PHYSICS

BOOKS - MODERN PUBLICATION

ELECTRIC POTENTIAL

Example

1. 5J work is done in moving a positive charge of 0.5 C between two points. What is the potential difference between these points?

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2. Calculate the electric potential at the surface of a gold nucleus. Given radius of nucleus = $6.6 \times 10^{-15} m$ and atomic wight of gold is 79.

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3. Two parallel plates are 5 cm apart and a potential difference of 6- V is set up across them. Find the electric field intensily between the two plates.

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4. Find the electrostatic potential energy of the configuration of four charges +q,-q,+q and -q placed at the four corner A,B,C and D of a square of side r.

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5. An electric dipole of length 2 cm is placed with its axis making an angle of 30° to a uniform electric field of $10^5 NC^{-1}$. If it experiences a torque of $10\sqrt{3}Nm$, calculate the magnitude of the charge on the diple

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6. An electric dipole of length 2 cm is placed with its axis making an angle of 30° to a uniform electric field of $10^5 NC^{-1}$. If it experiences a torque of $10\sqrt{3}Nm$, calculate potential energy of the dipole.

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7. If 100 joule of work must be done to move electtric charge equal to 4C from a plae, where potential is -10 volt to another place, where potential is V volt, find the value of V.

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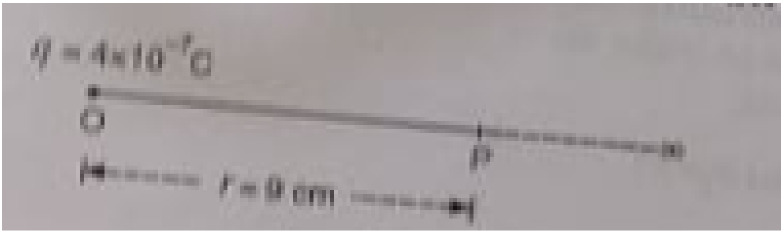
8. Calculate the potential at a point P due to a charge of 4×10^{-7} C located 9 cm away as shown in the figure.



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9. Calcualte the potential at a point P due to a charge of 4 xx 10^(-7) C located 9 cm away. Hence obtain the work done in bringing a charge of $2 \times 10^{-9} C$ from infinity to the point P. Does the answer depend on the path along which the charge is brought?

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10. A charge of $20\mu C$ produces an electric field. Two points are 10 cm and 5 cm from this charge. Find the vlaue of potentials at these points and also find the amount of work doe to take an electron from one point to the other.

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11. At a point due to a point charge, the values of electric field intensity and potential are $32NC^{-1}$ and $16JC^{-1}$ respectively. Calculate magnitude of charge and distance of the charge from the point of observation.

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12. Calculate the potential at the centre of a square ABCD of each side $\sqrt{2}$ m due to charges 2,-2,-3,and 6muC` at four corners of it.

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13. A metal wire is bent into a circle of radius 10 cm. It is given a charge of $200\mu C$, which spreads on it uniformly, Calculate the electric potential at its centre.

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14. Two charges $3 \times 10^{-8} C$ and $-2 \times 10^{-8} C$ are located 15 cm apart. At what point on the line joining the two charges is the electrical potential zero? Take the potential at infinity to be zero.

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15. ABCD is a square of side 0.2 m. Charges of $2 \times 10^{-9}, 4 \times 10^{-9}, 8 \times 10^{-9}$ coulomb are placed at the corners. A,B and C respectively. Calculate the work required to transfer a charge of 2×10^{-9} coulomb from corner D to the centre of the square.

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16. Calculate the voltage needed to balance an oil drop carrying 10 electrons, when located between plates of a capacitor, which are 5 mm apart. Given, mass of the drop $= 3 \times 10^{-16} kg$, charge on electrno $= 1.6 \times 10^{-19} C$ and $g = 9.8 ms^{-2}$

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17. Two points charges $+10\mu C$ and $-10\mu C$ are separated by a distance of 40 cm in air. Calculate the electrostatic potential energy of the system, assuming the zero of the potential energy to be at infinity.

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18. Two points charges $+10\mu C$ and $-10\mu C$ are separated by a distance of 40 cm in air. How much work is required to separated the two charges infinitely away from each other?

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19. An electron is circulating around the nucleus of a hydrogen ato in a circular orbit of radius $5.3c \times 10^{-11}$m. Calculate the electric potential at this radius

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20. An electron is circulating around the nucleus of a hydrogen ato in a circular orbit of radius $5.3c \times 10^{-11}$m. Calculate the electric potential energy of the atom in eV. What would be the electric potential due to a helium nucleus at the same radius. Given, that $(4\pi\varepsilon_0)^{-1} = 9 \times 10^9 mF^{-1}$ and $e = 1.6 \times 10^{-19} C$

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21. A molecule of a substance has a permanent electric dipole moment of magnitude 10^{-29} C m. A mole of this substance is polarized at low temperature by appling a strong elecrostatic field of magnitude $10^6 Vm^{-1}$. The direction of the field is suddenly changed by an angle of 60°. Estimate the heat released by the substance in aligning its dipole along the new direction of the field. For simplicity, assume 100% polarisation of sample.

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22. A conducting bubble of radius a, thickness t where t is very small than a has potential V. Now the bubble collapses into a droplet. Find the potential of the droplet.

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23. An electric dipole of length 4 cm, when placed with its axis making an angle of 60° with a uniform eletric field experiences a torque of $4\sqrt{3}$ N m. Calculate the potential energy of the dipole, if the dipole has charges of $\pm 8nC$.

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24. An electric dipole of length 4 cm, when placed with its axis making an angle of 60° with a uniform eletric field experiences a torque of $4\sqrt{3}$ N m. Calculate the potential energy of the dipole, if the dipole has charges of $\pm 8nC$.

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25. An electric dipole consists of two opposite charges of magnitude 1 μC (micro-coulomb) separated by a distance of 2 cm . The dipole is placed in an electric field of $10^5 Vm^{-1}$. What maximum torque does the field exert on the dipole ?

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26. An electric dipole consists of two opposite charges of magnitude 1 μC (micro-coulomb) separated by a distance of 2 cm . The dipole is placed in an electric field of $10^5 Vm^{-1}$.How much work must an external agent do to turn the dipole end for end , starting from a position of alignment $\theta = 0$?

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27. Three concentric spherical metal sheels A,B and C of radii a,b and c a'< 'b'<'c have surface charge densities $+\sigma, -\sigma$ and $+\sigma$ respectively. Find the potentials of three sheels A,B and C.

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28. Three concentric spherical metal sheels A,B and C of radii a,b and c a'<'b'<'c have surface charge densities $+\sigma, -\sigma$ and $+\sigma$ respectively. 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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29. Three charges of +0.1 C each are placed at the vertices of an equilateral triangle of each side 1m. If the energy is supplied at the rate of 1.0 kw, how many hours would be required to move one of the charges on to the mid point of the line joining the other two?

Given $= \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 N^2 C^{-2}$

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30. Three point charges q, 2q and 8q are to be placed on a

. 9cm long straight line. Find the

. positions where the charges shouldbe placed such that the potential energy

. of this sysrem is minimum. In this situation, what is the

. electric field at the charge q due to the other two charges?

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31. A drop of water of mass 18×10^{-3} g falls away from the bottom of a charged conducting sphere of radius 20 cm, carrying with it a charge of $10^{-9}C$ and leaving on the sphere a uniformly distributed charge of$2.5 \times 10^{-6}C$. What is the speed of the drop after it has fallen 30 cm? $(4\pi\varepsilon_0)^{-1} = 9 \times 10^9 JmC^{-2}$

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32. Two identical particles of mass m carry a charge Q, each. Initially one is at rest on a smooth horizontal plane and the other is projected along the plane directly towards first particle from a large distance with speed v. The closest distance of approach be .

