

A. E_0a^2

B. $2E_0a^2$

C. $6E_0a^2$

D. None of these

Answer: D

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4. Flux coming out from a positive unit charge placed in air, is

A. ε_0

B. ε_0^{-1}

C. $\left(4\pi\varepsilon_0\right)^{-1}$

D. $4\pi\varepsilon_0$

Answer: B

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

A. $\left(\phi_1 + \phi_2\right)\varepsilon_0$

B. $\left(\phi_2 - \phi_1\right)\varepsilon_0$

C. $\left(\phi_1 + \phi_2\right)/\varepsilon_0$

D. $\left(\phi_2 - \phi_1\right)/\varepsilon_0$

Answer: B

Watch Video Solution

6. Charge of 2 C is placed at the centre of a cube. What is the electric flux passing through one face ?

A. $\frac{1}{(3\varepsilon_0)}$

B. $\left(\frac{1}{4}\right)\varepsilon_0$

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

D. $\frac{3}{\varepsilon_0}$

Answer: A

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7. For a given surface the Gauss's law is stated as $\oint \vec{E}. d\vec{A} = 0$. From this we can conclude that

A. E is necessarily zero on the surface

B. E is perpendicular to the surface at every point

C. The total flux through the surface is zero

D. The flux is only going out to the surface

Answer: C

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8. The total electric flux emanating from a closed surface enclosing an alpha particale (e = electronic chage) is

A. $\frac{2e}{\varepsilon_0}$

B. $\frac{e}{\varepsilon_0}$

C. $e\varepsilon_0$

D. $\frac{\varepsilon_0 e}{4}$

Answer: A

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9. The inward and outward electric flux for a closed surface in unit of $N\text{-}m^2/C$ are respectively 8×10^3 and 4×10^3. Then the total charge inside the surface is [where $\varepsilon_0 =$ permittivity constant]

A. $4 \times 10^3 C$

B. $-4 \times 10^3 C$

C. $\frac{\left(-4 \times 10^3\right)}{\varepsilon_0} C$

D. $-4 \times 10^3 \varepsilon_0 C$

Answer: D

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10. If the flux of the electric field through a closed surface is zero ,

(i) the electric field must be zero everywhere on the surface

(ii) the electric field may be zero everywhere on the surface

(iii) the charge inside the surface must be zero

(iv) the charge in the vicinity of the surface must be zero

A. (i), (ii)

B. (ii), (iii)

C. (ii), (iv)

D. (i), (iii)

Answer: B

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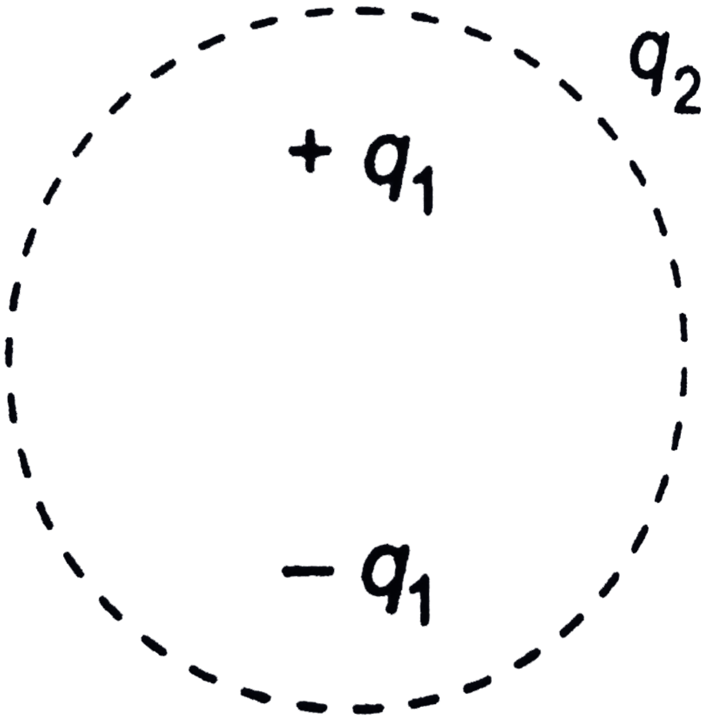
11. Consider the charge configuration and a spherical Gaussian surface as shown in the figure. When calculating the flux of the electric field over the spherical surface, the electric field will be due to.



A. q_2

B. only the positive charge

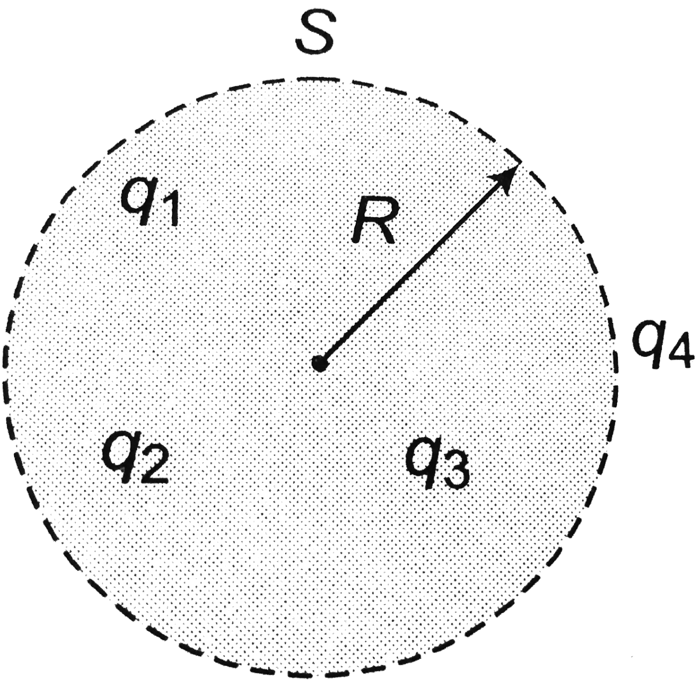
C. all the charges

D. $+q_1$ and $-q_1$

Answer: C

Watch Video Solution

12. q_1, q_2, q_3 and q_4 are point charges located at point 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. $\oint s\left(E_1 + E_2 + E_3\right). dA = \frac{q_1 + q_2 + q_3}{2\varepsilon_0}$

B. $\oint s\left(E_1 + E_2 + E_3\right). dA = \frac{\left(q_1 + q_2 + q_3\right)}{\varepsilon_0}$

C. $\oint s\left(E_1 + E_2 + E_3\right). dA = \frac{\left(q_1 + q_2 + q_3 + q_4\right)}{\varepsilon_0}$

D. None of the above

Answer: D

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13. The Gaussian surface for calculating the electric field due to a charge distribution is

A. any surface near the charge distribution

B. always a spherical surface

C. a symmetrical closed surface containing the charge distribution, at very point of which electric field has a single fixed value

D. None of the given options

Answer: C

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14. If Coulomb's law involved $\frac{1}{r^3}$ instead of $\frac{1}{r^2}$, would Gauss's law still be true?

A. there were magnetic monopoles

B. the inverse square law were not exactly true

C. the velocity of light were not a universal constant

D. None of the above

Answer: B

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15. Two parallel infinite line charges with linear charge densities $+\lambda C/m$ and -$\lambda C/m$ are placed at a distance of $2R$ in free space. What is the electric field mid-way between the two line charges?

A. zero

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

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

D. $\frac{1}{2\pi\varepsilon_0 R}$

Answer: B

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16. An infinite line charge produces a field of $9 \times 10^4 NC$ at a distance of $2cm$. Calculate the linear charge density.

A. $2 \times 10^{-7} C/m$

B. $10^{-8} C/m$

C. $10^7 C/m$

D. $10^{-4} C/m$

Answer: A

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17. A charge of $17.7 \times 10^{-4} C$ is distributed uniformly over a large sheet of area $200 m^2$. The electric field intensity at a distance 20 cm from it in air will be

A. $5 \times 10^5 N/C$

B. $6 \times 10^5 N/C$

C. $7 \times 10^5 N/C$

D. $8 \times 10^5 N/C$

Answer: A

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18. From what distance should a 100 eV electron be fired towards a large metal plate having a surface charge of $-2.0 \times 10^{-6} Cm^{-2}$, so that it just fails to strike the plate ?

A. 0.50 mm

B. 0.44 m

C. 0.60 mm

D. 0.77 mm

Answer: B

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19. If the field near the earth's surface is $300 Vm^{-1}$ directed downwards , what is the surface density of change on the surface of the earth?

A. $3.0 \times 10^{-9} C/m^2$

B. $5.0 \times 10^{-9} C/m^2$

C. $2.6 \times 10^{-9} C/m^2$

D. $7.0 \times 10^{-9} C/m^2$

Answer: C

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20. A thin spherical shell of metal has a radius of $0.25m$ and carries a charge of$0.2\mu C$. The electric intensity at a point for outside the shell will be

A. $2.88 \times 10^4 N/C$

B. $3.4 \times 10^4 N/C$

C. $325 \times 10^4 N/C$

D. $3.88 \times 10^4 N/C$

Answer: A

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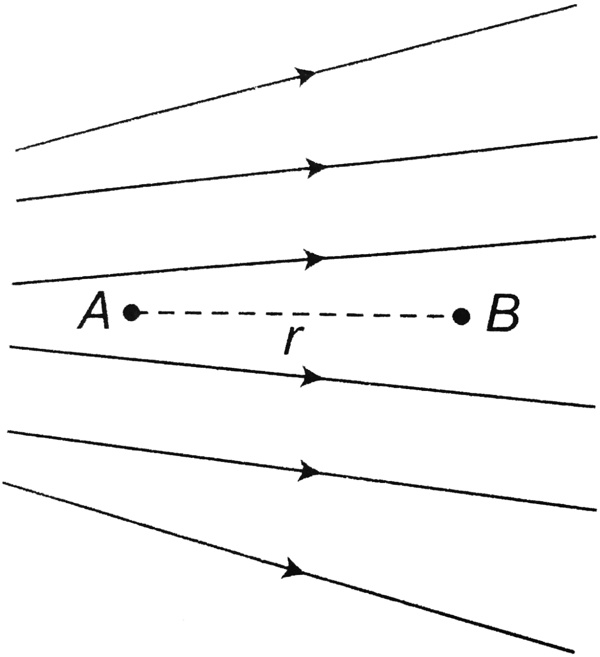
Taking it together

1. Figure shows the electric lines of force emerging from a charged body. If the electric field at$A$ and B are E_A and E_B respectively and if the displacement between A and B is r then



A. $E_A > E_B$

B. $E_A < E_B$

C. $E_A = \frac{E_B}{r}$

D. $E_A = \frac{E_B}{r^2}$

Answer: A

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2. The unit of physical quantity obtained by the line integral of electric field is

A. NC^{-1}

B. Vm^{-1}

C. JC^{-1}

D. $C^2N^{-1}m^{-2}$

Answer: C

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3. Two point charge $+2C$ and $+6C$ repel each other with a force of $12N$. If a charge of $-2C$ is given to each other of these charges , the force will now be

A. 4 N (repulsive)

B. 4 N (attractive)

C. 12 N (attractive)

D. 8 N (repulsive)

Answer: B

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4. 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 $\left(F_{12}/F_{13}\right)$ is

A. $1/2$

B. 2

C. $1/\sqrt{2}$

D. $\sqrt{2}$

Answer: B

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5. The insulation property of air breaks down at $E = 3 \times 10^6 \text{volt}/meter$. The maximum charge that can be given to a sphere of diameter $5m$ is approximately (in coulombs)

A. 2×10^{-2}

B. 2×10^{-3}

C. 2×10^{-4}

D. 2×10^{-5}

Answer: B

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6. The electric field near a conducting surface having a uniform surface charge denstiy σ is given by

A. $\frac{\sigma}{\varepsilon_0}$ and is parallel to the surface

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

C. $\frac{\sigma}{\varepsilon_0}$ and is normal to the surface

D. $\frac{2\sigma}{\varepsilon_0}$ and is normal to the surface

Answer: C

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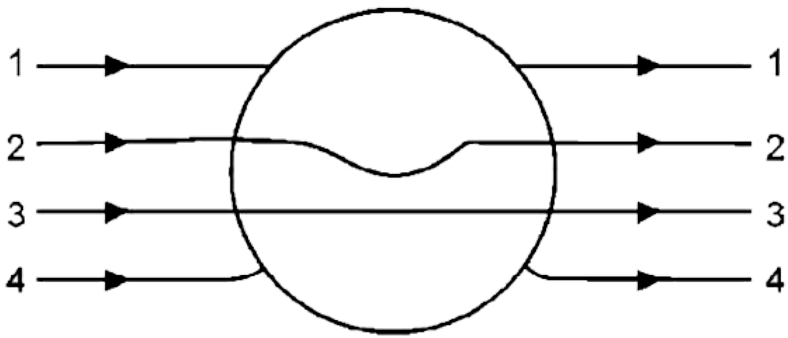
7. A metallic solid sphere is placed in a uniform electric fied. The lines of force follow the path(s) shown in Figure as



A. 1

B. 2

C. 3

D. 4

Answer: D

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8. A conductor has been given a charge $-3 \times 10^{-7} C$ by transferring electron. Mass increase (in kg) of the conductor and the number of electrons added to the conductor are respectively

A. 2×10^{-16} and 2×10^{31}

B. 5×10^{-31} and 5×10^{19}

C. 3×10^{-19} and 9×10^{16}

D. 2×10^{-18} and 2×10^{12}

Answer: D

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9. Two point charges of $20\mu C$ and $80\mu C$ are 10 cm apart where will the electric field strength be zero on the line joining the charges from $20\mu C$ charge

A. 0.1 m

B. 0.04 m

C. 0.033 m

D. 0.33 m

Answer: C

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10. For a dipole $q = 2 \times 10^{-6} C$ and $d = 0.01 m$. Calculate the maximum torque for this dipole if $E = 5 \times 10^{5} N/C$

A. $1 \times 10^{-3} N - m^{-1}$

B. $10 \times 10^{-3} N - m^{-1}$

C. $10 \times 10^{-3} N - m$

D. $1 \times 10^{2} N - m^{2}$

Answer: C

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11. What is the magnitude of a point charge due to which the electric field $30cm$ away the magnitude 2?

