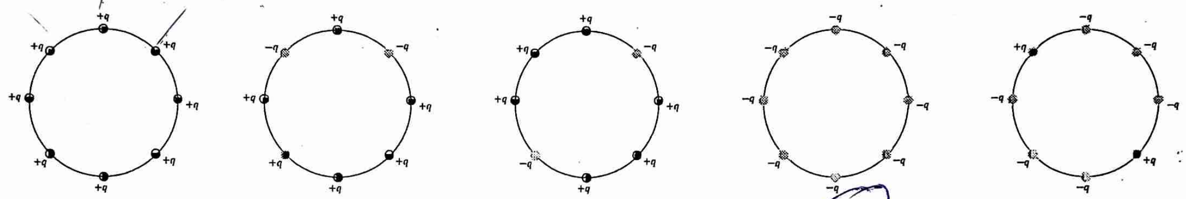
1) Suppose the electric potential due to a given charge distribution can be written in Cartesian coordinates as $V(x, y, z) = x^2 - y^2 + z\ volts$. The associated electric field at the point $(1.0, 1.0, 1.0)\ m$ is

(a) $-2.0\,\hat{\imath} - 2.0\hat{\jmath} + 1.0\,\hat{k}\ N/C$
(b) $-1.0\,\hat{\imath} - 1.0\hat{\jmath} + 1.0\,\hat{k}\ N/C$
(c) $-2.0\,\hat{\imath} + 2.0\hat{\jmath} - 1.0\,\hat{k}\ N/C$
(d) $1.0\,\hat{\imath} + 1.0\hat{\jmath} + 1.0\,\hat{k}\ N/C$
(e) $2.0\,\hat{\imath} - 2.0\hat{\jmath} + 1.0\,\hat{k}\ N/C$

2) Eight charges are equally spaced on a circle of radius R. The magnitude of the electric field at the center of the circle is greatest for charge configuration:



(a) (b) (c) (d) (e)

3) Two electrons are fixed $4.00\ cm$ apart. Another electron is shot from infinity and stops midway between the two. Its initial speed is

(a) $80.0\ m/s$
(b) $25.0\ m/s$
(c) $160\ m/s$
(d) $225\ m/s$
(e) $500\ m/s$

4) The following charges on an object are physically possible, except

(a) $8 \times 10^{-21}\ C$.
(b) $8 \times 10^{-19}\ C$.
(c) $8 \times 10^{-17}\ C$.
(d) $8 \times 10^{-15}\ C$.
(e) $8 \times 10^{-13}\ C$.

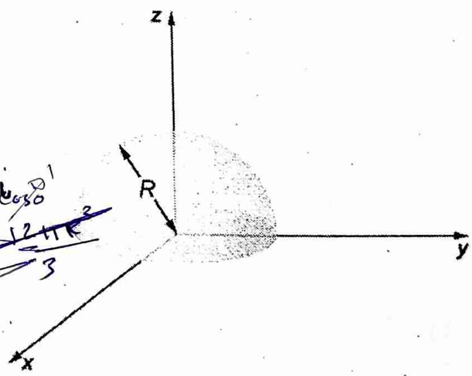
5) A particle that has a mass of $0.50\ g$ and carries a charge of $5.00\ \mu C$ is placed in a region in which the electric field is given by $\vec{E} = (1.00 + 4.00x^3)\hat{\imath}\ \frac{N}{C}$. If the particle starts at rest at $x = 0$, then its speed when it reaches position $x = 2.00\ m$ is

(a) $0.03\ m/s$
(b) $0.15\ m/s$
(c) $0.40\ m/s$
(d) $0.18\ m/s$
(e) $0.60\ m/s$

6) Two charged particles are arranged as shown. In which region could a third particle, with charge $+1\ C$, be placed so that the net electrostatic force on it is zero

(a) I only
(b) II only
(c) III only
(d) I and II only
(e) I and III only

7) The electric field flux through the open hemispherical (نصف كرة) surface due to the uniform electric field $\vec{E} = \hat{\imath} + 2\hat{\jmath} + 3\hat{k}\ N/C$ is