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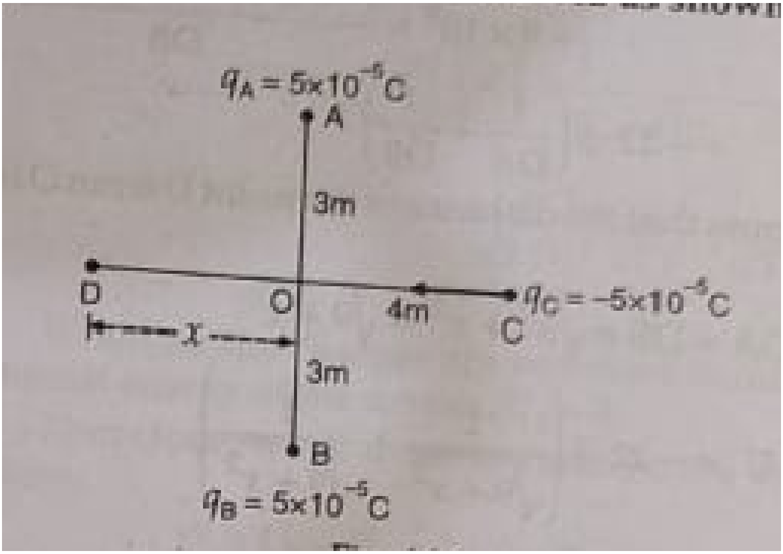
33. Two fixed, equal, positive charges, each of magnitude 5xx10^-5 coul are located at points A and B separated by a distance of 6m. An equal and opposite charge moves towards them along the line COD, the perpendicular bisector of the line AB.

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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34. A circular ring of radius R with uniform positive charge density λ per unit length is located in the y z plane with its center at the origin O. A particle of mass m and positive charge q is projected from that point $p(-\sqrt{3}R, 0, 0)$ on the negative x - axis directly toward O, with initial speed V. Find the smallest (nonzero) value of the speed such that the particle does not return to P ?

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35. Three charges each of value q are placed the corers of an equilaterla triangle. A fourth charge Q is placed at the centre of the triangle.

If Q = -q, will the charges at the corners move towards the centre or fly away from it?

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36. Three charges each of value q are placed the corners of an equilaterla triangle. A fourth charge Q is placed at the centre of the triangle.

For what value of Q, will the charges remain stationary? In this situation, how much work is done in removing the charges to infinity?

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37. 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.

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

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38. 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.

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

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39. A non-conducting disc of radius a and uniform positive surface charge density sigma 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 $q/m = 4 \in_0 g/\sigma$

Find the value of H if the particle just reaches the disc.

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40. A charge Q coulomb is uniformly distributed over a sphere volume of radius R metres. Obtain an expression for the energy of the system.

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41. What will be the corresponding expression for the energy needed to completely diassemble the planet earth against the gravitational pull amongst its constituent particles? Assume the earth to be a sphere of uniform mass density. calculate the energy, given that the product of the mass and the radius of the earth to be $2.5 \times 10^{31} kg - m$

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42. If the same charge of Q coulomb as in part above is given to a spherical conductor of the same radius R, what will be the energy of the system?

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43. A charge $5\mu C$ is placed at a point. What is the work required to carry 1 C of charge once round it in a cricle of 12 cm radius?

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44. What would be the work done if a point charge + q is taken from a point A to the point on the circumference of a circle with another point charge +q at the centre?

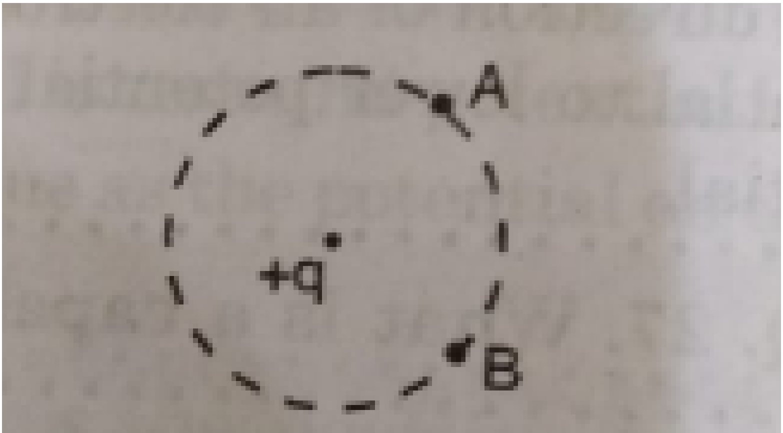

Fig. VSAQ 46

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45. If a point charge +q is taken first from A to C and then from C to B of a circle drawn with another point charge +q as centre as shown in the figure, then along which path more than will be done.

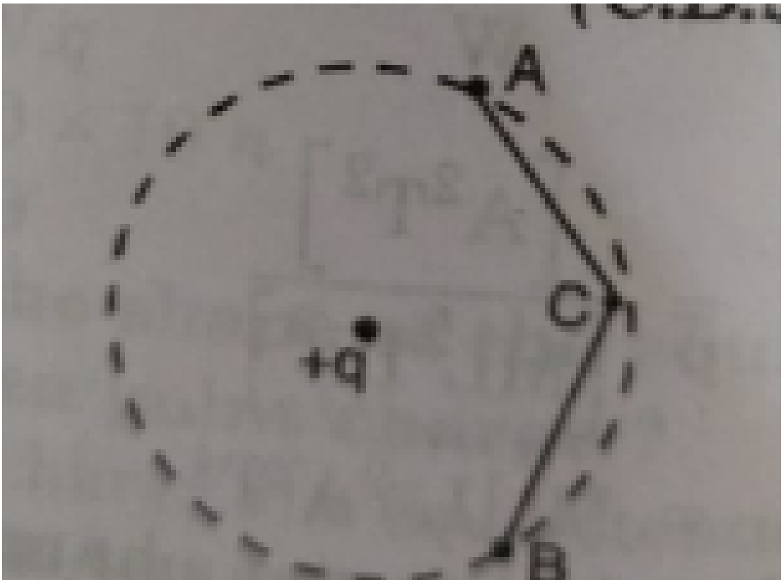

Fig. VSAQ 50

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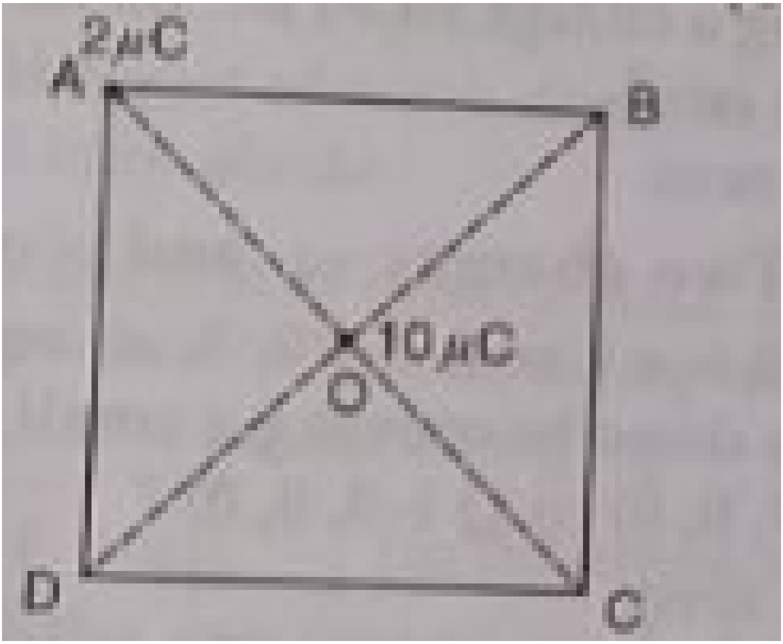
46. What is the work done in moving a $2\mu C$ point charge from corner A to corner B of a square ABCD as shown in the figure, when a $10\mu C$ charge exists at the centre of the square?