$\left[1/4\pi\varepsilon_0 = 9 \times 10^9 Nm^2/C^2\right]$

A. $2 \times 10^{-11} C$

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

C. $5 \times 10^{-11} C$

D. $9 \times 10^{-11} C$

Answer: A

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12. A dipole of electric dipole moment p is placed in a uniform electric field of strength E. If θ is the angle between positive direction of p and E, then the potential energy of the electric dipole is largest when θ is

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

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

C. π

D. zero

Answer: C

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13. The ratio of electrostatic and gravitational force acting between electron and proton separated by a distance $5 \times 10^{-11} m$, will be (charge on electron $= 1.6 \times 10^{-19} C$, mass of electron $= 9.1 \times 10^{-31} kg$, mass of proton $= 1.6 \times 10^{-27} kg$, $G = 6.7 \times 10^{-11} N - m^2 / kg^2$)

A. 2.36×10^{39}

B. 2.36×10^{40}

C. 2.34×10^{41}

D. 2.34×10^{42}

Answer: A

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14. An electric dipole is placed in an uniform electric field with the dipole axis making an angle θ with the direction of the electric field. The orientation of the dipole for stable equilibrium is

A. $\frac{\pi}{6}$

B. $\frac{\pi}{3}$

C. 0

D. $\frac{\pi}{2}$

Answer: C

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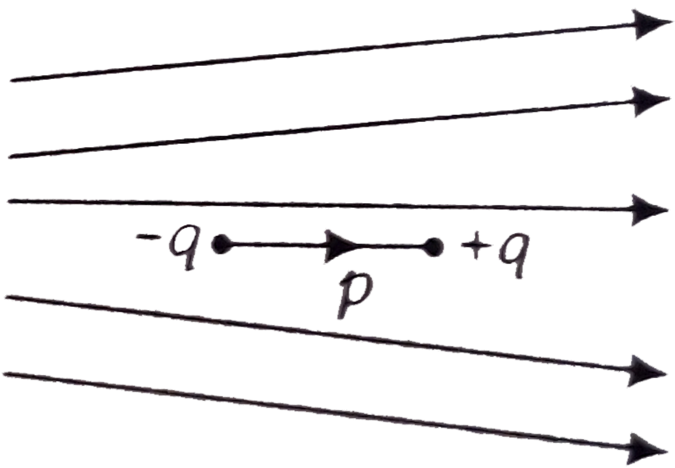
15. Figure shows electric field lines in which an electric dipole p is placed as shown. Which of the following statements is correct ?



A. The dipole will not experience any force

B. The dipole will experience a force towards right

C. The dipole will experience a force towards left

D. The dipole will experience of force upwards

Answer: C

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16. Two similar spheres having $+q$ and -q and $+4q$ charges are kept at a certain distance. The force acts between the two is F. If in the middle of two spheres, another similar sphere having $+q$ charge is kept,then it experience a force in magnitude and direction as

A. zero having no direction

B. 8 F towards $+q$ charge

C. 8 F towards -q charge

D. 4 F towards $+q$ charge

Answer: C

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17. Two small conducting spheres of equal radius have charges $+10\mu C$ and $-20\mu C$ respectively and placed at a distance R from each other. They experience force F_1. If they are brought in contact and separated to the same distance, they experience force F_2. The ratio of F_1 to F_2 is

A. $1:8$

B. $-8:1$

C. $1:2$

D. $-2:1$

Answer: B

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18. A charges Q is placed at each of the two opposite corners of a square. A charge q is placed to each of the other two corners. If the resultant force on each charge q is zero, then

A. $Q = \sqrt{2}q$

B. $Q = -\sqrt{2}q$

C. $Q = 2\sqrt{2}q$

D. $Q = -2\sqrt{2}q$

Answer: D

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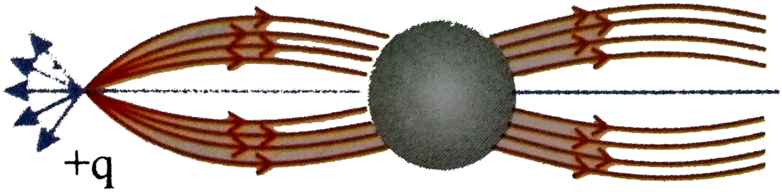
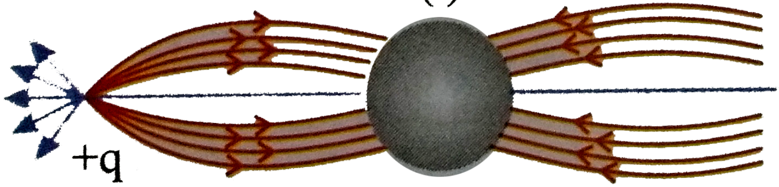
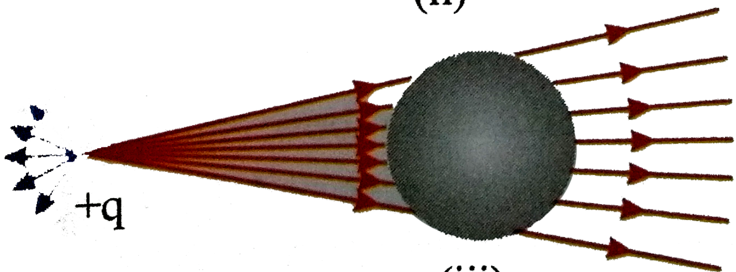
19. A point positive charge is brought near an isolated conducting sphere as shown in figure the electric field is best given by



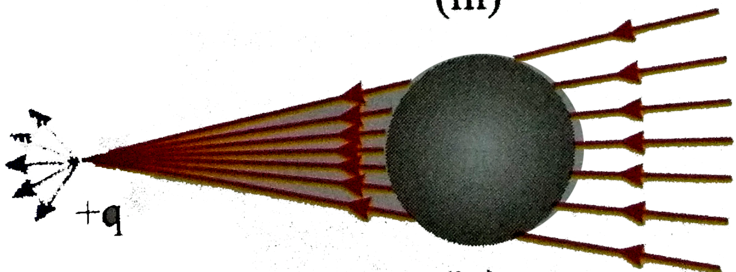
(i)



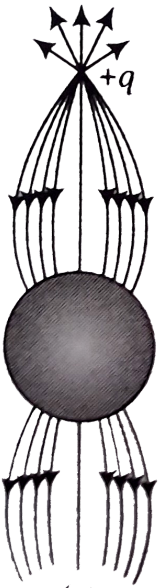
(ii)



(iii)

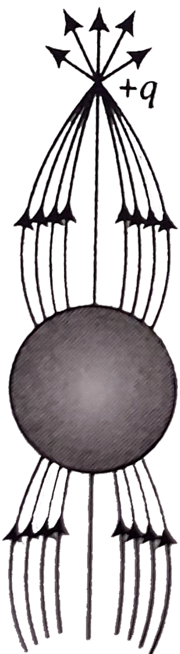


(iv)



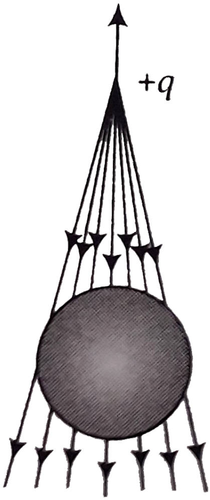
(a)

A.



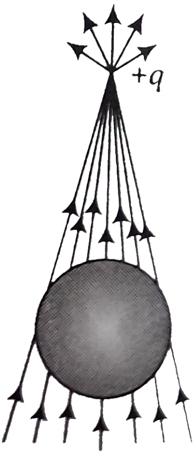
(b)

B.



(c)

C.



(d)

D.

Answer: A

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20. 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. $Q/2$

B. $-Q/2$

C. $Q/4$

D. $-Q/4$

Answer: D

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21. The centres of two identical small conducting spheres are 1m apart. They carry charge of opposite kind and attract each other with a force F. When they are connected by a conducting thin wire they repel each other with a force $F/3$. What is the ratio of magnitude of charge carried by the sphere initially ?

A. $1:1$

B. $2:1$

C. $3:1$

D. $4:1$

Answer: C

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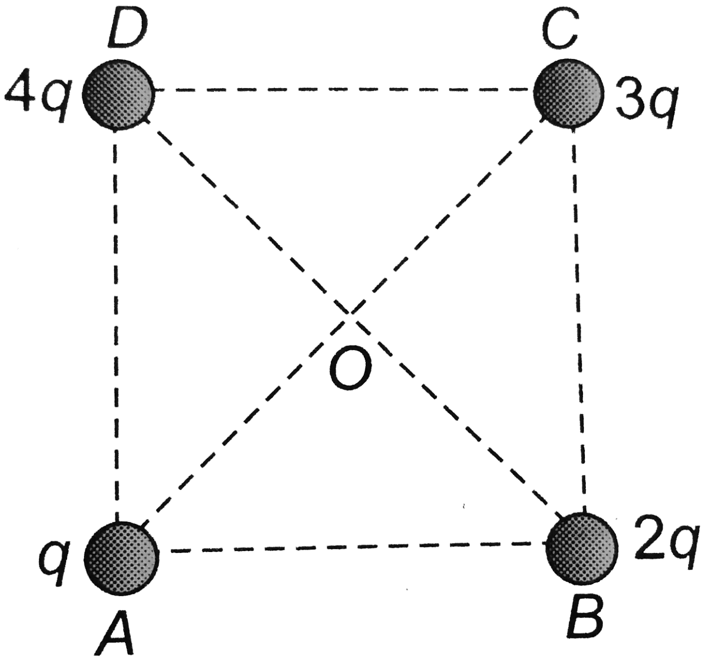
22. Charges q, $2q$, $3q$ and $4q$ are placed at the corners A, B, C and D of a square as shown in the following figure. The directon of electric field at the centre of the square is along



A. AB

B. CB

C. AC

D. BD

Answer: B

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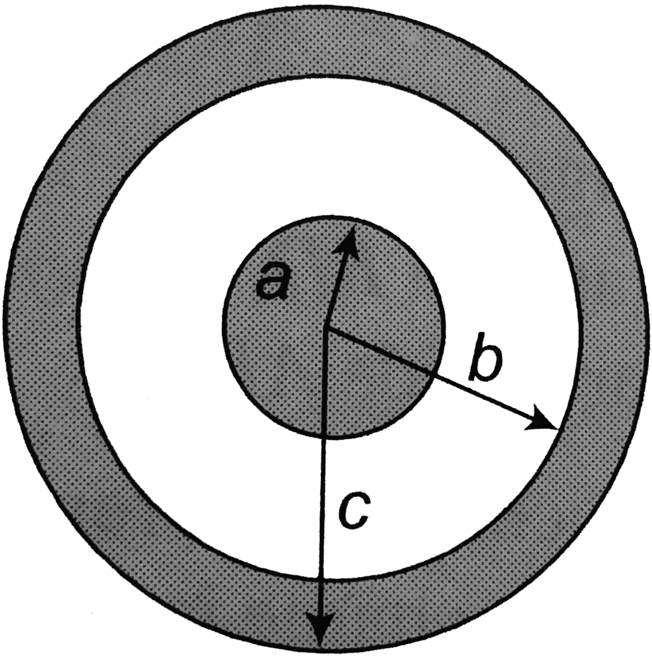
23. A solid conducting sphere of radius a has a net positive charge $2Q$. A conducting spherical shell of inner radius b and outer radius c is concentric with the solid sphere and has a net charge $-Q$. The surface charge density on the inner and outer surfaces of the spherical shell will be



A. $-\frac{2Q}{4\pi b^2}, \frac{Q}{4\pi c^2}$

B. $-\frac{Q}{4\pi b^2}, \frac{Q}{4\pi c^2}$

C. $0, \frac{Q}{4\pi c^2}$

D. None of these

Answer: A

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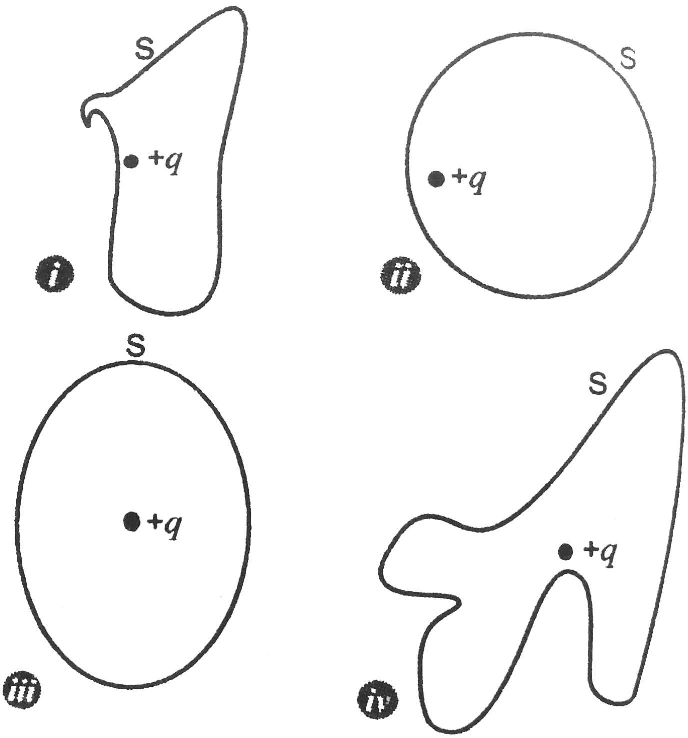
24. The electric flux through the surface



A. in Fig. (iv) is the largest

B. in (fig. (iii) is the least

C. in fig. (ii) is same as fig.(iii) but is smaller than fig. (iv)

D. is the same for all the figure

Answer: D

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25. The point charges Q and -$2Q$ are placed at some distance apart. If the electirc field at the location of Q is E, the electric field at the location of -$2Q$ will be

A. 3 E

B. $E/2$

C. E

D. None of these

Answer: D

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26. A ball with charge $-50e$ is placed at the centre of a hollow spherical shell has a net charge of $-50e$. What is the charge on the shell's outer surface ?