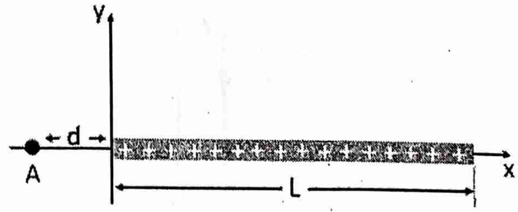


(a) πR^2
(b) $2\pi R^2$
(c) $3\pi R^2$
(d) $4\pi R^2$
(e) 0

8) The electric potential of an object made from a conducting material is

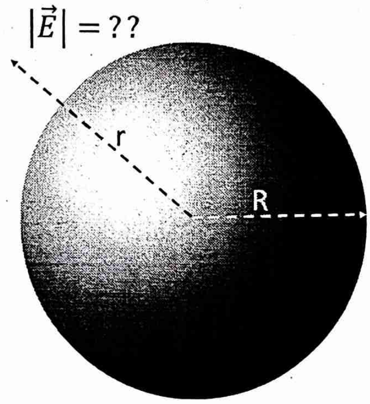
(a) greatest at its surface.
(b) greatest at its center.
(c) lowest at its surface.
(d) lowest at its center.
(e) constant.

9) A thin plastic rod of length L lying on the x axis and has a nonuniform positive linear charge density $\lambda = x \times 10^{-9} C/m$. If $L = d = 10.0\ cm$, the electric field at point A is



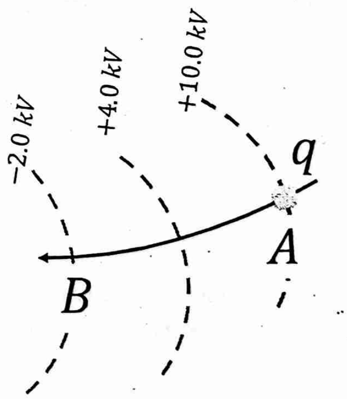
(a) $1.7\,\hat{j}\ N/C$
(b) $2.3\,\hat{\imath}\ N/C$
(c) $-1.7\,\hat{\imath}\ N/C$
(d) $-3.2\,\hat{\imath}\ N/C$
(e) 0

10) The magnitude of the electric field outside a non-conducting sphere of radius R that has a volume charge distribution that varies with radial distance r as given by $\rho(r) = \rho_0(1 - \frac{4}{3}\frac{r}{R})$



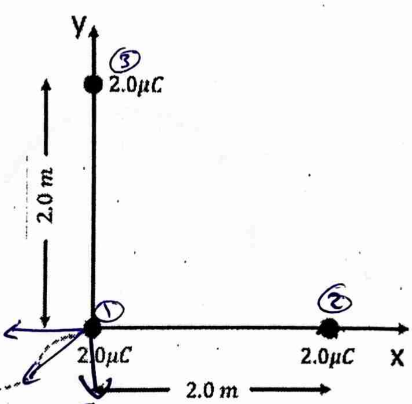
(a) $\frac{\rho_0 r^2}{\epsilon_0 R}\left(1 - \frac{4}{3}\frac{r}{R}\right)$
(b) $\frac{\rho_0 R^2}{\epsilon_0 r}\left(1 - \frac{r}{R}\right)$
(c) $\frac{\rho_0 r^2}{4\pi\epsilon_0 R}\left(1 - \frac{4}{3}\frac{r}{R}\right)$
(d) 0
(e) $\frac{\rho_0 r^2}{\epsilon_0}\left(1 - \frac{16}{9}\frac{r^2}{R^2}\right)$

11) A particle with charge $+1.5\ nC$ and mass $1.0\ \mu g$ is released from rest at point A and accelerates for a distance of $2.4\ m$ to point B by moving through the equipotentials shown. The velocity of the particle at B is



(a) $15\ m/s$
(b) $6.0\ m/s$
(c) $3.0\ m/s$
(d) $2.0\ m/s$
(e) $13\ m/s$

12) A particle with charge $2.0\mu C$ charge is placed at the origin. An identical particle, with the same charge, is placed $2.0\ m$ from the origin on the x axis, and a third identical particle, with the same charge, is placed $2.0\ m$ from the origin on the y axis. The magnitude of the net force on the particle at the origin is



(a) $9.0 \times 10^{-3}\ N$
(b) $6.4 \times 10^{-3}\ N$
(c) $1.8 \times 10^{-2}\ N$
(d) $1.3 \times 10^{-2}\ N$
(e) $1.4 \times 10^{-3}\ N$