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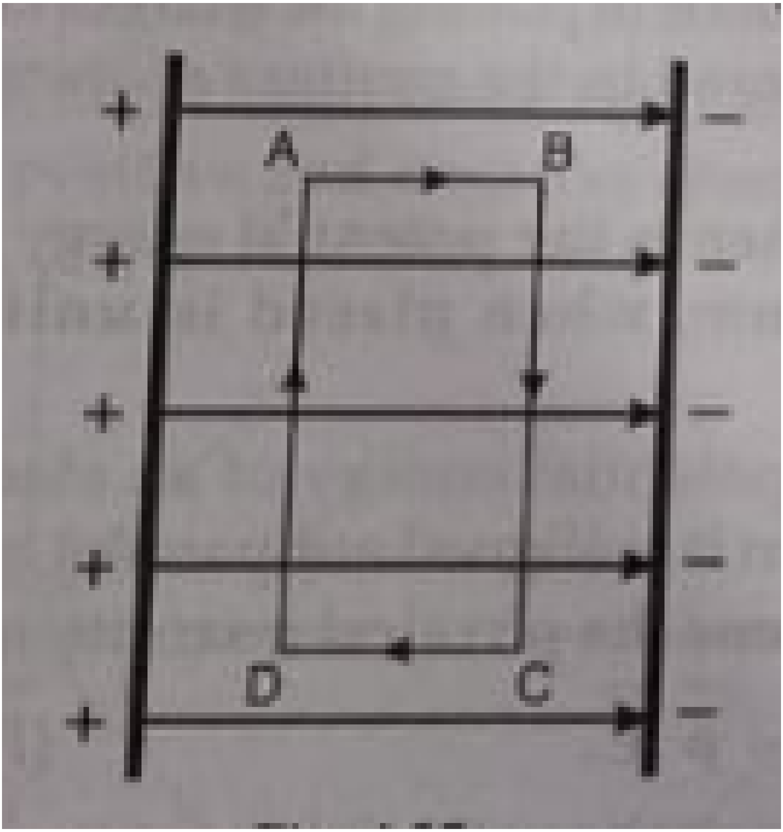
47. A uniform field E exists between two charged plates as shown in the figure. What would be the work done in moving a charge q along the closed rectagnualr path ABCDA?



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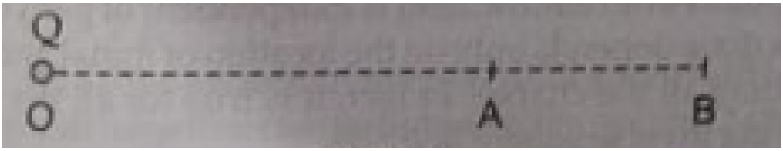
48. A point charge Q is placed at point O as shown in the figure.



is the potential difference $V_A - V_B$ positive, negative or zero if Q is postive or negative?

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49. Name the physical quantity has its unit joule/coulomb. Is it scalar or vector?

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50. Define potential difference between two points in an electric field. Derive the relationship between the electric field and the potential difference.

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51. Electric potential at a point in an electric field.

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52. Define the unit of electric potential.

Watch Video Solution

53. Name the physical quantity has its unit joule/coulomb. Is it scalar or vector?

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54. A charge of 2 C moves between two plates maintained at a potential difference of 1 volt. What is the energy acquired by the charge?

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55. Give the dependence of electrostatic potential due to a small electric dipole at a far off point lying on the axial line

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56. Give the dependence of electrostatic potential due to a small electric dipole at a far off point lying on the equitorial line.

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57. How is electric field at a point related to potential gradient?

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58. What is the dimensiona formula of potential gradient?

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59. Potential difference between two given points 5, cm apart, is 20V. What is the value of electric field?

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60. Name the physical quantity whose unit is Volt $metre^{-1}$.

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61. In a certain $0.1m^3$ of space, electric potential is found to be 5 V throughout. What is the electric field in this region?

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62. The electric potential is constant in a region. What can you say about electric field there?

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63. If electrostatic field at a point is zero, must the electrostatic potential be also zero at that point?

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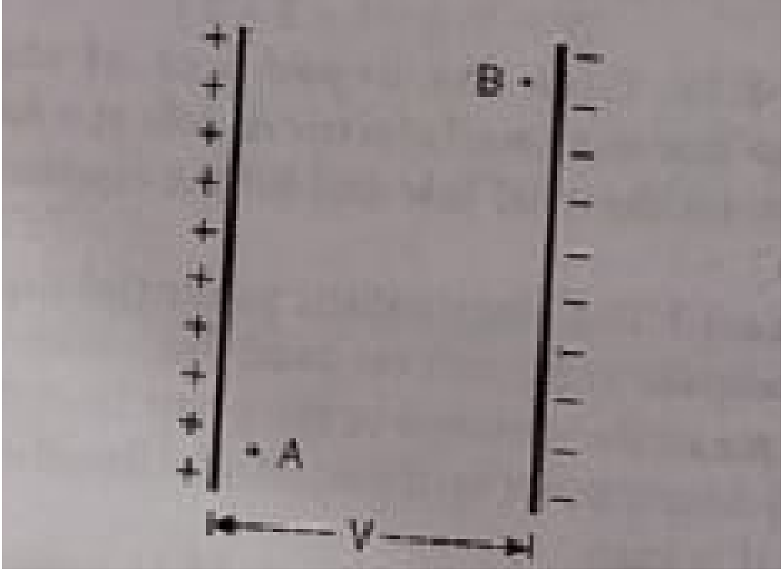
64. Two protons A and B are placed between two parallel plates having a potential difference V as shown in the figure.



Will these protons experience equal or unequal force?

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65. What is equipotential surface?

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66. What is the shape of equipotential surface for a given point charge?

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67. What is the shape of equipotential surfaces for a uniform electric field?

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68. How much work is done in moving a $500\mu C$ charge between two points on an equipotential surface?

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69. No work is done in moving a test charge over an equipotential surface. Explain, why.

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70. A charge of $+1$ C is placed at the centre of a spherical shell of radius 10 cm. what will be the work done in moving a charge of $+1\mu C$ on its surface through a distance of 5 cm?

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71. Two charges -q and +q are located at points (0, 0, -a) and (0, 0, a), respectively. How much work is done in moving a small test charge from the point (5,0,0) to (-7,0,0) along the x-axis? Does the answer change if the path of the test charge between the same points is not along the x-axis?

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72. What is the direction of electric field w.r.t. and equipotential surface?

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73. Why does a configuration of charges possess potential energy?

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74. When is the potential energy of an electric dipole maximum, when placed in uniform electric field?

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75. Name the physical quantity, represented by the expression $-\vec{p}.\vec{E}$.

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76. Show that work done in moving an electric charge is independent of the path followed?

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77. Define electric potential at a point. When kept in an electric field, does a proton move form lower to higher potential or from higher to lower potential region?