A. $-50e$

B. zero

C. $-100e$

D. $+100e$

Answer: C

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27. A mass $m = 20g$ has a charge $q = 3.0mC$. It moves with a velocity of 20 m/s and enters a region of electric field of 80 N/C in the same direction as the velocity of the mass. The velocity of the mass after 3 s in this region is

A. $80ms^{-1}$

B. $56ms^{-1}$

C. $44ms^{-1}$

D. $40ms^{-1}$

Answer: B

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28. Two parallel metal plates having charges $+Q$ and $-Q$ face each other at a certain distance between them.If the plates are now dipped in kerosene oil tank ,the electric field between the plates will

A. became zero

B. increase

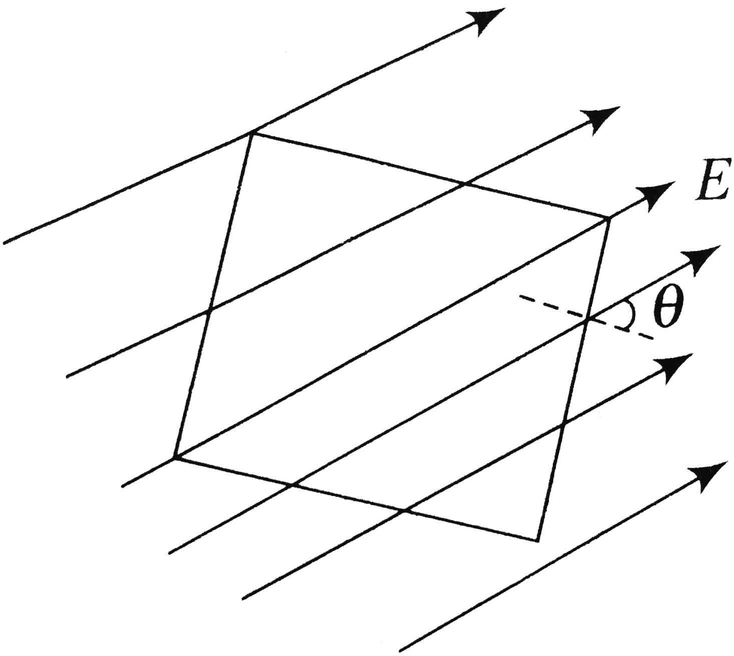
C. decrease

D. remain same

Answer: C

Watch Video Solution

29. A square surface of side L metre in the plane of the paper is placed in a uniform electric field $E(\text{volt}/m)$ acting along the same place at an anlge θ with the horizontal side of the square as shown in figure. The electric flux linked to the surface in uint of V - m is



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30. 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. $1:3:5$

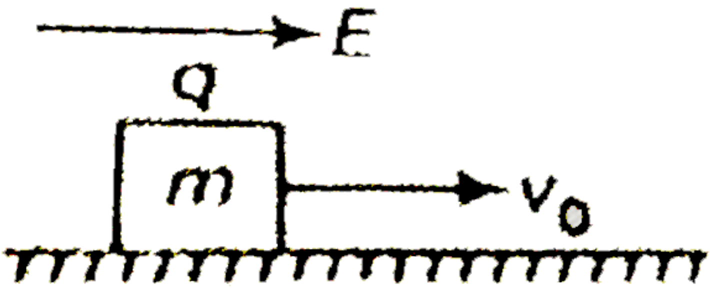
C. $1:4:9$

D. $1:8:18$

Answer: B

Watch Video Solution

31. If a charged particle is projected on a rough horizontal surface with speed v_0. Find the value of dynamic coefficient of friction, if the kinetic energy of system is constant.



A. $\frac{QE}{mg}$

B. $\frac{QE}{m}$

C. QE

D. None of these

Answer: A

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

A. ql

B. $2ql$

C. $\sqrt{3ql}$

D. $4ql$

Answer: C

Watch Video Solution

33. A point charge $+q$ is placed at a distance d from an isolated conducting plane. The field at a point P on the other side of plane is

A. directed perpendicular to the plane and away from the plane

B. directed perpendicular to the plane but towards the plane

C. directed radially away from the point charge

D. directed radially towards the point charge

Answer: A

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34. Under the influence of the Coulomb field of charge $+Q$, a charge $-q$ is moving around it in an elliptical orbit. Find out the correct statement(s).

A. The angular momentum of the charge $-q$ is constant

B. The linear momentum of the charge $-q$ is constant

C. The angular velocity of the charge $-q$ is constant

D. Thelinear speed of the charge $-q$ is constant

Answer: A

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35. Two identical conducting sphere carrying different charges attact each other with a force F when placed in air medium at a distance d apart.

The spheres are brought into contact and then taken to their original positions. Now, the two sphere repel each other with a force whole magnitude is equal to the initial attractive force. The ratio between initial charges on the spheres is

A. $-\left(3+\sqrt{8}\right)$ only

B. $-3+\sqrt{8}$ only

C. $-\left(3+\sqrt{8}\right)$ or $\left(-3+\sqrt{8}\right)$

D. $+\sqrt{3}$

Answer: C

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36. The electric field at a distance $3R/2$ from the centre of a charge conducting spherical shell of radius R is E. The electric field at a distance $R/2$ from the centre of the sphere is

A. zero

B. E is perpendicular to the surface at every point

C. $E/2$

D. $E/3$

Answer: A

Watch Video Solution

37. Under the action of a given coulombic force the acceleration of an electron is $2.5 \times 10^{22} ms^{-1}$. Then, the magnitude of the acceleration of a proton under the action of same force is nearly

A. $1.6 \times 10^{-19} ms^{-2}$

B. $9.1 \times 10^{31} ms^{-2}$

C. $1.5 \times 10^{19} ms^{-2}$

D. $1.6 \times 10^{27} ms^{-2}$

Answer: C

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38. A drop of 10^{-6} kg water carries $10^{-6}C$ charge. What electric field should be applied to balance its weight (assume $g = 10ms^{-2}$)

A. 10 V/m upward

B. 10 V/m downward

C. 0.1 V/m downward

D. 0.1 V/m upward

Answer: A

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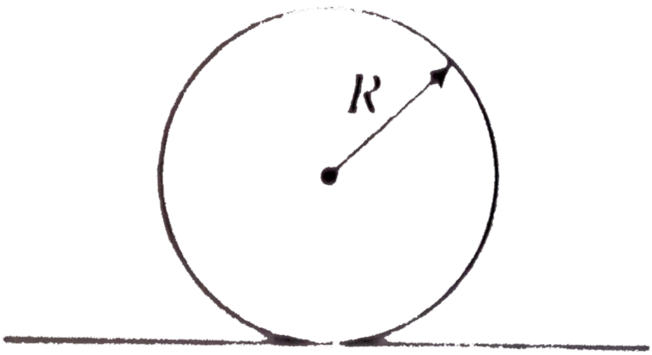
39. If linear charge density of a wire as shown in the figure is λ



A. potential at the centre is $\frac{\lambda}{2\varepsilon_0}$

B. electric field at the centre of the loop is $\frac{\lambda}{2\pi\varepsilon_0 R}$

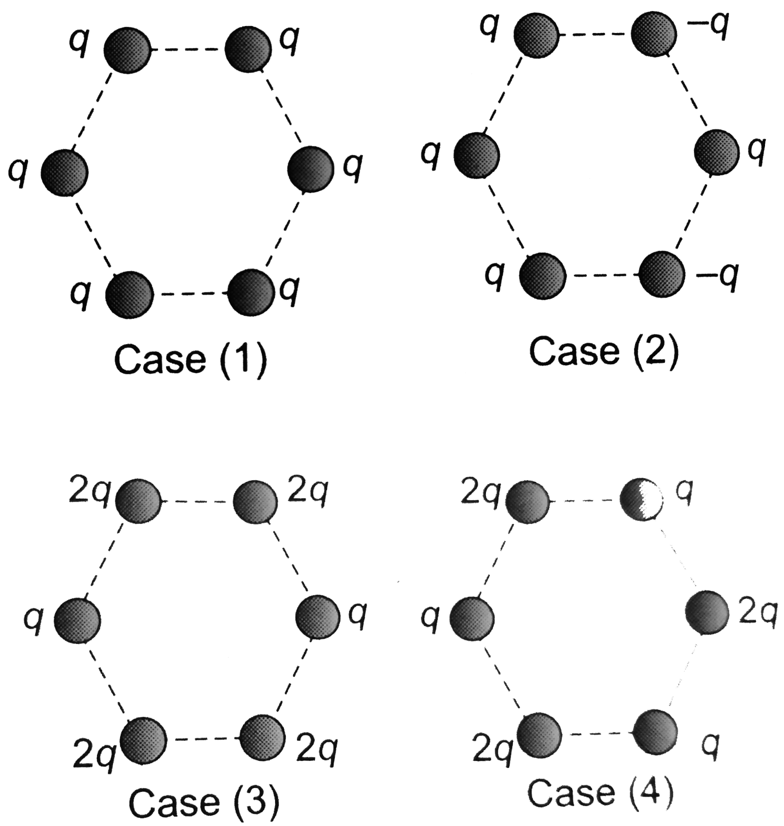
C. electric field at the centre of the loop is $\frac{\lambda}{2\pi\varepsilon_0 R}+\frac{\lambda}{2\varepsilon_0 R}$

D. None of the above

Answer: B

View Text Solution

40. Figure below show regular hexagons with charges at the vertices. In which of the following cases the electric field at the centre is not zero



A. 1

B. 2

C. 3

D. 4

Answer: B

Watch Video Solution

41. Electric field intensity at a point in between two parallel sheets with like charges of same surface charge densities (σ) is

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

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

C. zero

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

Answer: C

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42. The electric charges are distributed in a small volume. The flux of the electric field through a spherica surface of radius 10 cm surrounding the total charge is $20V - m$. The flux over a concentric sphere of radius 20 cm will be

A. 20 Vm

B. 10 Vm

C. 40 Vm

D. 5 Vm

Answer: A

Watch Video Solution

43. Two charges of $-4\mu C$ and $+4\mu C$ are placed at the points $A(1, 0, 4)$ and $B(2, -1, 5)$ location in an electric field $\vec{E} = 0.20\hat{i}V/cm$. Calculate the torque acting on the dipole.

A. $2.31 \times 10^{-4}N/m$

B. $7.98 \times 10^{-4}C/m$

C. $7.11 \times 10^{-4}C/m$

D. $7.04 \times 10^{-4} C/m$

Answer: B

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44. An infinite line charge produces a field of $7.182 \times 10^{8} N/C$ at distance of 2 cm. the linear charge density is

A. $7.27 \times 10^{-4} C/m$

B. $7.98 \times 10^{-4} C/m$

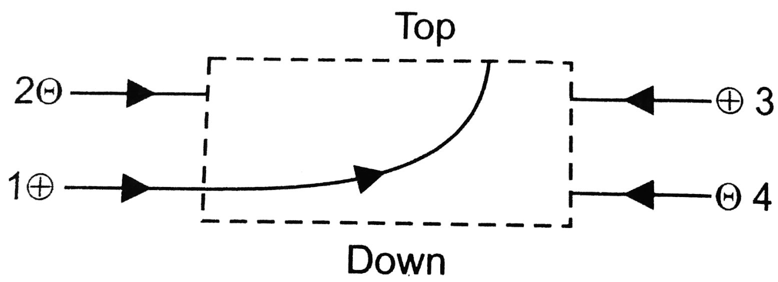
C. $7.11 \times 10^{-4} C/m$

D. $7.04 \times 10^{-4} C/m$

Answer: B

Watch Video Solution

45. The figure shows the path of a positively charged particle 1 through a rectangular region of uniform electric field as shown in the figure. What is the direction of electric field and the direction of deflection of particles



2, 3 and 4 ?

A. Top, down, top, down

B. Top, down, down, top

C. Down, top, top down

D. Down, top, down, down

Answer: A

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46. The electric intensity due to a dipole of length $10cm$ and having a charge of $500\mu C$, at a point on the axis at a distance $20cm$ from one of the charges in air is

A. $6.25 \times 10^{7} N/C$

B. $9.28 \times 10^{7} N/C$

C. $13.1 \times 10^{11} N/C$

D. $20.5 \times 10^{7} N/C$

Answer: A

Watch Video Solution

47. Two electric dipoles of moment P and $64P$ are placed in opposite direction on a line at a distance of $25cm$. The electric field will be zero at point between the dipoles whose distance from the dipole of moment P is

A. 5 cm

B. $\frac{25}{9} cm$

C. 10 cm

D. $\frac{4}{13} cm$

Answer: A

Watch Video Solution

48. Two spherical conductors B and C having equal radii and cayying equal charges on them repel each other with a force F when kept apart at some distance. A third spherical conductor having same radius as that B but uncharged is brought in contact with B, then brought in contact with C and finally removed away from both. The new force of repulsion between B and C is

A. $F/4$

B. $3F/4$

C. $F/8$

D. $3F/8$

Answer: D

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49. A sample of HCl gas is placed in an electrical field of $3 \times 10^4 NC^{-1}$. The dipole moment of each HCl molecule is $6 \times 10^{-30} C - m$. The maximum torque that can act on a moleucle is

A. $2 \times 10^{-34} C^2 N^{-1} m$

B. $2 \times 10^{-34} N - m$

C. $18 \times 10^{-26} N - m$

D. $0.5 \times 10^{34} C^{-2} N^{-1} m^{-1}$

Answer: C

Watch Video Solution

50. A neutral water molecule $\left(H_2O\right)$ in its vapour state has an electric dipole moment of magnitudes $6.4 \times 10^{-30} C - m$. How far apart are the molecules centres of positive and negative charge

