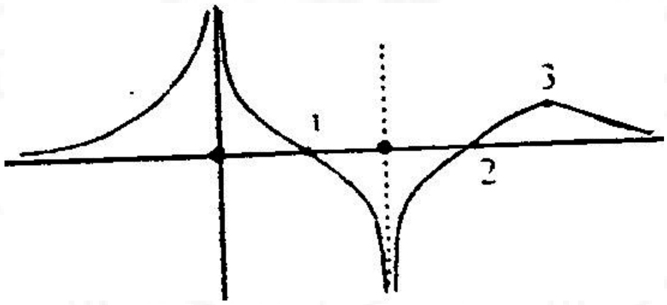
PHYSICS

31. Two point sized particles, each having a mass of 5g and charge $1.0\times10^{-7}C$, stay in limiting equilibrium on a horizontal table with a separation of 10 cm between them. The coefficient of friction between each particle and the table is the same. Find the value of this coefficient. (g = $10ms^{-2}$)

1) $\frac{9}{50}$ 2) $\frac{3}{50}$ 3) $\frac{1}{50}$ 4) $\frac{1}{25}$

32. Two point charges are kept fixed at a certain distance from one another. The graph represents the variation of the potential along the straight line connecting the two charges. At what point is the electric field zero?



1) 1 2) 2 3) 3 4) 1 and 2

33. The electric field of the earth at heights 200 m and 300 m are 100 Vm^{-1} 60 Vm^{-1} respectively in the downward direction. The net amount of charge contained in a cube 100 m of each edge placed between 200 m and 300 m, neglecting the curvature of the earth is (value of permittivity of free space is 8.85×10^{-12} SI units)

1) $14.16\mu c$ 2) $1.416\mu c$ 3) $35.4\mu c$ 4) $3.54\mu c$

34. Two equal positive point charges are separated by a distance 2a. A point test charge is located in a plane which is normal to the line joining these charges and midway between them. The radius of the circle of symmetry in this plane for which the force on the test charge has the maximum value is

1) $\frac{a}{2}$ 2) $\frac{a}{\sqrt{3}}$ 3) $\frac{a}{\sqrt{2}}$ 4) a

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

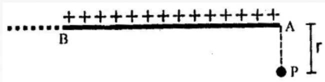
1) directed towards the gap and inversely proportional to R^3.

2) directed towards the gap and inversely proportional to R^2.

3) directed away from the gap and inversely proportional to R^3.

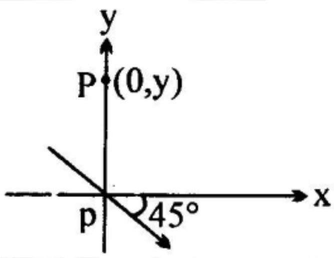
4) directed away from the gap and inversely proportional to R^2.

36. A semi-infinite insulting rod has linear charge density λ. The electric field at the point P shown in figure is :



1) $\frac{2\lambda^2}{(4\pi\varepsilon_0 r)^2}$ at 45^0 with BA
2) $\frac{\sqrt{2}\lambda}{4\pi\varepsilon_0 r^2}$ at 45^0 with BA
3) $\frac{\sqrt{2}\lambda}{4\pi\varepsilon_0 r}$ at 45^0 with BA
4) $\frac{\lambda}{4\pi\varepsilon_0 r}$ at 135^0 with BA

37. A small electric dipole of dipole moment '$\overline{p}$' is placed at origin of coordinate system as shown in figure. The electric field at point $p(o,y)$ is given as :



1) $\frac{Kp}{\sqrt{2}y^3}(-\hat{i}-\hat{j})$ 2) $\frac{Kp}{y^3}(-\hat{i}+\sqrt{2}\hat{j})$ 3) $\frac{Kp}{y^3}(-\hat{i}-2\hat{j})$ 4) $\frac{Kp}{\sqrt{2}y^3}(-\hat{i}-2\hat{j})$

38. The magnitude of the electric field intensity at point B (2,0,0) due to an infinitesimally small electric dipole of moment, $\vec{P} = \hat{i} + \sqrt{3}\hat{j}$ kept at origin is ($k = \frac{1}{4\pi\varepsilon_0}$)(All quantities are in S.I units)