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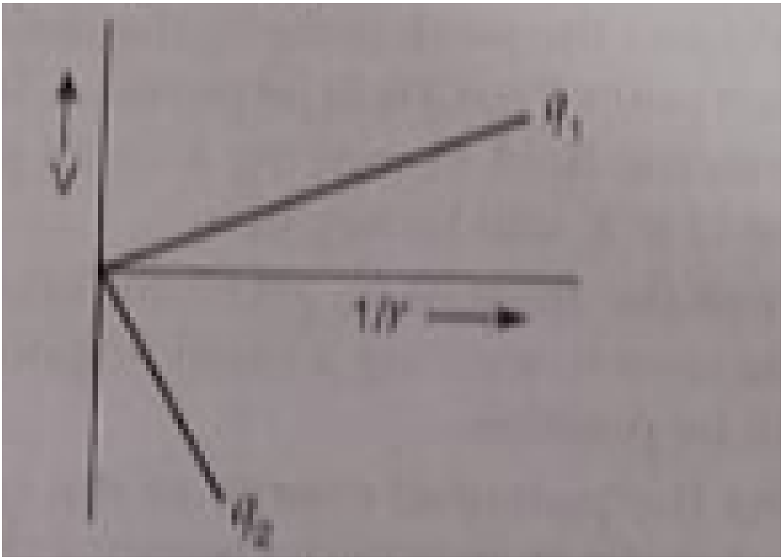
78. In figure, the two graphs show the variation of electrostatic potential (V) with 1/r (r being distance of the field point form the point charge) for two point charges q_1 and q_2



What are the signs of the two charges?

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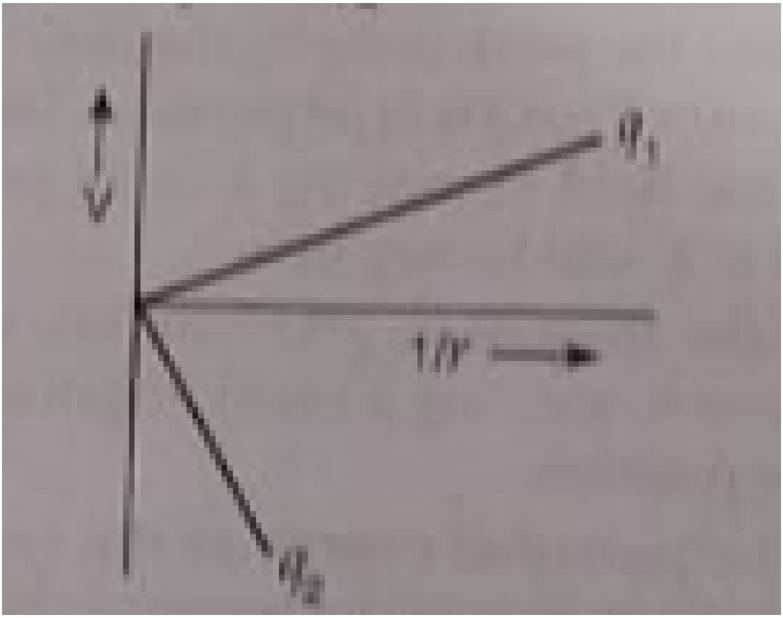
79. In figure, the two graphs show the variation of electrostatic potential (V) with 1/r (r being distance of the field point form the point charge) for two point charges q_1 and q_2



Which of the two charges has a larger magnitude and why?

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80. Is the electrostatic potential necessarily zero at a point where the electric field strength is zero? Give an example to illustrate your answer.

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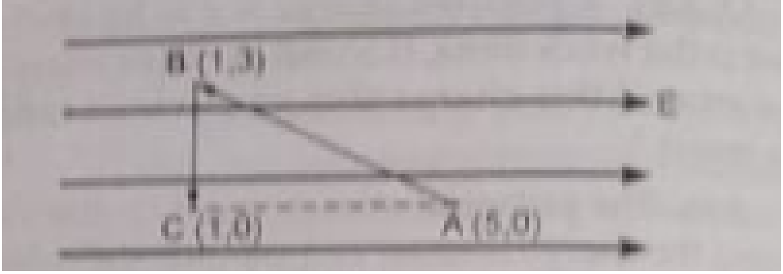
81. A test charge q is moved without acceleration from A to C along the path from the point A to B and then from B to C in electric field as shown in fig. 

Calculate the potential difference between A and C.

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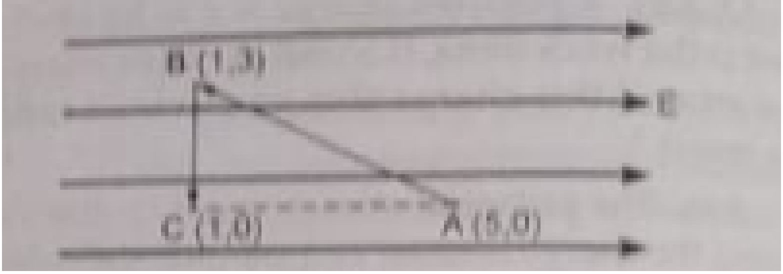
82. A test charge q is moved without acceleration from A to C along the path from the point A to B and then from B to C in electric field as shown in fig.



At which point(of the two) is the electric potential more and why?

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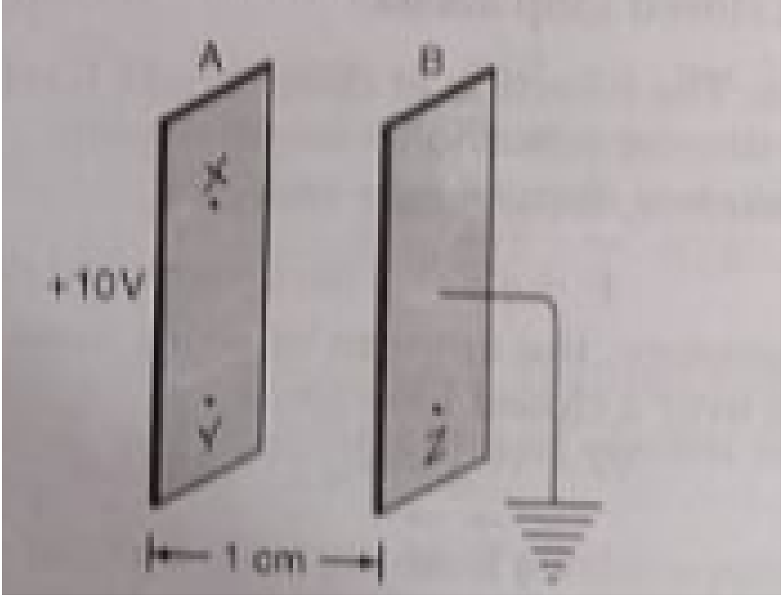
83. Two identical plane metallic surfaces A and B are parallel to each other in air separated by a distance of 1 cm as shown in the fig.



Surface A is given a postive potential 10 V and the outer surface of B is earthend What is the magnitude and direction of the uniform electric field between points Y and Z?

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84. Draw a plot showing the variation of electric field E

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85. Draw a plot showin the variation of electric potential V with distance r due to a point charge q.

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86. Derive an expression for the electric potential at a point along the axial line of an electric dipole.

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87. Show mathematically that the potential at a point on the equitorial line of an electic dipole is zero.

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88. Two point charge +q and -q are separated by a distance d. Where besides at infinity is the electric potential zero?

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89. A regular hexagon of side 10 cm has a charge $5\mu C$ at each of its vertices. Calculate the potential at the centre of the hexagon.

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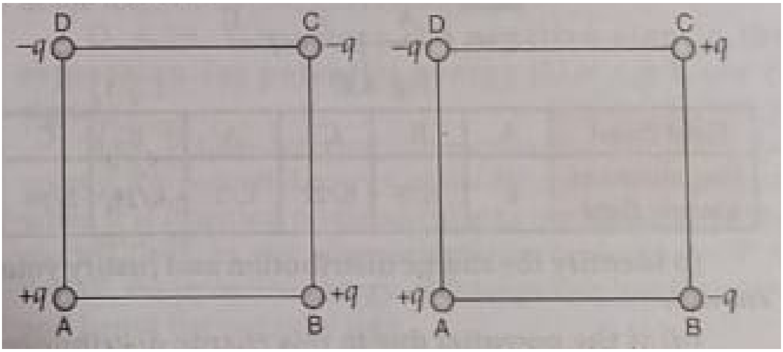
90. Four point charges are placed at the four corners of a square in the two ways as shown in the fig.