A. 4×10^{-10}

B. 4×10^{-11}

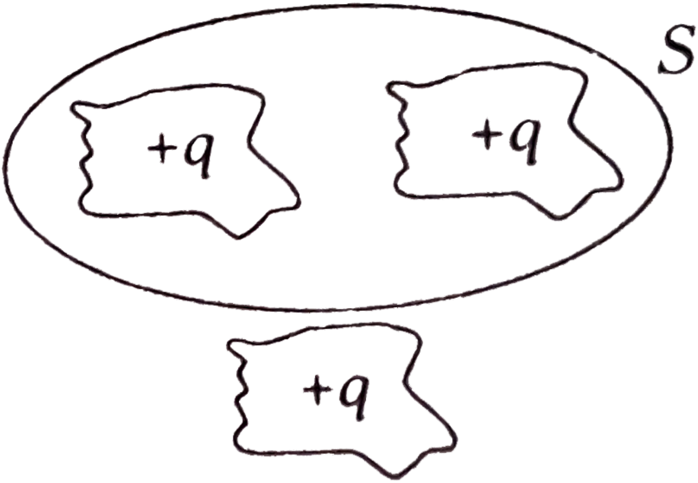
C. 4×10^{-12}

D. 4×10^{-13}

Answer: B

Watch Video Solution

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



A. $3q/\varepsilon_0$

B. $2q/\varepsilon_0$

C. q/ε_0

D. zero

Answer: B

Watch Video Solution

52. There exists an electric field of $1NC^{-1}$ along Y direction. The flux passing through the square of 1 m placed in xy - plane inside the electric field is

A. $1.0Nm^2C^{-1}$

B. $10.0Nm^2C^{-1}$

C. $2.0Nm^2C^{-1}$

D. zero

Answer: D

Watch Video Solution

53. Two positive ions , each carrying a charge q , are separated by a distance d.If F is the force of repulsion between the ions , the number of electrons missing from each ion will be (e being the charge on an electron)

A. $\frac{4\pi epai_0 Fd^2}{e}$

B. $\sqrt{\frac{4\pi\varepsilon_0 Fe^2}{d^2}}$

C. $\sqrt{\frac{4\pi\varepsilon_0 Fd^2}{e^2}}$

D. $\frac{4\pi\varepsilon_0 Fd^2}{e^2}$

Answer: C

Watch Video Solution

54. All charge on a conductor must reside on its outer surface. This statement is true

A. in all cases

B. for spherical conductors only (both solid and hollow)

C. for hollow spherical conductors only

D. for conductors which do not have any sharp points or corners

Answer: A

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55. Two charges $+4e$ and $+e$ are at a distance x apart. At what distance,a charge q must be placed from charge $+e$ so that is in equilibrium

A. $x/2$

B. $2x/3$

C. $x/3$

D. $x/4$

Answer: C

Watch Video Solution

56. Among two discs A and B, first have radius 10 cm and charge $10-^{6}$ - μC and second have radius 30 cm and charge 10^{-5}- C. When they are touched, charge on both q_A andq_B respectively will, be

A. $q_A = 2.75\mu C, q_B = 3.15\mu C$

B. $q_A = 1.09\mu C, q_B 1.53\mu C$

C. $q_A = q_B = 5.5\mu C$

D. None of these

Answer: C

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57. Two charges are at a distance d apart. If a copper plate (conducting medium) of thickness $d/2$ is placed between them , the effictive force will be

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

B. zero

C. 2F

D. $\sqrt{2F}$

Answer: B

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58. Two point charge $-q$ and $+q/2$ are situated at the origin and the point $(a, 0, 0)$ respectively. The point along the X-axis where the electic field Vanishes is

A. $x = \frac{a}{\sqrt{2}}$

B. $x = \sqrt{2}a$

C. $x = \frac{\sqrt{2a}}{\sqrt{2} - 1}$

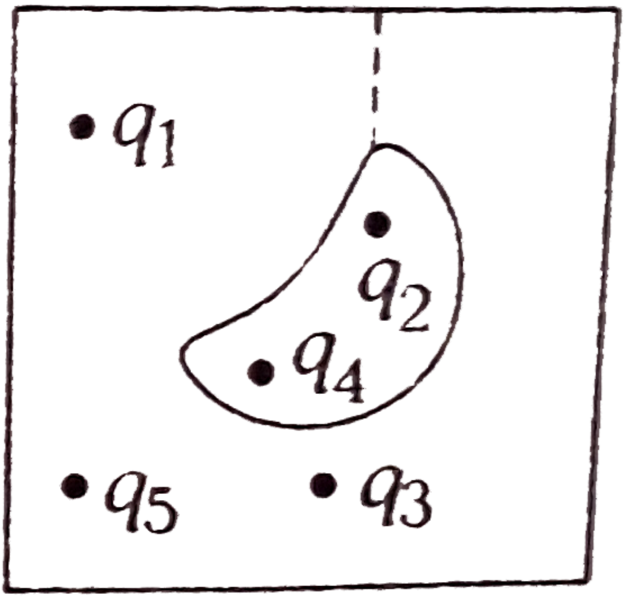
D. $x = \frac{\sqrt{2a}}{\sqrt{2} + 1}$

Answer: C

Watch Video Solution

59. Five charge q_1, q_2, q_3, q_4 and q_5 are fixed at their positions as shown in figure, S is a Gaussian surface. The Gauss's law is given by $\int_S E.\,dS = \frac{q}{\varepsilon_0}$.

Which of the following statement is correct ?



A. E on the LHS of the above equation will have a contribution from q_1, q_5 and q_1, q_5 and q_3 while q on the RHS will have a contribution from q_2 and q_4 only

B. E on the LHS of the above equation will have a contribution from all charges while q on the RHS will have a contribution from q_2 and q_4 only

C. E on the LHS of the above equation will have a contribution from all charges while q on the RHS will have a contribution from q_1, q_3 and q_5 only

D. Both E on the LHS and q on the RHS will contribution from q_2 and q_4 only

Answer: B

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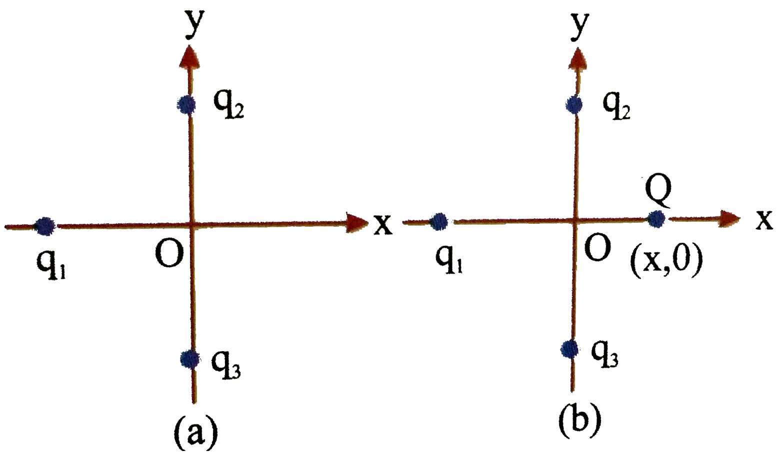
60. In figure two positive charges q_2 and q_3 fixed along the y-axis ,exert a net electric force in the $+x$ direction on a charge q_1 fixed along the x-axis if a positive charge Q is added at $(x, 0)$ the force on q_1



A. shall increase along the positive X-axis

B. shall decrease along the positive X-axis.

C. shall point along the negative X-axis

D. shall increase but the direction charges because of the intersection

of Q with q_2 and q_3

Answer: A

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61. A hemispherical shell is uniformly charge positively .the electric field at point on a diameter away from the centre is directed

A. perpendicular to the diameter

B. parallel to the diameter

C. at an angle tilted towards the diameter

D. at an angle tilted away from the diameter

Answer: A

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62. A charge q_0 is distributed uniformly on a ring of radius R. A sphere of equal radius R constructed with its centre on the circumference of the ring. Find the electric flux through the surface of the sphere.

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

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

C. zero

D. None of these

Answer: D

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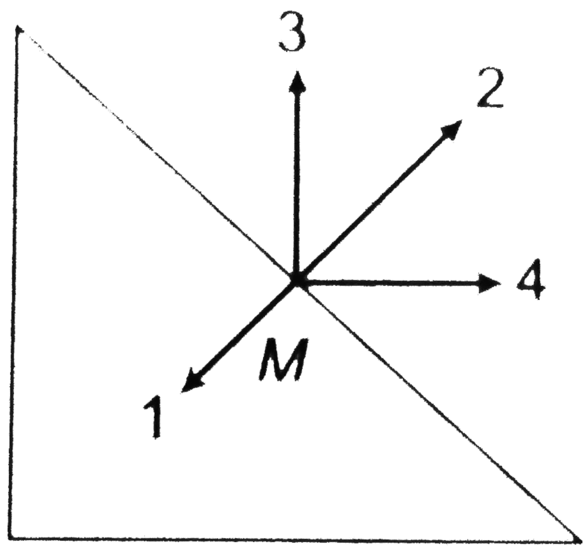
63. Three identical points charges, as shown are placed at the vertices of an isosceles right angled triangle. Which of the nembered vectors coincides in direction with the electric field at the mid-point M the hypotenuse



A. 1

B. 2

C. 3

D. 4

Answer: B

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64. Two identical charged spheres of material density ρ, suspended from the same point by inextensible strings of equal length make an angle θ between the string. When suspended in a liquid of density σ the angle θ remains the same. The dielectric constant K of the liquid is

A. $\dfrac{\rho}{\rho - \sigma}$

B. $\dfrac{\rho - \sigma}{\rho}$

C. $\dfrac{\rho}{\rho + \sigma}$

D. $\dfrac{\rho + \sigma}{\rho}$

Answer: A

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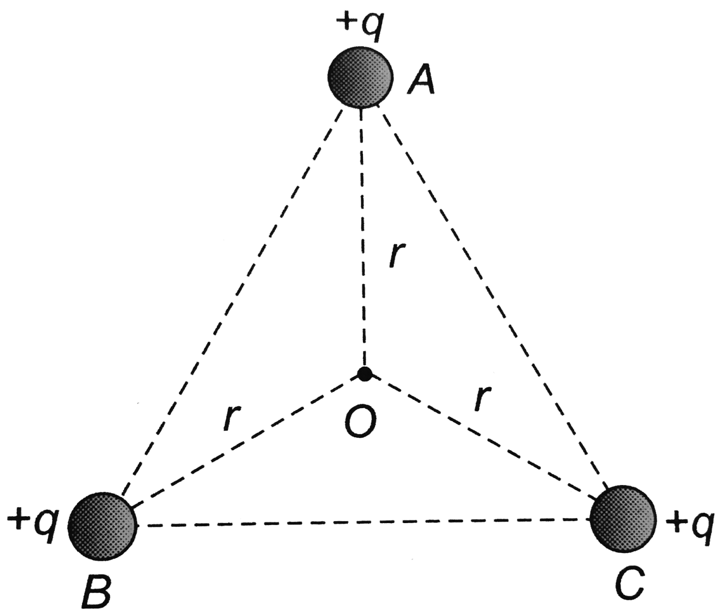
65. ABC is an equilateral triangle. Charges $+q$ are placed at each corner. The electric intensity at O will be



A. $\frac{1}{4\pi\varepsilon_0}\cdot\frac{q}{r^2}$

B. $\frac{3}{4\pi\varepsilon_0}\cdot\frac{q}{r}$

C. zero

D. $\frac{1}{4\pi\varepsilon_0}\cdot\frac{3q}{r^2}$

Answer: C

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66. A wire of linear charge density λ passes through a cuboid of length l, breadth b and height h(lgtbgth) in such a manner that the flux through the cuboid is maximum. The position of the wire is now changed, so that the flux through the cuboid is minimum. The raito of maximum flux to minimum flux will be

A. $\frac{\sqrt{l^2+B^2+h^2}}{h}$

B. $\frac{\sqrt{l^2+b^2}}{h}$

C. $\frac{h}{\sqrt{l^2+b^2}}$

D. $\frac{l}{\sqrt{l^2+b^2+h^2}}$

Answer: A

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67. 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. $\frac{3q^2}{4\pi\varepsilon_0 a^2}$

B. $\frac{q^2}{4\pi\varepsilon_0 a^2}$

C. $\left(\frac{1+2\sqrt{2}}{2}\right)\frac{q^2}{4\pi\varepsilon_0 a^2}$

D. $\left(2+\frac{1}{\sqrt{2}}\right)\frac{q^2}{4\pi\varepsilon_0 a^2}$

Answer: C

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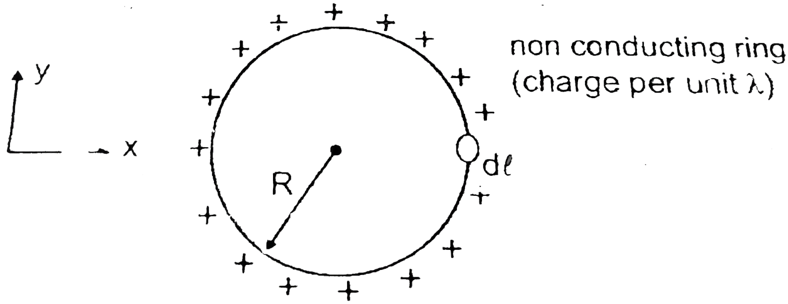
68.



A small part of dl length is removed from a ring having charge per unit length λ. Find electric field at centre due to remaining ring.