1) $\frac{\sqrt{13}k}{8}$ 2) $\frac{\sqrt{13}k}{4}$ 3) $\frac{\sqrt{7}k}{8}$ 4) $\frac{\sqrt{7}k}{4}$

39. A particle of charge - q and mass m moves in a circle around a long wire of linear charge density $+\lambda$. If r = radius of the circular path and T = time period of the motion on circular path. Then:

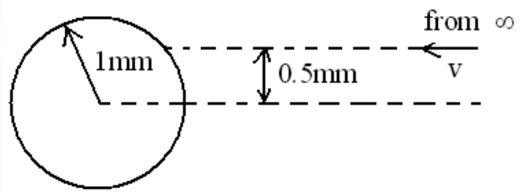
1) $T = 2\pi r\sqrt{\frac{m}{2K\lambda q}}$ 2) $T^2 = 4\pi^2\frac{mr^3}{2K\lambda q}$

3) $T = \frac{r}{2\pi}\sqrt{\frac{m}{K\lambda q}}$ 4) $T = 2\pi r\sqrt{\frac{2m}{K\lambda q}}$ where $k = \frac{1}{4\pi\varepsilon_0}$

40. The force per unit length between two infinite rods separated by distance R, having linear charge density λ_1 *and* λ_2 is $(k = 1/4\pi\varepsilon_0)$:

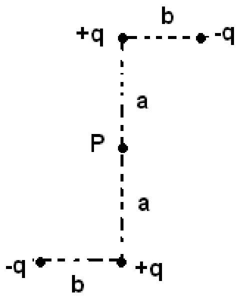
1) $F = \frac{k\lambda_1\lambda_2}{R}$ 2) $F = \frac{2k\lambda_1\lambda_2}{R}$ 3) $F = \frac{2k\lambda_1\lambda_2}{3R}$ 4) $F = \frac{k\lambda_1\lambda_2}{3R}$

41. A particle of mass 1 kg & charge $1/3\,\mu C$ is projected as shown in the figure 4towards a non conducting fixed spherical shell having the same charge uniformly distributed on its surface. Find the minimum initial velocity (v) of projection required if the particle just grazes the shell.



1) $\sqrt{\frac{2}{3}}\,m/s$ 2) $2\sqrt{\frac{2}{3}}\,m/s$ 3) $\frac{2}{3}\,m/s$ 4) $\frac{3}{2}\,m/s$

42. The electric potential due to the charge configuration at point 'P' for b<<a is

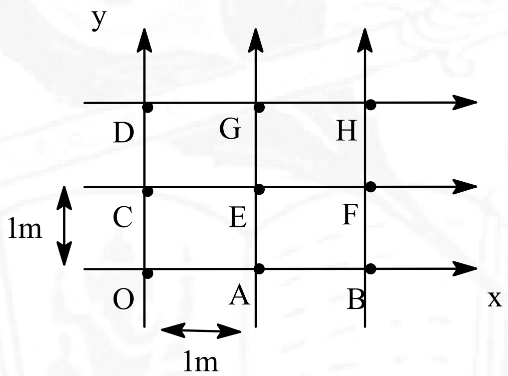


1) $\frac{2q}{4\pi \in_0 a}$ 2) $\frac{2qb^2}{4\pi \in_0 a^3}$ 3) $\frac{qb^2}{4\pi \in_0 a^3}$ 4) none

43. In a uniform electric field, the potential is 10 V at the origin of coordinate system and 8V at each of the points $(1,0,0)$, $(0,1,0)$ and $(0,0,1)$. The potential at the point P(1, 1, 1) will be

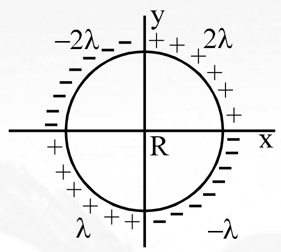
1) 0 2) 4 V 3) 6 V 4) 12 V

44. The grid (each square of $1m \times 1m$) represent a region in space containing a uniform electric field. If potentials at point O, A, B, C, D, E, F, G, H are respectively $0, -1, -2, 1, 2, 0, -1, 1$ and 0 volts, then the electric field intensity at any point is