Will the electric field at the centre of the square, be the same or different in the two configurations and why?

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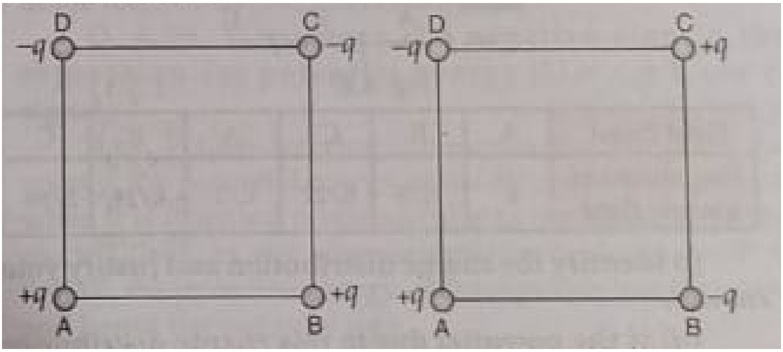
91. Four point charges are placed at the four corners of a square in the two ways as shown in the fig.



electric potential at the centre of the square be the same or difference in the two configurations and why?

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92. Two charged spherical conductors of radii R_1 and R_2 when connected by a conducting wire acquire cahrges q_1 and q_2 respectively. Find the ratio of their surface charge ensities in terms of their radii.

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93. The following data was obtained for the dependence of the magnitude of electric field with distance from a reference point O, within the charge distribution in the shaded region show in the fig.

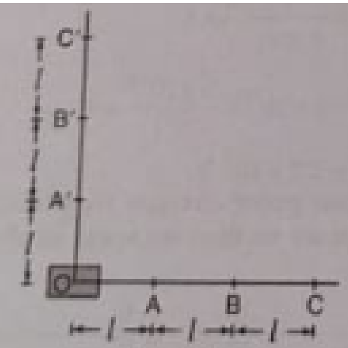

Fig. 4.47

Field Point	A	B	C	A'	B'	C'
Magnitude of electric field	E	E/8	E/27	E/2	E/16	E/64

Identify the charge distribution and justify your answer.

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94. The following data was obtained for the dependence of the magnitude of electric field with distance from a reference point O, within the charge distribution in the shaded region show in the fig.

If the potential due to this charge distribution has a value V at the point A, what is its value at the point A'?

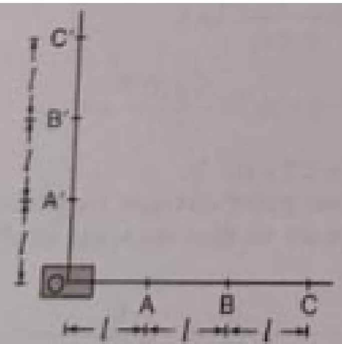

Fig. 4.47

Field Point	A	B	C	A'	B'	C'
Magnitude of electric field	E	E/8	E/27	E/2	E/16	E/64

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95. What is equipotential surface?

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96. Show that electric field everywhere is normal to the equipotential surface.

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97. Draw the equipotential surfaces due to an isolated point charge.

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98. For any charge configuration, equipotential surface through a point is normal to the electric field Justify.

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99. Draw the equipotential surfaces due to an isolated point charge.

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100. Draw equipotential surfaces due to a point q>o.Are these surfaces equidistant from each. Other? If not, explain why.

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101. Two point charges $+5\mu C$ and $-5\mu c$ are placed at a distance 5 cm apart. Draw the equipotential surfaces of the system.

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102. Two point charges $+5\mu C$ and $-5\mu c$ are placed at a distance 5 cm apart. Draw the equipotential surfaces of the system.

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103. Draw an equipotential surface in a uniform electric field?

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104. What is the shape of equipotential surface for a given point charge?

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105. The work done in moving a positive charge on an equipotential surface is:

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106. Show that electric field everywhere is normal to the equipotential surface.

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107. Can two different equipotential surfaces intersect each other?

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108. Can two different equipotential surfaces intersect each other?

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109. A dipole, with its charges, -q an +q, are located at the ponit (0,-b,0) and (0,+b,0), is present in uniform electric field E. the equipotential surfaces of this field are planes parallel to the YZ-planes. What is the direction of the electric field E?

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110. A dipole, with its charges, -q an +q, are located at the ponit (0,-b,0) and (0,+b,0), is present in uniform electric field E. the equipotential surfaces of this field are planes parallel to the YZ-planes. How much torque would the dipole experience in this field?

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111. Distinguish between electric potential and electric potential energy and state the relation between them.

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112. What do you mean by potential eneryg fo an electric dipoel, when placed in electri field?

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113. What does the negative sign in the expression for potential energy $(U = -pE\cos\theta)$ signify?

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114. State the significane of the Millikan experiment.

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115. The Millikan oil-drop experiment enabled the charge on the electron to be deterined. Two parallel metal plates P and Q are situated in a vaccum. The plates are horizontal and separated by a distance of 5.4 mm, as illustrated in fig.

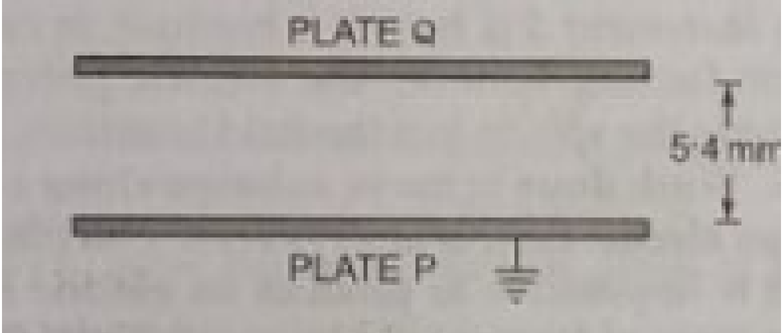

Fig. 4.48

The lower plate P is earthed. The potential difference between the plates can be varied. An oil droplet of mass 7.7×10^{-15} kg is oserved to remain stationary between the plates , when palte Q is a t a potential of +850 suggest why plates p and Q must be parallel and horizontal and calcualte the charge with its gin, on the oil droplet.

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116. The procedure in was repeated for three further oil droplets. The magnitude of the charge on each of the droplets was found to be $3.2 \times 10^{-19} C, 6.4 \times 10^{-19} C$ and $3.2 \times 10^{-19} C$. Explain what value these data and your answer in would guggest for the charge on the electron.

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117. Following are two statements about the relationship between the electric field an electric potential. If the electric field at a certain point is

zero, the nthe electric potential at the same point is also zero.

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118. Following are two statements about the relationship between the electric field an electric potential. If the electric potential at a certain point is zero, then the electric field at the same point is also zero.

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119. Following are two statements about the relationship between the electric field an electric potential. If the electric potential is constant in a region, then the electric field is zero in that region. Giving example, predict whether these statements are correct or false.

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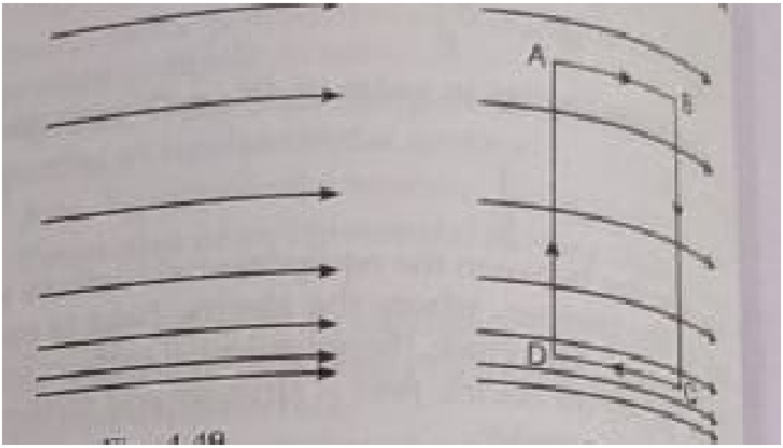
120. Work done to move a charge along a closed path inside an electric field is always zero. Use this fact to prove that it is impossible to produce an electric field in which all the lines of force would be parallel straight lines and the density of their distribution would constantly increase in a direction perpendicular to the lines of force as shown in Figure.