A. zero

B. $\dfrac{-\lambda l}{4\pi\varepsilon_0 a^2}$

C. infinity

D. $\dfrac{\lambda}{4\pi\varepsilon_0 l}$

Answer: B

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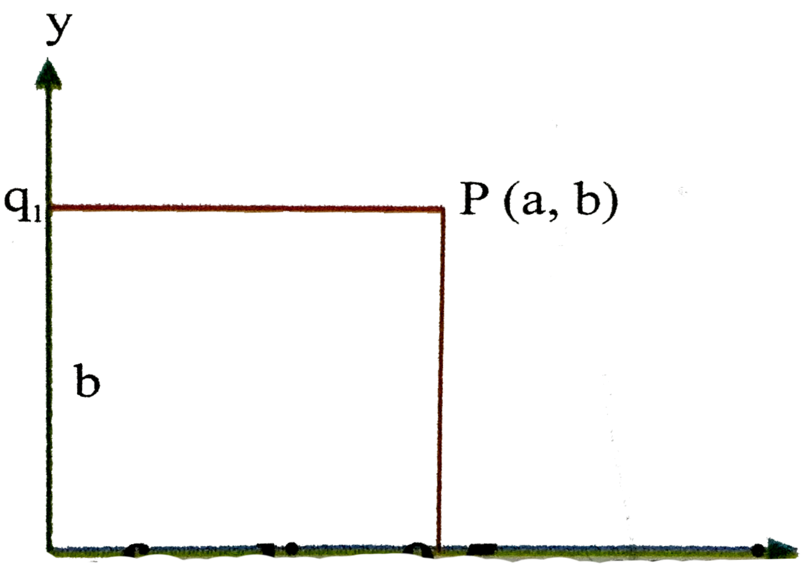
69. Two point charge $q_1 = 2\mu C$ and $q_2 = 1\mu C$ are placed at distance $b = 1$ and $a = 2cm$ from the origin on the y and x axes as shown in figure .The electric field vector at point $(a), (b)$ will subtend on angle θ with the "x-axis" given by



A. $\tan\theta = 1$

B. $\tan\theta = 2$

C. $\tan\theta = 3$

D. $\tan\theta = 4$

Answer: B

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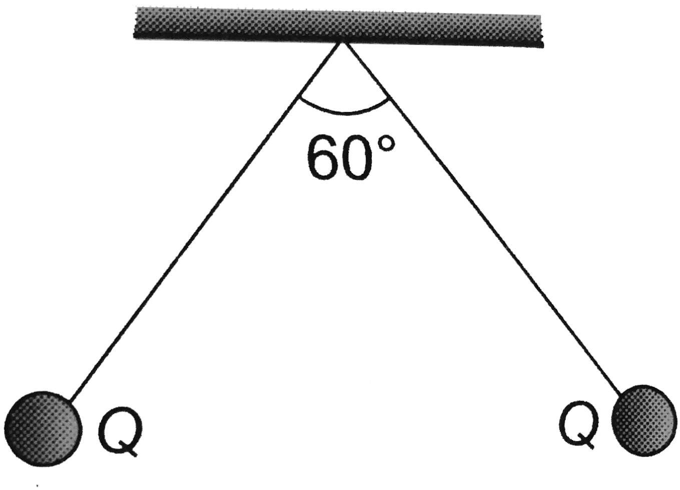
70. Two small spherical balls each carrying a charge $Q = 10\mu C$ are suspended by two insulating threads of equal lengths $1cm$ each, from a point fixed in the ceiling. It is found that in equilibrium threads are separated by an angle 60° between them, as shown in figure. What is the tension in the threads

(Given $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 Nm/C^2$)



A. 18 N

B. 1.8 N

C. 0.18 N

D. None of these

Answer: B

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71. An infinite number of charges, each of charge $1\mu C$ are placed on the x-axis with co-ordinates $x = 1, 2, 4, 8 \dots \infty$ If a charge of $1C$ is kept at the origin, then what is the net force action on $1C$ charge

A. 9000 N

B. 12000 N

C. 24000 N

D. 36000 N

Answer: B

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72. An electron moving with the speed 5×10^6 per sec is shot parallel to the electric field of intensity $1 \times 10^3 N/C$. Field is responsible for the retardation of motion of electron. Now evaluate the distance travelled by the electron before coming to rest for an instant (mass of $e = 9 \times 10^{-31} Kg$ charge $= 1.6 \times 10^{-19} C$)

A. 7 m

B. 0.7 mm

C. 7 cm

D. 0.7 cm

Answer: C

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73. An electric dipole coincides on Z-axis and its mid-point is on origin of the coordinates system. The electric field at an axial point at a distance z from origin is $E_{(z)}$ and electric field at an equatorial point at a distance y

from origin is $E_{(y)}$. Here, $z = y > > a$, so $\left|\frac{E_{(z)}}{E_{(y)}}\right| = ...$

A. 1

B. 4

C. 3

D. 2

Answer: D

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74. The point charges $+q$, $-2q$ and $+q$ are placed at point $(x = 0, y = a, z = 0)$, $(x = 0, y = 0, z = 0)$ and $(x = a, y = 0, z = 0)$, repectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are

A. $\sqrt{2qa}$ along + y -direction

B. $\sqrt{2}qa$ along the line joining points $(x = 0, y = 0, z = 0)$ and $(x = a, y = a, z = 0)$

C. qa along the line joining point $(x = 0, y = 0, z = 0)$ and $(x = a, y = a, z = 0)$

D. $\sqrt{2}qa$ along + x-direction

Answer: B

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75. A cylinder of radius R and length L is placed in a uniform electric field E parallel to the axis. The total flux for the surface of the cylinder is given by

A. $2\pi R^2 E$

B. $\pi R^2 / E$

C. $\left(\pi R^2 - \pi R\right)/E$

D. zero

Answer: D

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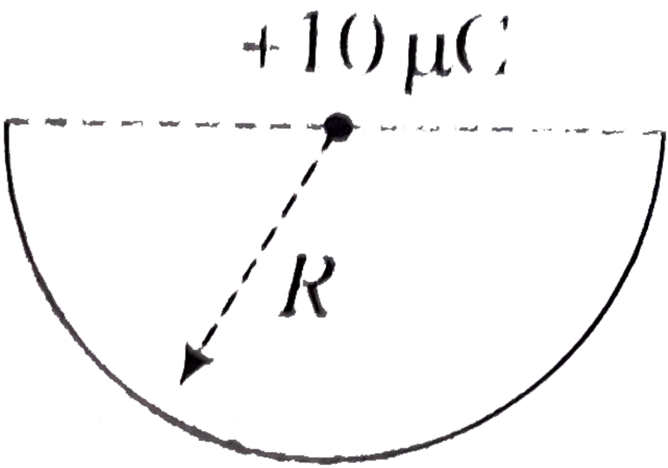
76. A charge $10\mu C$ is placed at the centre of a hemisphere of radius $R = 10cm$ as shown. The electric flux through the hemisphere (in MKS units)is



A. 20×10^5

B. 10×10^5

C. $\left(6 \times 10^5\right.$

D. 2×10^{5}

Answer: C

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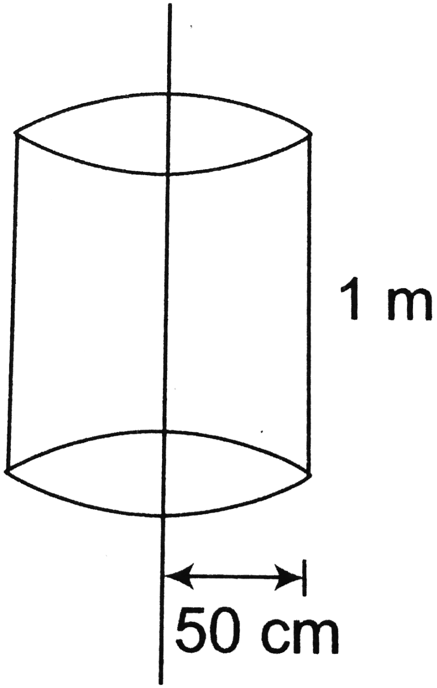
77. Electric charge is uniformly distributed along a straight wire of radius $1mm$. The charge per centimeter length of the wire is Q coulomb. Another cylindrical surface of radius $50cm$ and length $1m$ symmetrically enclose the wire as shown in figure. The total electric flux passing through the cylindrical 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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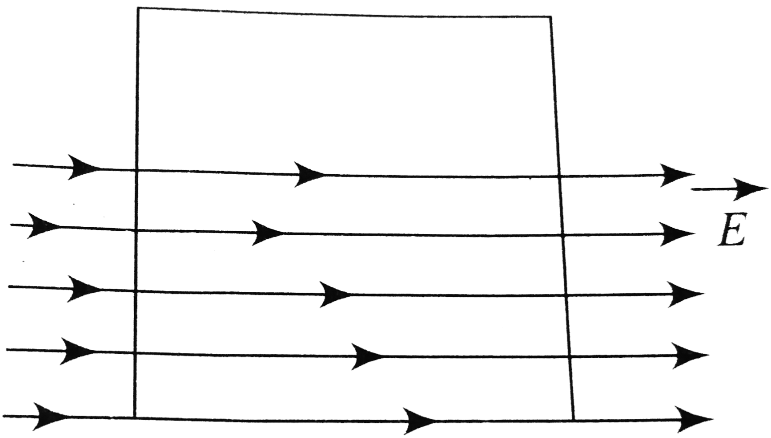
78. A square surface of side Lm is in the plane of the paper. A uniform electric field $\vec{E}(V/m)$, also in the plane of the paper, is limited only to the lower half of the square surface (see figure). The electric flux in SI units associated with the surface is:



A. zero

B. EL^2

C. $EL^2/(2\varepsilon_0)$

D. $EL^2/2$

Answer: A

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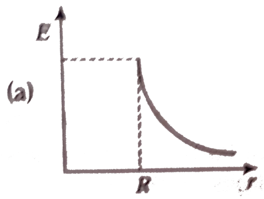
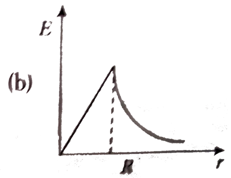
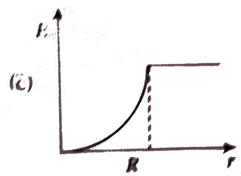
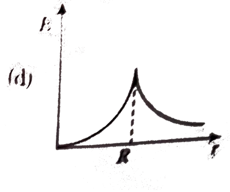
79. Which one of the following graphs represents the variation of electric field with distance r from the centre of a charged spherical conductor of radius R?

A. 

B. 

C. 

D. 

Answer: A

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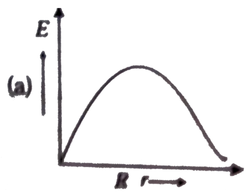
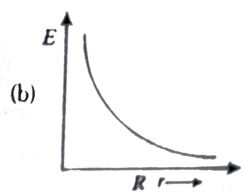
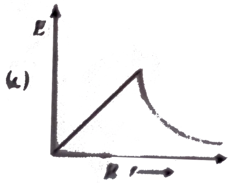
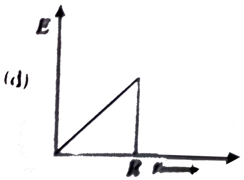
80. In a uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as function of distance from the centre, The graph which would correspond to the above will be:

A. 

B. 

C. 

D. 

Answer: C

Watch Video Solution

81. An electric dipole is situated in an electric field of uniform intensity E whose dipole moment is p and moment of inertia is I. If the dipole is displaced slightly from the equilibrium position, then the angular frequency of its oscillations is

A. $\left(\frac{pE}{I}\right)^{1/2}$

B. $\left(\frac{pE}{I}\right)^{3/2}$

C. $\left(\frac{I}{pE}\right)^{1/2}$

D. $\left(\frac{p}{IE}\right)^{1/2}$

Answer: A

Watch Video Solution

82. Two point charges $(+Q)$ and $(-2Q)$ are fixed on the X-axis at positions a and $2a$ from origin respectively. At what positions on the axis, the resultant electric field is zero

A. only $x = \sqrt{2}a$

B. only $x = -\sqrt{2}a$

C. Both $x = \pm\sqrt{2}a$

D. only $x = \frac{3a}{2}$

Answer: B

Watch Video Solution

83. Charge q_2 of mass m revolves around a stationary charge q_1 in a circulare orbit of radius r. The orbital periodic time of q_2 would be

A. $\left[\frac{4\pi^2 mr^3}{kq_1q_2}\right]^{1/2}$

B. $\left[\frac{kq_1q_2}{4\pi^2 mr^3}\right]^{1/2}$

C. $\left[\frac{4\pi^2 mr^4}{kq_1q_2}\right]^{1/2}$

D. $\left[\frac{4\pi^2 mr^2}{kq_1q_2}\right]^{1/2}$

Answer: A

Watch Video Solution

84. 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. $\frac{-Q}{4}\left(1+2\sqrt{2}\right)$

B. $\frac{Q}{4}\left(1+2\sqrt{2}\right)$

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

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

Answer: B

Watch Video Solution

85. The distance between the two charges $25\mu C$ and $36\mu C$ is $11cm$. At what point on the line joining the two, the intensity will be zero

A. At a distance of 5 cm from $25\mu C$

B. At a distance of 5 cm from $36\mu C$

C. At a distance of 4 cm from $25\mu C$

D. At a distance of 4 cm from $36\mu C$

Answer: A

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86. The electric field at a point due to an electric dipole, on an axis inclined at an angle $\theta\left(< 90^\circ\right)$ to the dipole axis, is perpendicular to the dipole axis, if the angle θ is

A. $\tan^{-1}(2)$

B. $\tan^{-1}\left(\frac{1}{2}\right)$

C. $\tan^{-1}\left(\sqrt{2}\right)$

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

Answer: C

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87. If 10^{10} electrons are acquired by a body every second, the time required for the body to get a total charge of C will be