$F_{12} = \frac{9\times10^9 (2\times10^{-6})^2}{2^2}$

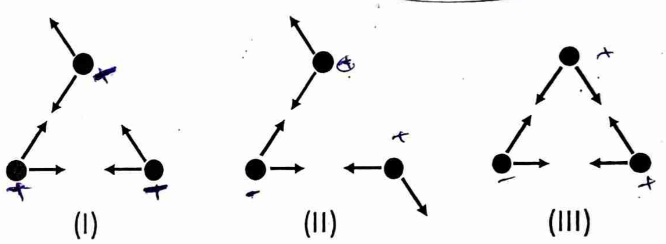
$F_{13} = \frac{9\times10^9 (2\times10^{-6})^2}{2^2}$

$F_1 = -0.036\hat{i} - 0.036\hat{j}$

$F = \sqrt{(-0.036)^2 + (-0.036)^2}$

$F = 0.05$

13) The following diagrams represent the forces that three charged objects might exert on each other, except



(a) I
(b) II
(c) III
(d) II and III
(e) None

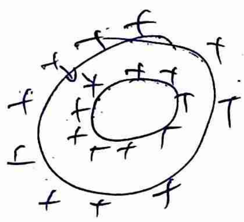
14) An electric dipole of dipole moment $\vec{p} = p_0\hat{j}$ is placed in a uniform electric field $\vec{E} = E_0\hat{i}$. The value of the torque applied on the dipole by the electric field is

(a) zero
(b) $p_0E_0\hat{k}$
(c) $-p_0E_0\hat{i}$
(d) $p_0E_0\hat{j}$
(e) $-p_0E_0\hat{k}$

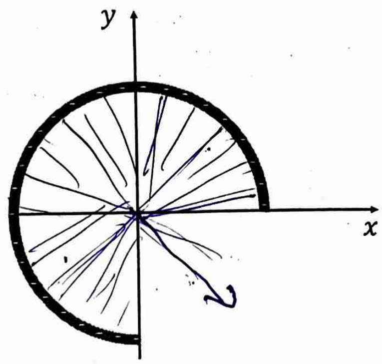
$\tau = \vec{P} \times \vec{E}$
$= P_0\hat{j} \times E_0\hat{i}$
$- P_0E_0\hat{k}$

15) Consider a closed Gaussian surface that has a positive flux. If a second closed Gaussian surface is completely inside the first one and has a smaller positive charge, then

(a) There is a negative charge between the two surfaces.
(b) There is a positive charge between the two surfaces.
(c) There is a positive charge outside the first surface.
(d) There is a negative charge outside the first surface.
(e) There is a negative charge inside the second surface.



16) Consider the negative linear, uniform charge distribution shown in the figure. The angle of the electric field vector at the origin with the positive x-axis is

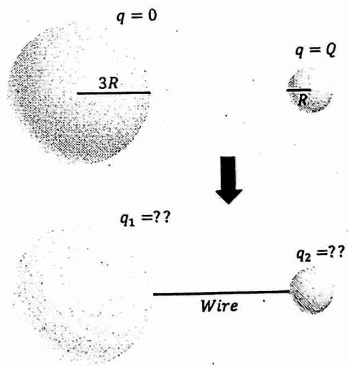


(a) $90°$
(b) $-45°$
(c) $-135°$
(d) $45°$
(e) $135°$

17) A charge Q is distributed uniformly throughout a sphere of radius R. The magnitude of the electric field at a point $R/3$ from the center is

(a) $\frac{1}{4\pi\epsilon_0}\frac{Q}{R^2}$
(b) $\frac{1}{8\pi\epsilon_0}\frac{Q}{R^2}$
(c) $\frac{1}{12\pi\epsilon_0}\frac{Q}{R^2}$
(d) $\frac{1}{16\pi\epsilon_0}\frac{Q}{R^2}$
(e) $\frac{1}{24\pi\epsilon_0}\frac{Q}{R^2}$

18) Two conducting spheres are far apart. The smaller sphere carries a total charge of Q. The larger sphere has a radius that is three times that of the smaller sphere and is neutral. After the two spheres are connected by a conducting wire, the charges on the larger and smaller spheres, respectively, are:



(a) Q/2 and Q/2
(b) 3Q/4 and Q/4
(c) 2Q/3 and Q/3
(d) zero and Q
(e) 2Q and –Q