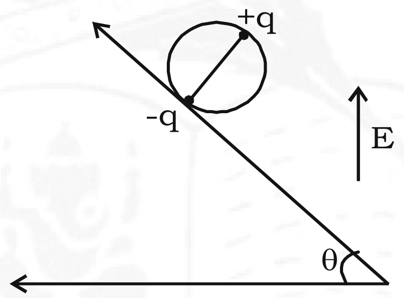
1) $(\hat{i}+\hat{j})V/m$ 2) $(\hat{i}-\hat{j})V/m$ 3) $(-\hat{i}+\hat{j})V/m$ 4) $(-\hat{i}-\hat{j})V/m$

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



1) $-\frac{\lambda}{2\pi\varepsilon_0 R}\hat{i}$ 2) $\frac{\lambda}{2\pi\varepsilon_0 R}\hat{i}$ 3) $-\frac{\sqrt{2}\,\lambda}{4\pi\varepsilon_0 R}\hat{i}$ 4) $\frac{\sqrt{2}\,\lambda}{4\pi\varepsilon_0 R}\hat{i}$

46. A wheel having mass *m* has charges +q and –q on diametrically opposite points. It remains in equilibrium on a very rough inclined plane in the presence of uniform vertical electric field E. The value of 'E' is



1) mg/q 2) $mg/2q$ 3) $mg\tan\theta/2q$ 4) $mg\cot\theta/2q$

47. An electric field in given by $\vec{E}=\left(y\hat{i}+x\hat{j}\right)N/C.$ Find the work done (in J) by electric field in moving a 1C charge from $\vec{r}_A=\left(2\hat{i}+2\hat{j}\right)m$ to $\vec{r}_B=\left(4\hat{i}+\hat{j}\right)m.$

1) 6 2) 2 3) -6 4) 0

48. Two positively charged particles X and Y are initially far away from each other and at rest. X begins to move towards Y with some initial velocity. The total momentum and energy of the system are p and E. Choose the correct option

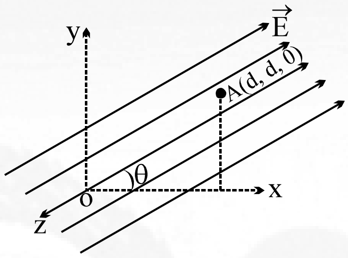
1) If Y is fixed, both p and E are conserved.

2) If Y is fixed, E is conserved, but not p.

3) If both are free to move, p is conserved but not E.

4) If both are free, E is conserved, but not p.

49. A uniform electric field having strength $\vec{E}$ is existing in x-y plane as shown in figure. Find the p.d. between origin O & A(d, d, 0)



1) Ed $(\cos\theta + \sin\theta)$ 2) –Ed $(\sin\theta - \cos\theta)$

3) Ed 4) –Ed

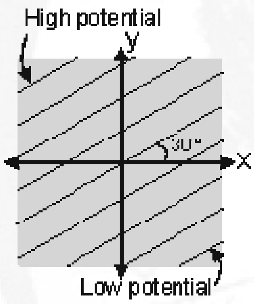
50. If a small positive charge q of mass m is projected towards the sheet of charge of charge density σ from a distance z, along the perpendicular, such that it just stops before touching the sheet, then velocity of projection is

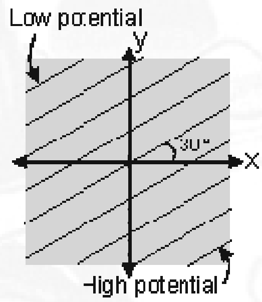
1) $2\sqrt{\frac{q\sigma z}{m \in_0}}$ 2) $\sqrt{\frac{2q\sigma z}{m \in_0}}$ 3) $\sqrt{\frac{q\sigma z}{2m \in_0}}$ 4) $\sqrt{\frac{q\sigma z}{m \in_0}}$

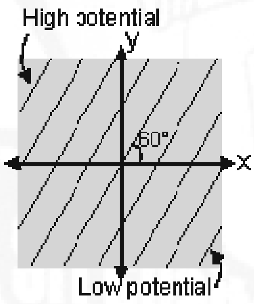
51. An arc of radius r carries charge. The linear density of charge is λ and the arc subtends an angle $\frac{\pi}{3}$ at the centre. What is electric potential at the centre?