A. 2h

B. 2 days

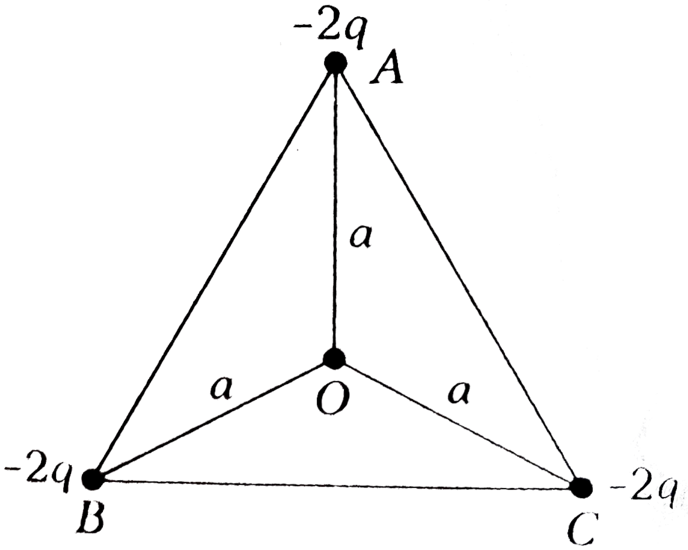
C. 2 yr

D. 20 yr

Answer: D

Watch Video Solution

88. ABC is an equilateral triangle. Charges $-2q$ are placed at each corner. The electric intensity at O will be



A. $\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

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

C. zero

D. $\frac{1}{4\pi\varepsilon_0}\frac{3q}{r^2}$

Answer: C

Watch Video Solution

89. Two equally charged, indentical metal spheres A and B repel each other with a force F. The spheres are kept fixed with a distance r between them. A third identical, but uncharged sphere C is brought in contact with A and The magnitude of the net electric force on C is

A. F

B. $F/4$

C. $F/2$

D. 4F

Answer: A

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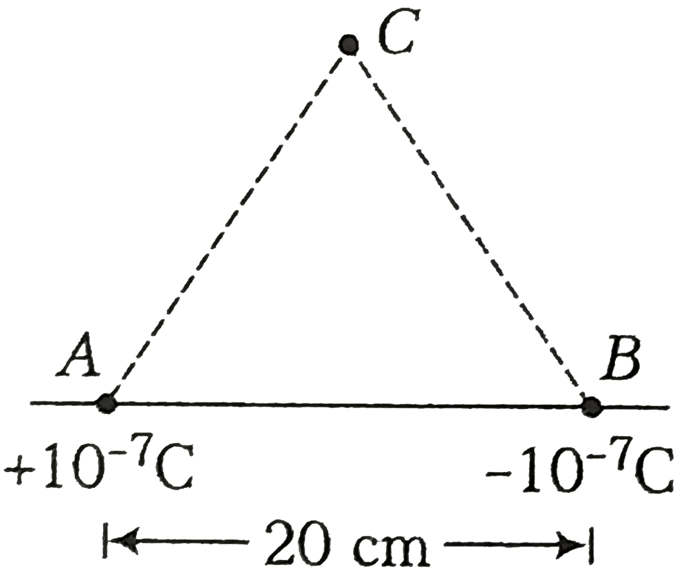
90. Two point charges $+10^{-7}C$ and $-10^{-7}C$ are placed at A and B 20 cm apart as shown in the figure. Calculate the electric field at C, 20 cm apart from both A and B.



A. $1.5 \times 10^{-5} NC^{-1}$

B. $2.2 \times 10^{4} NC^{-1}$

C. $3.5 \times 10^{6} NC^{-1}$

D. $3.0 \times 10^{5} NC^{-1}$

Answer: B

Watch Video Solution

91. Infinite charges of magnitude q each are lying at $x = 1, 2, 4, 8.... meter$ on X-axis. The value of intensity of electric field at point $x = 0$ due to these charges will be

A. $12 \times 10^9 qNC^{-1}$

B. zero

C. $6 \times 10^9 qNC^{-1}$

D. $4 \times 10^9 qNC^{-1}$

Answer: A

Watch Video Solution

92. Two copper balls, each weighing $10g$ are kept in air $10cm$ apart. If one electron from every 10^6 atoms in trandferred from one ball to the other, the coulomb force between them is (atomic weight of copper is 63.5)

A. $2.0 \times 10^{10} N$

B. $2.0 \times 10^4 N$

C. $2.0 \times 10^8 N$

D. $2.0 \times 10^6 N$

Answer: C

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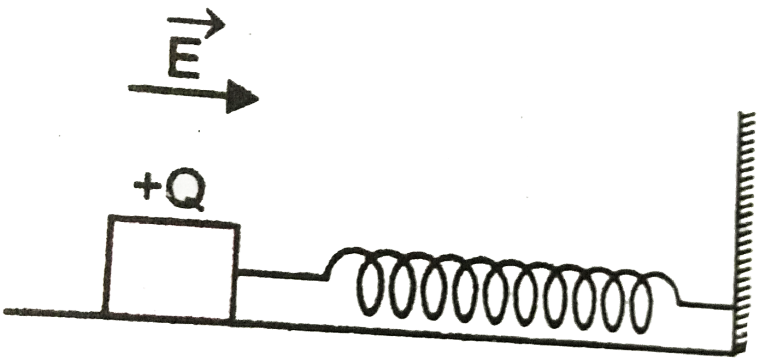
93. A wooden block performs SHM on a frictionless surface with frequency, v_0. The block carries a charge $+Q$ on its surface. If now a uniform electric field $\vec{E}$ is switched on as shwon in figure., then the SHM of the block will be



A. of the same frequencty and with shifted mean position

B. of the same frequency and with the same mean position

C. of changed frequency and with shifted mean position

D. of changed frequency and with the same mean position

Answer: A

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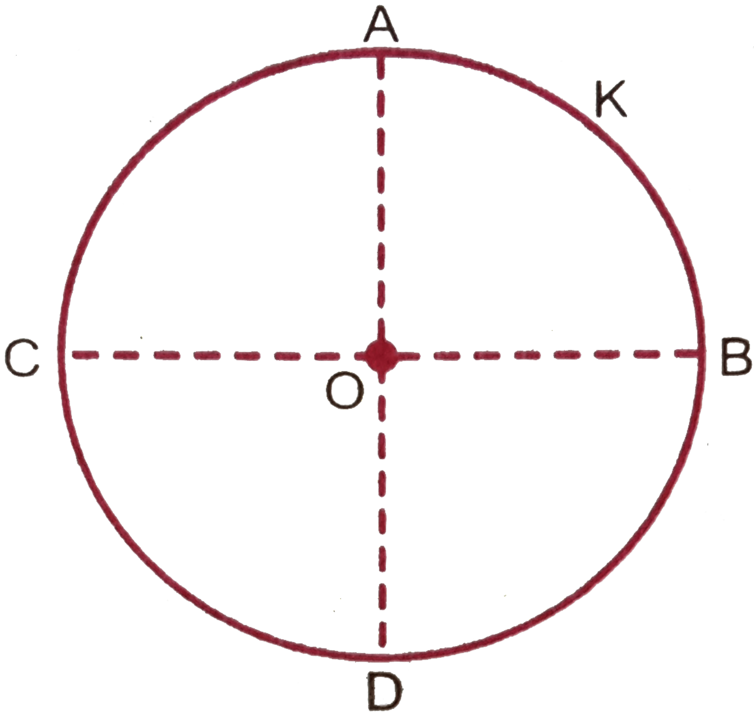
94. A thin conducting ring of radius R is given a charge $+Q$, Fig. The electric field at the center O of the ring due to the charge on the part AKB of the ring is E. The electric field at the center due to the charge on part *ACDB* of the ring is



A. E along KO

B. 3 E along OK

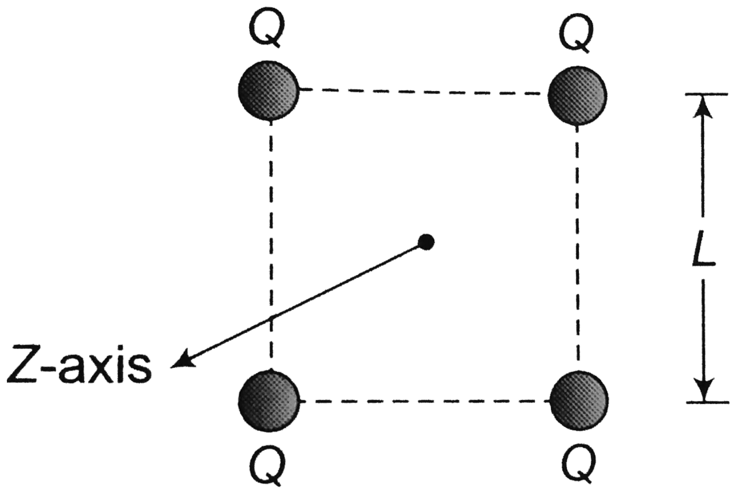
C. 3E along KO

D. E along OK

Answer: D

Watch Video Solution

95. Four point $+ve$ charges of same magnitude(Q) are placed at four corners of a rigid square frame as shown in figure. The plane of the frame is perpendicular to z-axis. If a $-ve$ point charge is placed at a distance z away from the above frame $(z < < L)$ then



A. negative charge oscillates along the Z-axis

B. it moves away from the frame

C. it moves slowly towards the frame and stays in the plane of the frame

D. it passes through the frame only once

Answer: A

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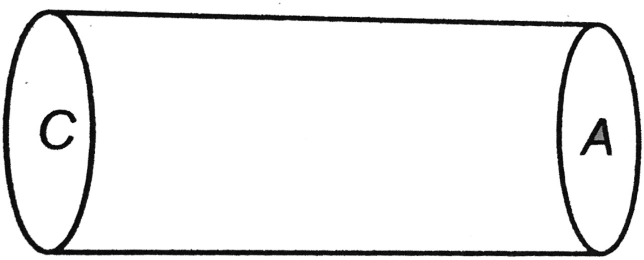
96. A hollow cylinder has a charge qC within it. If ϕ is the electric flux in unit of voltmeter associated with the curved surface B the flux linked with the plane surface A in unit of voltmeter will be



A. $\frac{1}{2}\left(\frac{q}{\varepsilon_0} - \phi\right)$

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

C. $\frac{\phi}{3}$

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

Answer: A

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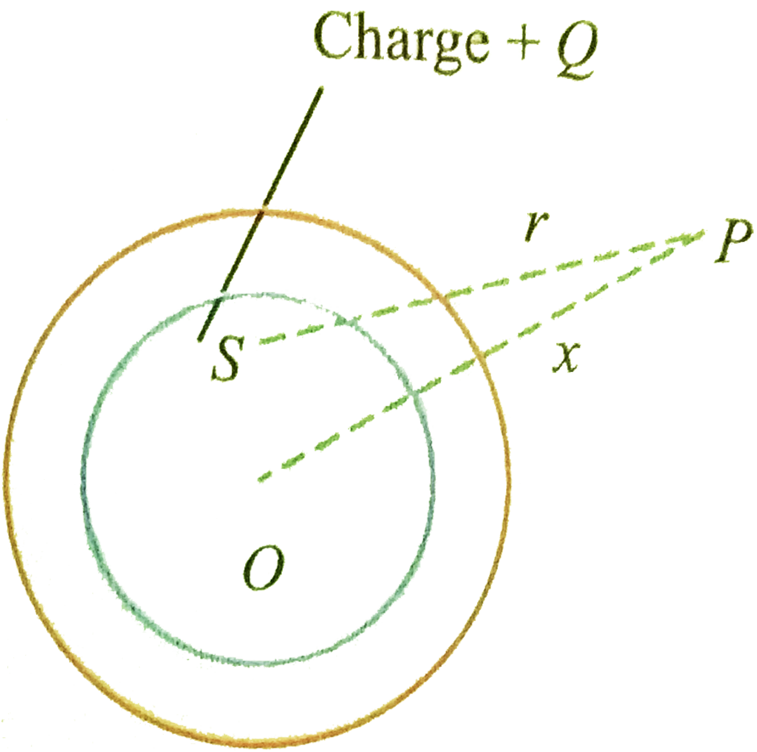
97. The adjacent diagram shows a charge $+Q$ held on an insulating support S and enclosed by a hollow spherical conductor, O represent the center of the spherical conductors and P is a point such that $OP = x$ and $SP = r$ .The electric field at point P will be



A. $\frac{Q}{4\pi\varepsilon_0 x^2}$

B. $\frac{Q}{4\pi\varepsilon_0 r^2}$

C. 0

D. None of these

Answer: A

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98. An infinitely long thin straight wire has uniform linear charge density of $1/3Cm^{-1}$ .Then the magnitude of the electric intensity at a point $18cm$ away is

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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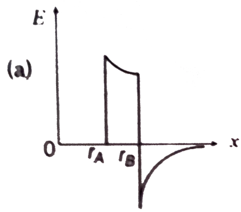
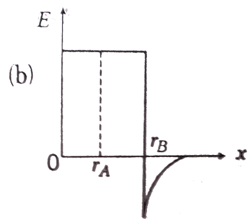
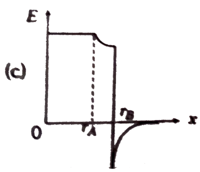
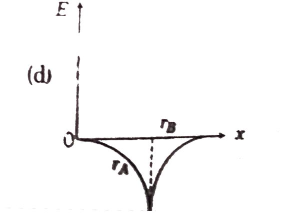
99. Two concentric conducting thin spherical shells A andB having radii rA and $r8\left(r_8 > r_A\right)$ are charged to Q_A and -$Q_B\left(\left|Q_B\right| > \left|Q_A\right|\right)$. The electric field strength along a line passing through the centre varies with the distance x as :

A. 

B. 

C. 

D. 

Answer: A

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100. Two identical charged spheres suspended from a common point by two mass-less strings of length l are initially at a distance d ($d < < l$) apart because of their mutual repulsion . The charge begins to leak from both the spheres at a constant rate. As a result the charge approach each other with a velocity v. Then as a function of distance x between them .