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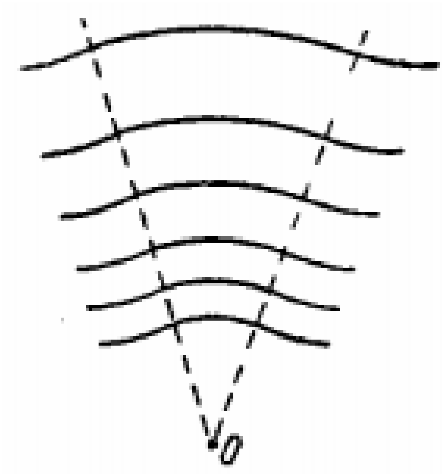
121. Show that if at some part of a field the lines of force have the form of arcs of concentric circles whose centres are at point O (Fig.), the field intensity at each point in this part of the field should be inversely proportional to the distance from the point to O.



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122. Two small charged bodies interact in air with a force F. what will be the force of interaction between these bodies be after they are placed in a dielectric of permittivity K, if their potentials are kept the same as they were in air?

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123. Two charged conducting spheres A and B having radii a and b connected to each other by a copper wire. Find the ratio of the electric fields at the surfaces of the two spheres.

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124. In the electric field $\overrightarrow{E} = 3x\hat{i} - 2y\hat{j} + 5z\hat{k}$, find the potential difference between the ponts A(1,3,5) and B(3,2,7)`

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125. The electric potential at a point is given by $V = 3x^2y + 5y^2 + 7z^2X$. Find the magnitude of electric field at the point (3,2,1).

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126. A small charged metal sphere is situated in an earthed metal box. Illustrates the electric field between the sphere and the metal box. The radius r of the sphere is 2.4 cm. The magnitude of the charge q on the sphere is 0.76 n C.

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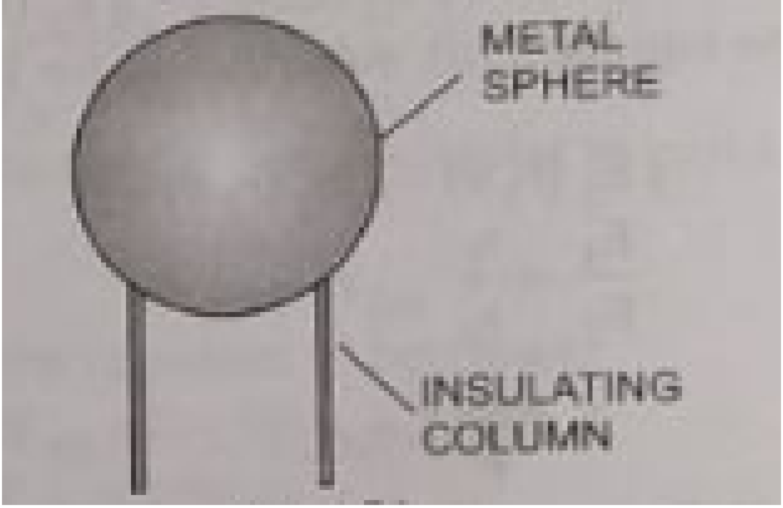
127. In a particular experiment, a high vltage is created by charging an isolated metal sphereas shown in the fig.



The sphere has diameter 42 cm and any charge on its surface may be considered as if IT were concentrated at its centre. The air surrounding the sphere loses its insultaing properties, causing a spark, when the electric field exceeds $20kVcm^{-1}$ by reference to an atom in the air, suggest the mechanism by which the electric field causes the air to become conducting.

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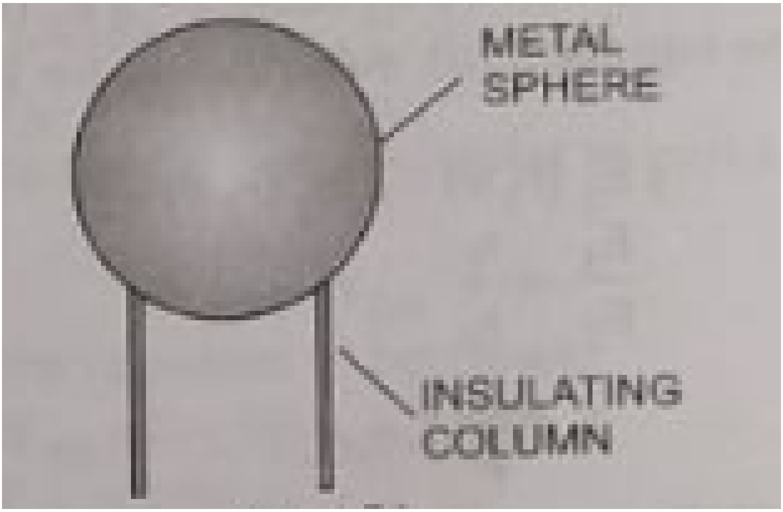
128. In a particular experiment, a high voltage is created by charging an isolated metal sphere as shown in the fig.

The sphere has diameter 42 cm and any charge on its surface may be considered as if it were concentrated at its center. The air surrounding the sphere loses its insulating properties, causing a spark, when the electric field exceeds $20kVcm^{-1}$. Calculate for the charged sphere when a spark is about to occur the charge on the sphere and its potential.



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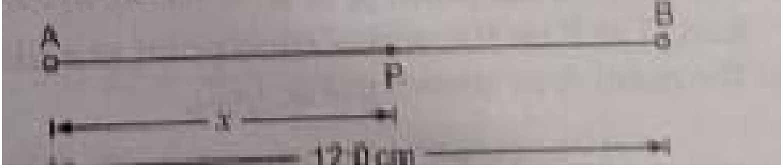
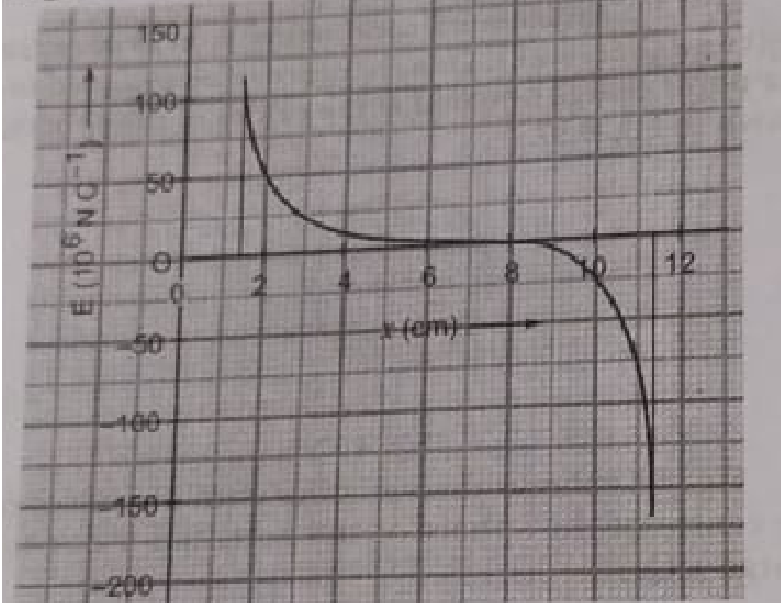
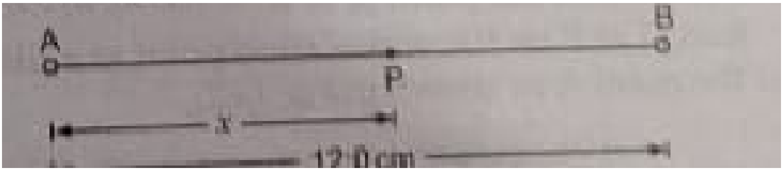
129. Two small charged metal sphere A and B are situated in a vaccum. The distance between the centres of the spheres is 12.0 cm, as shown in the fig. 