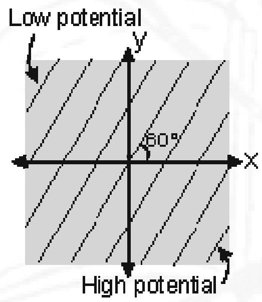
1) $\frac{\lambda}{4\varepsilon_0}$ 2) $\frac{\lambda}{8\varepsilon_0}$ 3) $\frac{\lambda}{12\varepsilon_0}$ 4) $\frac{\lambda}{16\varepsilon_0}$

52. The electric field intensity at all points in space is given by $\vec{E}=\sqrt{3}\hat{i}-\hat{j}$ volts/metre. The nature of equipotential lines in x-y plane is given by

1) 

2) 

3) 

4) 

53. An electric field given by $\vec{E} = 4\hat{i} - 3(y^2 + 2)\hat{j}$ pierces Gaussian cube of side 1m placed at origin such that its three sides represents x, y and z axes. The net charge enclosed within the cube is

1) $-3\varepsilon_0$ 2) $3\varepsilon_0$ 3) $5\varepsilon_0$ 4) zero

54. A fixed circle of radius a and centre O is drawn and a charge +q is placed at a distance $\frac{3a}{4}$ from O on the axis of the circle . If a second charge q' is placed at a distance $\frac{5a}{12}$ on the axis on other side of circle such that net electric flux through the circle is zero. The ratio $\frac{q'}{q}$ is

1) $\frac{13}{20}$ 2) $\frac{12}{25}$ 3) $\frac{7}{19}$ 4) $\frac{8}{19}$

55. The electric potential in a certain region of space is given by $V = -3x^2 + 4x$, where x is in metres and V is in volts. In this region, the equipotential surfaces are

1) planes parallel to XY plane

2) planes parallel to YZ plane

3) concentric cylinder with axis as x-axis

4) parabola in xy plane translated along z-axis to form a surface

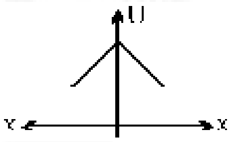
56. Two identical particles each of mass m carry a charge Q each. Initially, one of them is at rest on a smooth horizontal plane and the other is projected along the plane directly towards the first particle from a large distance with a speed v. If d is the distance of closest approach them.(Neglect gravitational effects)

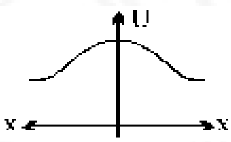
1) $d=\frac{1}{4\pi\varepsilon_0}\frac{Q^2}{mv^2}$ 2) $d=\frac{1}{4\pi\varepsilon_0}\frac{2Q^2}{mv^2}$ 3) $d=\frac{1}{4\pi\varepsilon_0}\frac{4Q^2}{mv^2}$ 4) $d=\frac{1}{4\pi\varepsilon_0}\frac{8Q^2}{mv^2}$

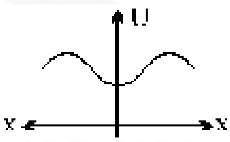
57. A dipole of dipole moment $\bar{P}=2\hat{i}-3\hat{j}+4\hat{k}$ is placed at point A (2, –3, 1). The electric potential due to this dipole at the point B (4 – 1, 0) is equal to (All the parameters specified here are in S.I. units.)

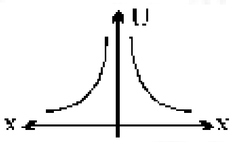
1) 2×10^9 volts 2) -2×10^9 volts
3) 3×10^9 volts 4) -3×10^9 volts

58. Four equal charges +q are placed at four corners of a square with its centre at origin and lying in yz plane. The electrostatic potential energy of a fifth charge +q' varies on x-axis as:

1) 

2) 

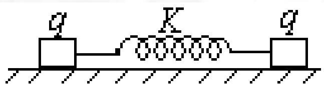
3) 

4) 

59. In a regular polygon of n sides, each corner is at a distance r from the centre. Identical charges are placed at (n – 1) corners. At the centre, the intensity is E and the potential is V. The ratio V/E has magnitude.

1) r n 2) r (n – 1) 3) (n – 1)/r 4) r(n – 1)/n

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



1) $\frac{q}{4r}\sqrt{\frac{1}{\pi\varepsilon_0 r}}$ 2) $\frac{q}{2r}\sqrt{\frac{1}{\pi\varepsilon_0 r}}$ 3) $\frac{2q}{r}\sqrt{\frac{1}{\pi\varepsilon_0 r}}$ 4) $\frac{q}{r}\sqrt{\frac{1}{\pi\varepsilon_0 r}}$