A. $v \propto x^{-1/2}$

B. $v \propto x^{-1}$

C. $v \propto x^{1/2}$

D. $v \propto x$

Answer: A

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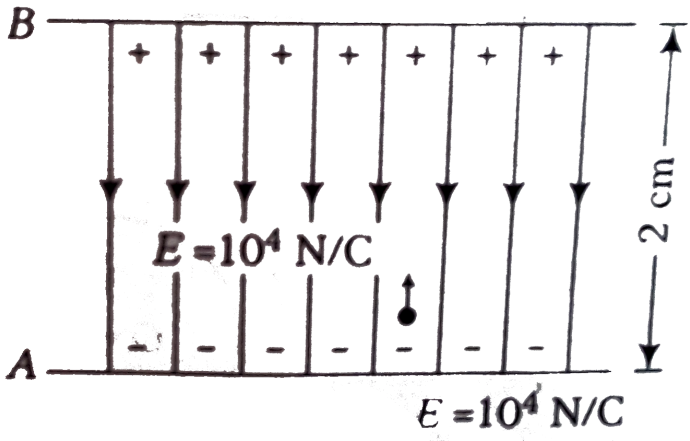
101. An electron is released from the bottom plate A as shown in the figure $\left(E = 10^4 N/C\right)$. The velocity of the electron when it reaches plate B will be nearly equal to



A. $0.85 \times 10^7 ms^{-1}$

B. $1.0 \times 10^7 ms^{-1}$

C. $1.25 \times 10^7 ms^{-1}$

D. $1.65 \times 10^7 ms^{-1}$

Answer: A

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102. Charges q is uniformly distributed over a thin half ring of radius R. The electric field at the centre of the ring is

A. $\frac{q}{2\pi^2\varepsilon_0 R^2}$

B. $\frac{q}{4\pi^2\varepsilon_0 R^2}$

C. $\frac{q}{4\pi\varepsilon_0 R^2}$

D. $\frac{q}{2\pi\varepsilon_0 R^2}$

Answer: A

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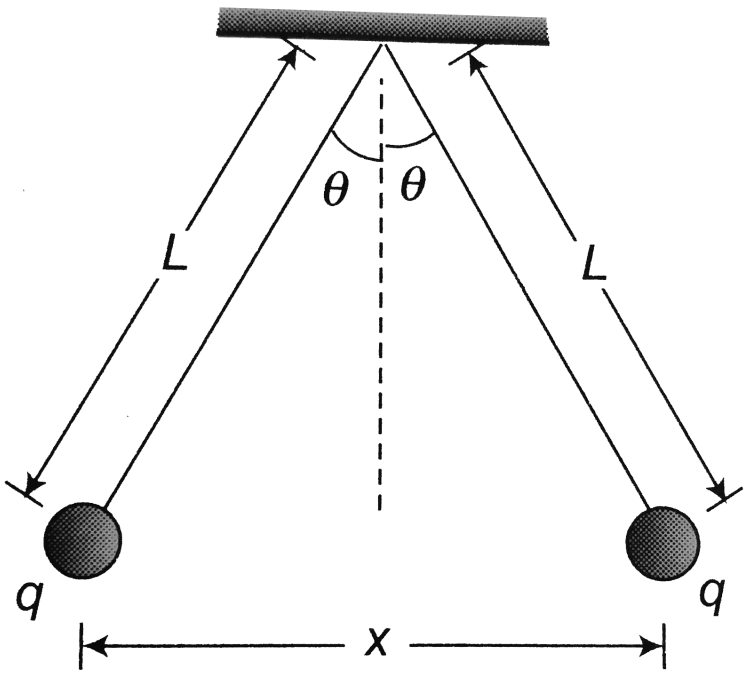
103. In the given figure two tiny conducting balls of identical mass m and identical charge q hang from non-conducting threads of equal length L.

Assume that θ is so small that than $\theta \approx \sin\theta$, then for equilibrium x is equal to



A. $\left(\frac{q^2L}{2\pi\varepsilon_0 mg}\right)^{1/3}$

B. $\left(\frac{qL^2}{2\pi\varepsilon_0 mg}\right)^{1/3}$

C. $\left(\frac{q^2L^2}{4\pi\varepsilon_0 mg}\right)^{1/3}$

D. $\left(\frac{q^2L}{4\pi\varepsilon_0 mg}\right)^{1/3}$

Answer: A

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104. Two small spheres of masses $M_1$and M_2 are suspended by weightless insulating threads of lengths L_1 and L_2. The spheres carry charges Q_1 and Q_2 respectively. The spheres are suspended such that they are in level with one another and the threads are inclined to the vertical at angles θ_1 and $\theta_2$respectively . Which one of the following conditions is essential for $\theta_1 = \theta_2$?

A. $M_1 \neq M_2$ but $Q_1 = Q_2$

B. $M_1 = M_2$

C. $Q_1 = Q_2$

D. $L_1 = L_2$

Answer: B

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105. At which distance along the centre axis of a uniformaly charged plastic disc of radius R is the magnitude of the electric field equal to one-half the magnitude of the field at the centre of the surface of the disc ?

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

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

C. $\sqrt{2}R$

D. $\sqrt{3R}$

Answer: B

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Assertion and Reason

1. Assertion Mass of ion is slightly differed from its element.

Reason Ion is formed, when some electrons are removed or added, so mass changes.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If Assertion is false but Reason is true

Answer: A

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2. Assertion. When charges are shared between any two bodies, no charge is really lost but some loss of energy does occur.

Reason. Some energy disappears in the from of heat, sparking etc.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If Assertion is false but Reason is true

Answer: B

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3. Assetrion: The coulomb force is the dominating force in the universe.

Reason: The coulomb force is weaker than the gravitational force.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false

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4. Assertion Due to two charges electric field cannot be zero at some simultaneously.

Reason Field is a vector quantity

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If Assertion is false but Reason is true

Answer: B

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5. Assertion At the centre of the line joining two equal and opposite charges, $E = 0$

Reason At the centre of the line joining two equal and similar charge, $E \neq 0$.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false

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6. Assertion A point charge produces a uniform electric field.

Reason Due to a point charge, electric lines of forces are parallel and equidistant.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false

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7. Assertion: A point charge is brought in an electric field. The field at a nearby point will increase, whatever be the nature of the charge.

Reason: The electric field is independent of the nature of charge.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false

Answer: D

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8. Assertion: On going away from a point charge or a small electric dipole, electric field decreases at the same rate in both the cases

Reason: Electric field is inversly proportional to square of distance from the charge or an electric dipole.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false

Answer: D

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9. Assetrion: Electric lines of force never cross each other.

Reason: Electric field at a point superimpose to give one resultant electric field

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false

Answer: D

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10. Assertion: The surface charge densities of two spherical conductors of different radii are equal. Then the electric field intensities near their surface are also equal.

Reason: Surface charge density is equal to charge per unit area.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If Assertion is false but Reason is true

Answer: B

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11. Assertion : Two identical balls are charged by q. They are suspended from a common point by two insulating threads l each. In equilibrium, the angle between the tension in the threads is 180°. (Ignore gravity).

Reason : In equilibrium tension in the spring is

$$T = \frac{1}{4\pi\varepsilon_0}\frac{q.q}{l^2}$$

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If Assertion is false but Reason is true

Answer: C

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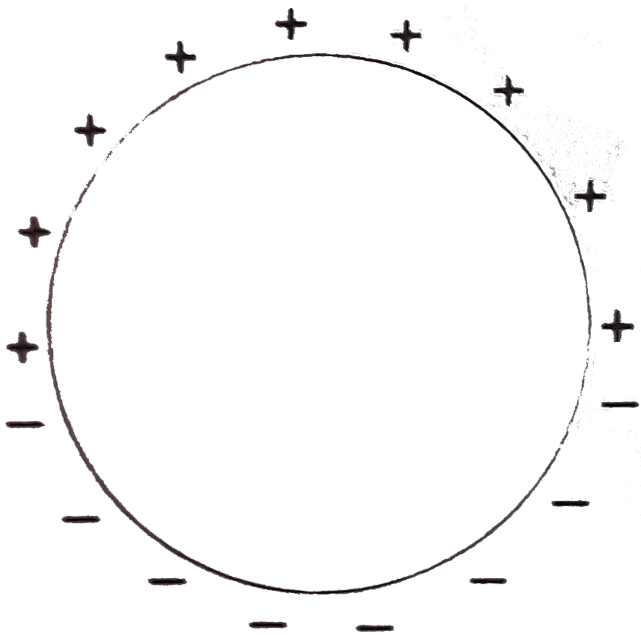
12. Assertion : Half of the ring is uniformly positively charged and other half uniformly negatively charged. Then, electric field is zero at centre.



Reason : At the centre of uniformly charged ring, electric field is zero.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If Assertion is false but Reason is true

Answer: D

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13. Assertion : If a dipole is enclosed by a surface, then according to Gauss's law, electric flux linked with it will be zero.

Reason : The charge enclosed by a surface is zero.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If Assertion is false but Reason is true

Answer: A

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14. Statement I: In a region where uniform electric field exists, the net charge with in volume of any size is zero.

Statement II: The electric flux within any closed surface in region of uniform electirc field is zero.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If Assertion is false but Reason is true

Answer: A

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15. Assertion : With the help of Gauss's theorm we can find electric field at any point.

Reason : Gauss's theorem can be applied for any type of charge distribution.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

C. If Assertion is true but Reason is false

D. If Assertion is false but Reason is true

Answer: C

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Match the columns

1. Match the following two columns.

Column I		Column II	
A.	Electric charge	p.	$[M^{-1}L^{-3}T^{4}A^{2}]$
B.	Electric field strength	q.	$[MLT^{-3}A^{-1}]$
C.	Absolute permittivity	r.	$[MT^{-3}A^{-1}]$
D.	Electric dipole	s.	None

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2. Two charges +q and -q are placed at distance r. Match the following two columns when distance between them is changed to r'.

Column I		Column II	
A.	$r' = 2r$	p.	Force between them will become half
B.	$r' = \frac{r}{2}$	q.	Force between them will become $\frac{1}{4}$ th
C.	$r' = 4r$	r.	Force between them will become four times
D.	$r' = \frac{r}{4}$	s.	None

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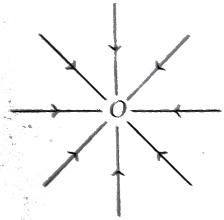
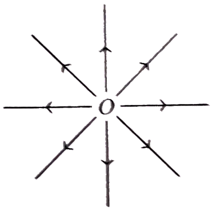
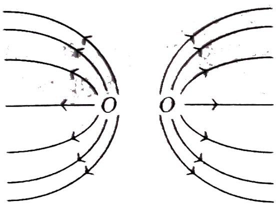
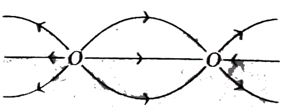
3. Match the field lines given in Column I with charge configuration due to which field lines exist in Column II.

	Column I		Column II
A.		p.	A pair of equal and opposite charges
B.		q.	A pair of positive chargs
C.		r.	A single positive charge
D.		s.	A single negative charge

A. A - S , P - R , C - Q , D - P

B. A - R , P - S , C - Q , D - P

C. A - S , P - Q , C - R , D - P

D. $A - P, P - R, C - Q, D - S$

Answer: A

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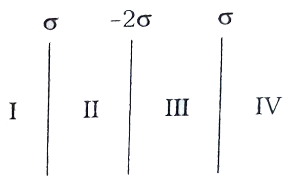
4. Four metallic plates are charged as shown in figure. Now, match the following two columns.

$\sigma \quad -2\sigma \quad \sigma$

$I \mid Ii \mid III \mid IV$



Column I		Column II	
A.	Electric field in region-I	p.	$\frac{\sigma}{\varepsilon_0}$
B.	Electric field in region-II	q.	$\frac{2\sigma}{\varepsilon_0}$
C.	Electric field in region-III	r.	$\frac{\sigma}{2\varepsilon_0}$
D.	Electric field in region-IV	s.	zero

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5. Match the following two columns.

	Column I		Column II
A.	Electric field outside the uniformly charged non-conducting sphere	p.	zero
B.	Electric field inside the conducting sphere	q.	$E \propto r^0$
C.	Electric field due to infinite thin plane sheet of charge	r.	$E \propto \frac{1}{r^2}$
D.	Electric field at centre of hemispherical charged body	s.	None

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Medical entrances gallery

1. An electric dipole is placed at an angle of 30° with an electric field intensity $2 \times 10^5 N/C$. It experiences a torque equal to $4Nm$. The charge on the dipole, if the dipole length is $2cm$, is

A. 8 mC

B. 2 mC

C. 5 mC

D. $7\mu C$

Answer: B

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2. The electric field in a certain region is acting radially outwards and is given by $E = Ar$. A charge contained in a sphere of radius $'a'$ centred at the origin of the field, will given by

A. $4\pi\varepsilon_0 Aa^2$

B. $A\varepsilon_0 a^2$

C. $4\pi\varepsilon_0 Aa^3$

D. $\varepsilon_0 Aa^3$

Answer: C

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3. A Gaussian surface in the cylinder of cross-section πa^2 and length L is immersed in a uniform electric field E with the cylinder axis parallel to the field. The flux ϕ of the electric field through the closed surface is

A. $2\pi a^2 E$

B. $\pi a^2 EL$

C. $\pi a^2 (2 + L)E$

D. zero

Answer: D

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4. A total charge of $5\mu C$ is distributed uniformly on the surface of the thin walled semispherical cup. If the electric field strength at the centre of the hemisphere is $9 \times 10^8 NC^{-1}$, then the radius of the cup is

$$\left(\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 N - m^2 C^{-2}\right)$$

A. 5 mm

B. 10 mm

C. 5 cm

D. 10 cm

Answer: A

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5. Two small spherical shells a and B are given positive charges of 9 C and 4 C respectively and placed such that their centres are separated by 10 m. If P is a point in between them, where the electric field intensity is zero, then the distance of the point P from the centre of A is

A. 5 m

B. 6 m

C. 7m

D. 8 m

Answer: B

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6. a point charge q is situated at a distance r from one end of a thin conduction rod of length L having a charge Q (uniformly distributed a long its length).find the magnitudes of electric force between the two.