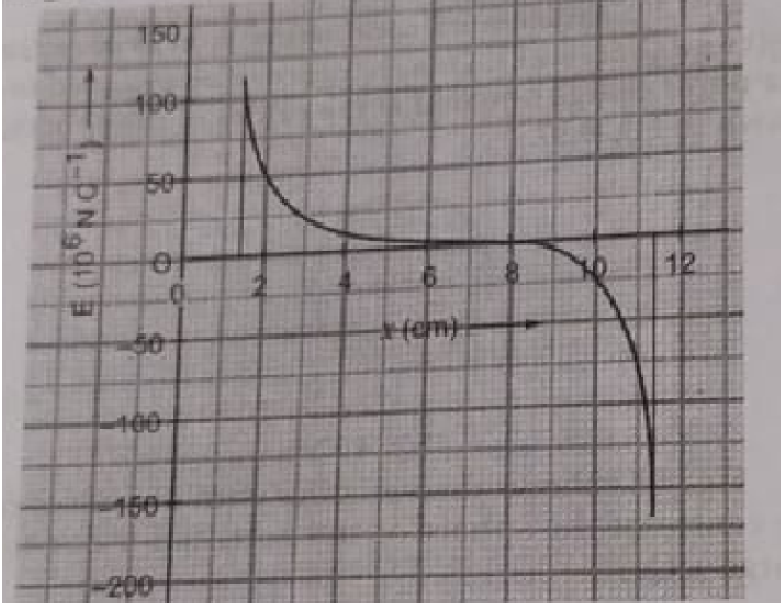
The charge on each sphere may be assumed to be a point charge at the centre of the sphere. Point P is a movable point that lies on the line joining the centres of the sphere and is distance x fromt he centre of sphere A. The variation with distance x fo the electric field strength E at point P as shown in the figure.



State the evidence provided by in the fig for the statement that the spheres are conductors, the charges on the spheres are either both positive or both negative.

130. Two small charged metal sphere A and B are situated in a vaccum. The distance between the centres of the spheres is 12.0 cm, as shown in the fig. 

The charge on each sphere may be assumed to be a point charge at the centre of the sphere. Point P is a movable point that lies on the line joining the centres of the sphere and is distance x fromt he centre of sphere A. The variation with distance x fo the electric field strength E at point P as shown in the figure.



Use fig to state and explain the distance x at which the rate of change of potential with distance is maximum and minimum.

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131. Two charges of 10^{-9}C each are placed at 1 m apart at two points A and B, grpahically, represent the variation of electric potential due to the two charges as one moves from the point A to B?

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132. A charge Q coulomb is uniformly distributed over a sphere volume of radius R metres. Obtain an expression for the energy of the system.

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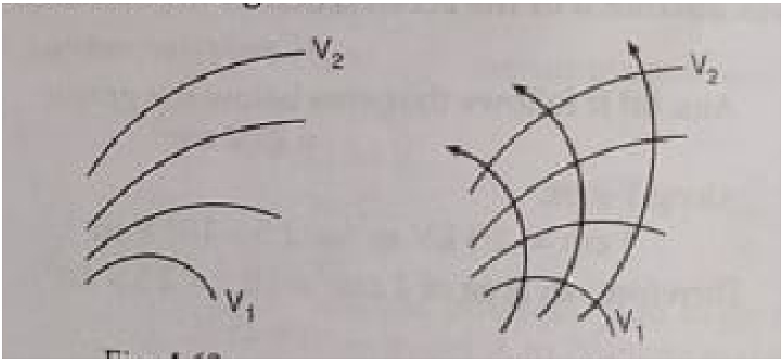
133. The equipotential surfaces of a certain electric field are shown in the fig.



It is known that $V_1 > V_2$. Use this pattern to reproduce approximately the lines of force of this field. Also indicate the region in which the intensity of the electric field is highest.

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134. A man inside an insulated metallic cage does not receive a shock, when the cage is highly charged. Explain, why.

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135. 60 J of work must be done to move electric charge equal to 5 C from a point, where potential is +20V to another point, where potential is V volt. Find the value of V.

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136. 10 joule of work must be done to move a charge of -200 C from the point A to point B. Which of the two points is at higher potential?

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137. 100 joule of work must be done to move a charge of -200 C from the point A to point B. What is the potential difference.?

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138. The potential at a point 0.1 m from an isolated point charge is +100 volt. Find the nature and magnitude of the point charge.

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139. What is the electric potential at the surface of an iron nucleus? The radius of the nucelus is 4.2×10^{-15} m and the atomic number is 26.

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140. The electric field at a point due to a point charge is $20NC^{-1}$ and the electric potential at the point is $10JC^{-1}$ Calculate the distance of the point from the charge and the magnitude of the charge.

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141. The potential at a certain distance from a point charge is 600 volt and the electric field is $200NC^{-1}$ find the distance of the point from the charge.

Watch Video Solution

142. The potential at a certain distance from a point charge is 600 volt and the electric field is $200NC^{-1}$ find the magnitude of the charge.

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143. A spherical oil drop of raiuds 10^{-4} cm has on it at a certain time a charge of 40 electrons. Calculate the energy that would be required to place an additional electron on the drop. Charge on a electron $= 1.6 \times 10^{-19} C$

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144. Two charges equal to $+20 \mu C$ and $-10 \mu C$ are placed at points 6 cm apart. Find the value of the potential at a point distant 4 cm on the right bisector of the line joining the two charges.

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145. Two tiny spheres carrying charges $1.5\mu C$ and $2.5\mu C$ are located 30 cm apart. Find the potential and electrical field at the mid-point of the line joining the two charges.

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146. Two charges of values $50\mu C$ and $100\mu C$ are placed at a distance of 6 cm apart. Find the field and potential at a distance of 6 cm apart. Find the field and potential at a point(between two charges) 2 cm from the charge of value $50\mu C$.

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147. Four point charges $16\mu C, -16\mu C, 16\mu C$ and $-16\mu C$ are located at the corners of a square of each side 10 cm. Find the vlaue of electric field intensity and electric potential at the centre of the square.

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148. Two point charges each of 3×10^{-9} C located at the two vertces of an equilatera triangle of side 20 cm. How much work must be done to bring a charge of 10^{-9} C upto the thrid corner of the triangle from infinity?

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149. A small particle carrying a negative charge of 1.6×10^{-19} C is suspended in equilibrium between the horizontal metal plates 5 cm apart, having a potential difference of 3000 volt across them. Find the mass of the particle.

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150. What is the potential gradient ($\in Vm^{-1}$) at a distance o 10^{-12} m from the centre fo the platinum nucleus? What is the potential gradient at the surface of nucleus? Atomic number of platinum is 78 and the radius of platinum nucleus may be taken as 5×10^{-15} m.

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151. The electric potential V(x) in a region along the X-axis varies with the distance x (in metre) according to the relation $V(x) = 4x^2$. Calculate the force experienced by a $1\mu C$ charge placed at point x = 1 m.

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152. The electric potential V(x) in a region along the X-axis varies with the distance x (in metre) according to the relation $V(x) = 4x^2$. Calculate the force experienced by a $1\mu C$ charge placed at point x = 1 m.

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153. In the nucleus of $\_(92)U^{238}$, two porotns at a distance of 6×10^{-1} m . Calculate their electrostatic potential energy.