A. $\frac{Kqq}{r^2}$

B. $\frac{2KQ}{r(r+L)}$

C. $\frac{KQq}{r(r-L)}$

D. $\frac{KQq}{r(r+L)}$

Answer: D

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7. When 10^{19} electrons are removed from a neutral metal plate through some process, then the charge on it becomes

A. $+1.6C$

B. $-1.6C$

C. $10^{19}C$

D. $10^{-19}C$

Answer: A

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8. A charge Q is uniformly distributed over a large plastic plate. The electric field at a point P close to the centre of the plate is $10Vm^{-1}$. If the plastic plate is replaced by a copper plate of the same geometrical dimension and carryin the same charge Q, the electric field at the point P will become

A. zero

B. $5Vm^{-1}$

C. $10Vm^{-1}$

D. $20Vm^{-1}$

Answer: C

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9. A uniform electric field E is created between two parallel

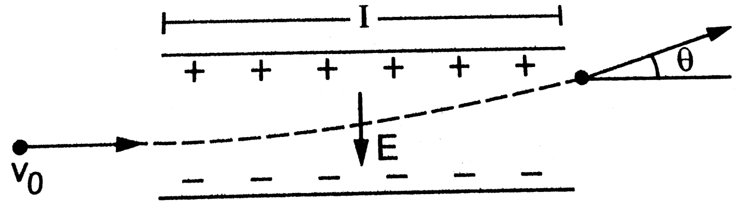
., charged plates as shown in figure . An electron

. enters the field symmetrically between the plataes with a

. speed `v_0. The length of each plate is l. Find the angle of

. deviation of the path of the electron as it comes out

. of the field.



A. $\theta = \tan^{-1}\frac{El}{mv_0^2}$

B. $\theta = \tan^{-1}\left(\frac{eEl}{mv_0^2}\right)$

C. $\theta = \tan^{-1}\left(\frac{eEl}{mv_0}\right)$

D. $\theta = \tan^{-1}\left(\frac{eE}{mv_0^2}\right)$

Answer: B

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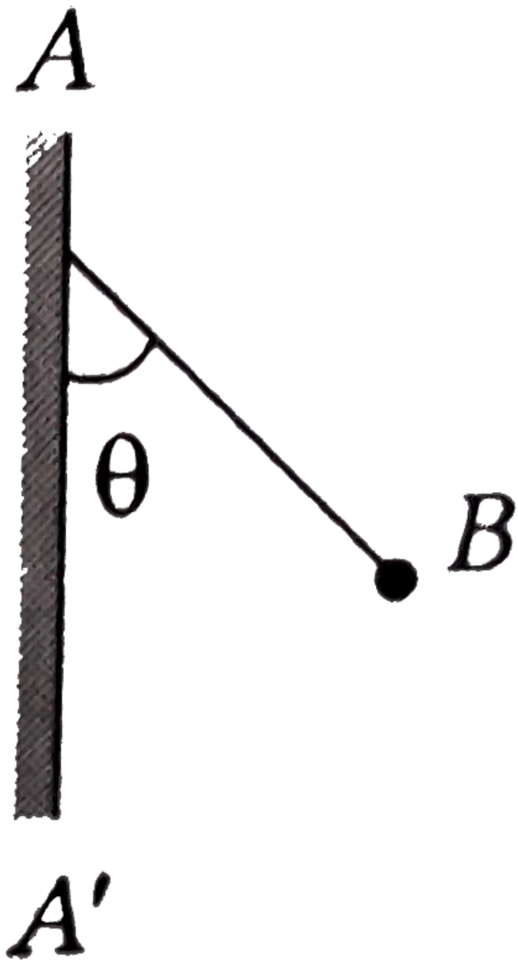
10. The line A A' is on charged infinite conducting plane which is perpendicular to the plane of the paper. The plane has a surface density of charge of magnitude q. B is connected by string from a point on the line A A'. The tangent of angle (θ) formed between the line A A' and the string is



A. $\frac{q\sigma}{2\varepsilon_0 mg}$

B. $\frac{q\sigma}{4\pi\varepsilon_0 mg}$

C. $\frac{q\sigma}{2\pi\varepsilon_0 mg}$

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

Answer: A

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11. The electric field at a point on equatorial of a dipole and direction of the dipole moment

A. 180°

B. 0°

C. 45°

D. 90°

Answer: A

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12. Pick out the statement which is incorrect?

A. A negative test charge experiences a force opposite to the direction of the field

B. The tangent drawn to a line of force represents the direction of electric field

C. Field lines never intersect

D. The electric field lines form closed loop

Answer: D

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13. An electron of mass m_e initially at rest moves through a certain distance in a uniform electric field in time t_1. A proton of mass m_p also initially at rest takes time t_2 to move through an equal distance in this uniform electric field.Neglecting the effect of gravity, the ratio of t_2/t_1 is nearly equal to

A. 1

B. $\sqrt{\frac{M_p}{M_e}}$

C. $\sqrt{\frac{M_e}{M_p}}$

D. 1836

Answer: B

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14. Two charges $10\mu C$ and $-10\mu C$ are placed at points $A.$ and B separated by a distance of 10 cm. Find the electric. field at a point P on the perpendicular bisector of AB at. a distance of 12 cm from its middle point.

A. $16.4 \times 10^6 NC^{-1}$

B. $28.4 \times 10^6 NC^{-1}$

C. $8.2 \times 10^6 NC^{-1}$

D. $4.1 \times 10^6 NC^{-1}$

Answer: D

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15. A uniform electric field exists in space. Find the flux of this field through a cylindrical surface with the axis parallel to the field.

A. $\frac{\sigma}{2\pi r\varepsilon_0}$

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

C. zero

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

Answer: C

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16. An inclined plane of length 5.60 m making an angle of 45° with the horizontal is placed in a uniform electric field $E = 100 Vm^{-1}$. A particle of mass $1kg$ and charge $10^{-2}C$ is allowed to slide down from rest position from maximum height of slope. If the coefficient of friction is 0.1, then the time taken by the particle to reach the bottom is

A. 1 s

B. 1.41 s

C. 2 s

D. None of these

Answer: B

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17. Two charge spheres separated at a distance d exert a force F on each other. If they are immersed in a liquid of dielectric constant K=2, then the force (if all conditions are same) is

A. $F/2$

B. F

C. $2F$

D. $4F$

Answer: A

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18. If a charge on the body is $1nC$, then how many electrons are present on the body?

A. 1.6×10^{19}

B. 6.25×10^{9}

C. 6.25×10^{27}

D. 6.25×10^{28}

Answer: B

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19. Electric field at a point of distance r from a uniformly charged wire of infinite length having linear charge density λ is directly proportional to

A. r^{-1}

B. r

C. r^2

D. r^{-2}

Answer: A

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20. Two equal and opposite charges of masses m_1 and m_2 are accelerated in a uniform electric field through the same distance. What is the ratio of their accelerations, if their ratio of masses is $\frac{m_1}{m_2} = 0.5$?

A. $\frac{a_1}{a_2} = 0.5$

B. $\frac{a_1}{a_2} = 1$

C. $\frac{a_1}{a_2} = 2$

D. $\frac{a_1}{a_2} = 3$

Answer: C

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

A. toeque experienced by the dipole is $E \times p$

B. torque is zero, if p is perpendicular to E

C. torque is maximum, if p is perpendicular to E

D. potential energy is maximum, if p is parallel to E

Answer: C

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22. An electric dipole in a uniform electric field experiences (When it is placed at an angle θ with the field)

A. Both a torque and a net force

B. Only a force but no torque

C. Only a torque but no net force

D. No torque and no net force

Answer: A

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23. What is the nature of Gaussian surface involved in Gauss's law of electrostatics?

A. Scalar

B. Electrical

C. Magnetic

D. Vector

Answer: D

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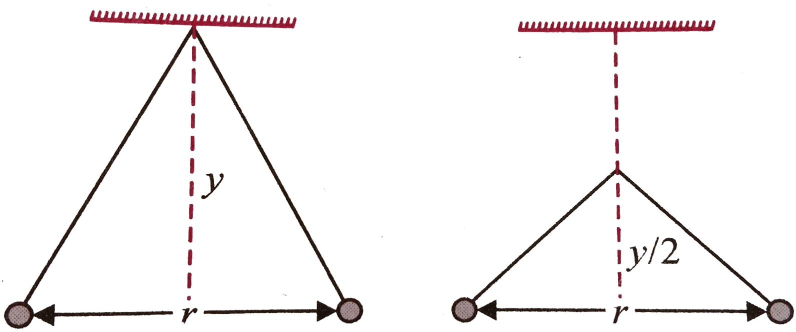
24. Two path balls carrying equal charges are suspended from a common point by strings of equal length, the strings are rightly clamped at half the height. The equilibrium separation between the balls, now becomes :



A. $\left(\frac{1}{\sqrt{2}}\right)^2$

B. $\left(\frac{r}{\sqrt[3]{2}}\right)$

C. $\left(\frac{2r}{\sqrt{3}}\right)$

D. $\left(\frac{2r}{3}\right)$

Answer: B

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25. An electric charge does not have which of the following properties?

A. Total charge conservation

B. Quantisation of charge

C. Two types of charge

D. Circular line of force

Answer: D

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26. The net electric force on a charge of $+3\mu C$ at the mid-point on the line joining two charges of magnitude $+2\mu C$ and $-2\mu C$ separated by the distance of 6 mm, is

A. 6000 N

B. 500 N

C. 60 N

D. zero

Answer: D

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27. The force of repulsion between two electrons at a certain distance is F. The force between two protons separated by the same distance is $\left(m_p = 1836m_e\right)$

A. 2F

B. F

C. 1836 F

D. $\frac{F}{1836}$

Answer: B

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28. A point charge q is placed at a distance $a/2$ directly above the centre of a square of side a. The electric flux through the square is

A. q/ε_0

B. $q/2\varepsilon_0$

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

D. q/ε_0

Answer: D

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29. Electrical force is acting between two charge kept in vacuum. A copper plate is placed between the charges, the force now is

A. more

B. less but not zero

C. remains unchanged

D. zero

Answer: B

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30. Equal charges q are placed at the vertices A and B of an equilatral triangle ABC of side a. The magnitude of electric field at the point C is

A. $\frac{q}{4\pi\varepsilon_0 a^2}$

B. $\frac{\sqrt{2}q}{4\pi\varepsilon_0 a^2}$

C. $\frac{\sqrt{2}q}{4\pi\varepsilon_0 a^2}$

D. $\frac{2q}{4\pi\varepsilon_0 a^2}$

Answer: C

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31. Two charges $+4e$ and $+e$ are at a distance x apart. At what distance,a charge q must be placed from charge $+e$ so that is in equilibrium

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

B. $\frac{x}{3}$

C. $\frac{x}{6}$

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

Answer: B

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32. A mass $m = 20g$ has a charge $q = 3.0mC$. It moves with a velocity of 20 m/s and enters a region of electric field of 80 N/C in the same direction as the velocity of the mass. The velocity of the mass after 3 s in this region is

A. $40ms^{-1}$

B. $44ms^{-1}$

C. $56ms^{-1}$

D. $80ms^{-1}$

Answer: C

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33. A rod lies along the X-axis with one end at the origin and the other at $x \rightarrow \infty$. It carries a uniform charge λCm^{-1}. The electric field at the point $x = -a$ on the axis will be

A. $E = \frac{\lambda}{4\pi\varepsilon_0 a}\left(-\hat{i}\right)$

B. $E = \frac{\lambda}{4\pi\varepsilon_0 a}\left(\hat{i}\right)$

C. $E = \frac{\lambda}{2\pi\varepsilon_0 a}\left(-\hat{i}\right)$

D. $E = \frac{\lambda}{2\pi\varepsilon_0 a}\left(\hat{i}\right)$

Answer: C

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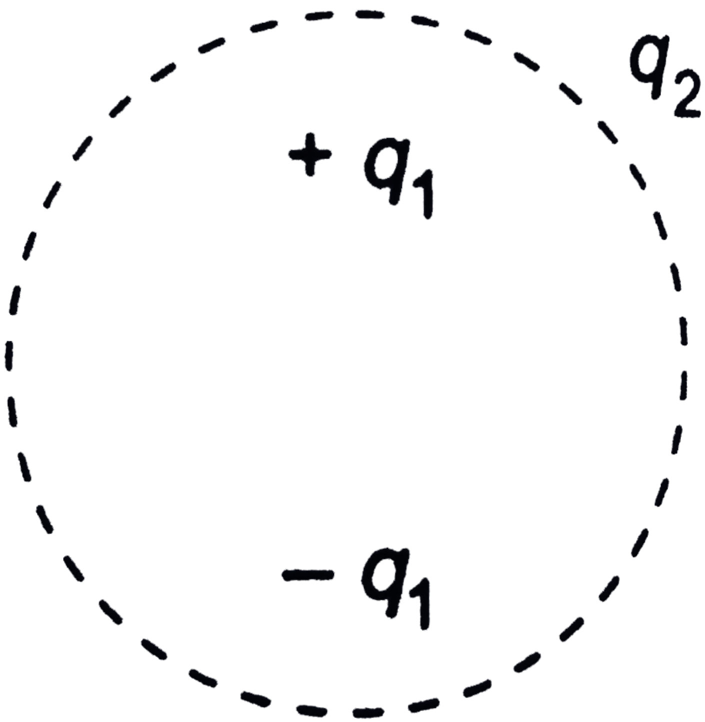
34. Consider the charge configuration and a spherical Gaussian surface as shown in the figure. When calculating the flux of the electric field over the spherical surface, the electric field will be due to.



A. $+q_3$ alone

B. $+q_1$ and $+q_3$

C. $+q_1, +q_3$ and $-q_2$

D. $+q_1$ and $-q_2$

Answer: C

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35. What is the flux through a cube of side $'a'$ if a point charge of q is at one of its corner :

A. $\frac{2q}{\varepsilon_0}$

B. $\frac{q}{8\varepsilon_0}$

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

D. $\frac{q}{2\varepsilon_0}6a^2$

Answer: B

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36. If the electric field given by $\left(5\hat{i} + 4\hat{j} + 9\hat{k}\right)$, then the electric flux through a surface of area 20 unit lying in the yz- plane will be

A. 100 unit

B. 80 unit

C. 180 unit

D. 20 unit

Answer: A

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37. Charge Q is divided into two parts which are then kept some distance apart . The force between them will be maximum if the two parts are

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

B. $\frac{Q}{4}$ and $\frac{3Q}{4}$

C. $\frac{Q}{3}$ and $\frac{2Q}{3}$

D. None of these

Answer: A

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