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154. Two points charges $q_1 = 10 \times 10^{-8} c$ and $q_2 = -2 \times 10^{-8} C$ are separated by a distance of 60cm in air. Find at what distance form the charge, would the electric potential be zero.

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155. Two points charges $q_1 = 10 \times 10^{-8} c$ and $q_2 = -2 \times 10^{-8} C$ are separated by a distance of 60cm in air. Also calulate the electrostatic potential energy of the system.

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156. Two point charges 4Q and Q are separated by a distance of 1 m in air. At what point on the line joining the two charges is the electric field intensity zero?

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157. Two point charges 4Q and Q are separated by a distance of 1 m in air. Also calculate the electrostatic potential energy of the system of two charges, taking $Q = 2 \times 10^{-7} C$.

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158. Determine the electrostaic energy of a system containing two charges

$7\mu C$ and $-2\mu C$ separated by a distance of 18 cm.

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159. How much work is required to separate the two charges infinitely away from each other?

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160. Two point charges equal to $+10\mu C$ and $+20\mu C$ are 1 m apart. What is the amount of work done to bring them clsoer to each other by 50 cm.

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161. Three charges -q, Q and -q are placed at equal distances on a striaght line. If the potential energy of the system of three charges is zero, then what is the ratio of Q:q?

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162. Three points charges +q,+2q and Q are placed at the three vertices of an equilateral triangle. Find the value of charge Q (in terms of q), so that electric otential energy of the system is zero.

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

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164. Two electrons are moving towards each other, each with a velocity of $10^6 ms^{-1}$. What will be closest distance of approach between them?

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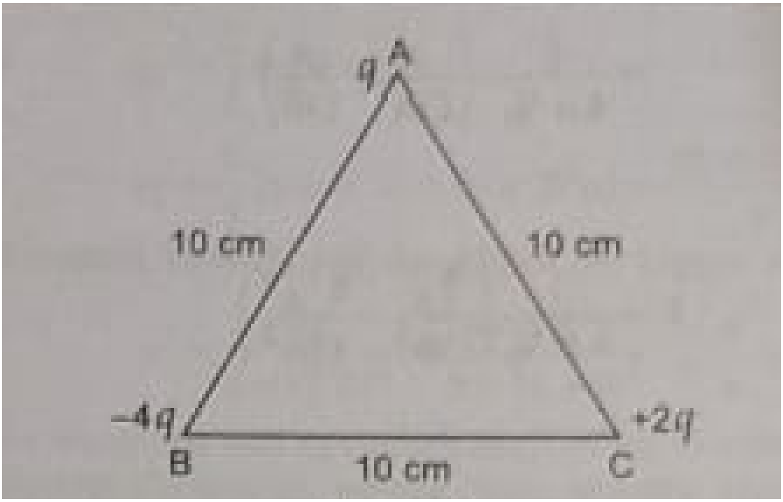
165. Calculate the work done to dissociate the system of three charges $\left(q = 1.6 \times 10^{-10} C\right)$ placed on the vertices of a triangle as shown in the fig



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166. An electric dipoole, when placed at an angle 30° with a uniform electric field of $10^4 NC^{-1}$, expereinces a torque of 9×10^{-26}N m. Calculate the dipole moment and electrostatic potential energy in this position.

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167. An electric dipole consists of two opposite charges each of magnitude 6×10^{-8} coulomb separated by $6.0 cm$. The dipole is placed in an external electric field of $5 \times 10^{-5} NC^{-1}$ What maximum torque will the field exert on the dipole?

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168. An electric dipole consists of two opposite charges each of magnitude 6×10^{-8} coulomb separated by $6.0 cm$. The dipole is placed in an external electric field of $5 \times 10^{-5} NC^{-1}$ How much work will an external agent have to do in turning the dipole through 180°, starting from the position $\theta = 0^{\circ}$?

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Exercise

1. Find an expression for line integral of electric intensity.

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2. The work done in moving a positive charge on an equipotential surface is:

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3. Show that the work done in moving a unit charge along a closed path is zero.

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4. Derive an expression for electric potential at a point due to a point charge.

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5. Define electric potential. What is the SI unit of potential? Obtain an expression for electric potential at a distance r from isolated unit positive charge.

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6. Define electric potential at a point. Derive an expression for the potential at a point due to a point charge.

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7. Derive an expression for the electric potential at a point along the axial line of an electric dipole.

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8. Derive an expression for electric field intensity at a distance r from a point charge q.

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9. Deduce an expression for electric potential due to an electric dipole at any point on its axis. Mention one contrasting feature of electric potential of dipole at a point as compared to that due to a single charge.

Watch Video Solution

10. Deduce an expression for electric potential due to an electric dipole at any point on its axis. Mention one contrasting feature of electric potential of dipole at a point as compared to that due to a single charge.

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11. How is electric field at a point related to potential gradient?

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12. How is electric field at a point related to potential gradient?

Watch Video Solution

13. What is the shape of equipotential surfaces for a uniform electric field?

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14. Draw the equipotential surfaces due to an electric dipole. Locate the points, where the potential due to the dipole is zero.

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15. Obtain an expression for potential energy of the configuration of three charges

Hence generalise the result for a system of n point charges?

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16. Depict the equipotential surfaces for a system of two identical positive point charges placed at a distance d apart.

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17. Deduce the expression for the potential energy of a system of two point charges q_1 and q_2 brought from infinity to the points $\overrightarrow{r}_1$ and $\overrightarrow{r}_2$ respectively in the presence of electric field $\overrightarrow{E}$.

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18. Two uniformly large parallel thin plates having charge densities $+\sigma$ and $-\sigma$ are kept in the X-Z plane at a distance 'd' apart. Sketch an equipotential surface due to electric field between the plates. IF a particle of mass m and charge -q remains stationary between the plates, what is the magnitude and direction of this field?

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19. Two point charges q_1 and q_2 are kept at a distance of r_{12} in air. Deduce the expression for the electrostatic potential energy of the system.

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20. Derive an expression for potential at a point due to a group of point charges?

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21. Define electric potential energy. Give its units. Calculate electric potential energy of system of n point charges.

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22. When is the torque acting on an electric dipole maximum when placed in uniform electric field ?

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23. Derive an expression for torque experiencedby electric dipole in a uniform electric field

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24. When is the potential energy of an electric dipole maximum, when placed in uniform electric field?

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25. Show that the line integral of electric field is independent of the path followed?

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26. Show that work done in moving an electric charge is independent of the path followed?

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27. Define electric potential. What is the SI unit of potential? Obtain an expression for electric potential at a distance r from isolated unit positive charge.

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28. Define potential difference between two points in an electrostatic field. Find an expresion for it. Define its SI unit.

Watch Video Solution

29. Define potential difference between two points in an electrostatic field. Find an expresion for it. Define its SI unit.

Watch Video Solution

30. Define potential difference between two points in an electric field. Derive the relationship between the electric field and the potential difference.

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31. Find an expression for line integral of electric intensity.

Watch Video Solution

32. Derive an expression for electric potential at a point due to electric dipole. Hence find its value on

equatorial line?

Watch Video Solution

33. Derive an expression for electric potential at a point due to electric dipole. Hence find its value on

equatorial line?

Watch Video Solution

34. Obtain an expression for potential energy of the configuration of three charges

Hence generalise the result for a system of n point charges?

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35. Find out the expression for the potential energy of a system of three point charges

q_1, q_2 and q_3 located at $\vec{r}_1, \vec{r}_2$ and $\vec{r}_n$ w.r.t the common origin O.

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36. When is the potential energy of an electric dipole maximum, when placed in uniform electric field?

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37. Depict the orientation of the dipole in (a)stable and (b) unstable equilibrium in a uniform electric field.

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38. When is the potential energy of an electric dipole maximum, when placed in uniform electric field?

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