OL Academy

Test 1

PHYCS102

Test 1 Revision

Past exams questions

T. Sayed Ali Madan

Outline

- Past exams questions

Past exams questions

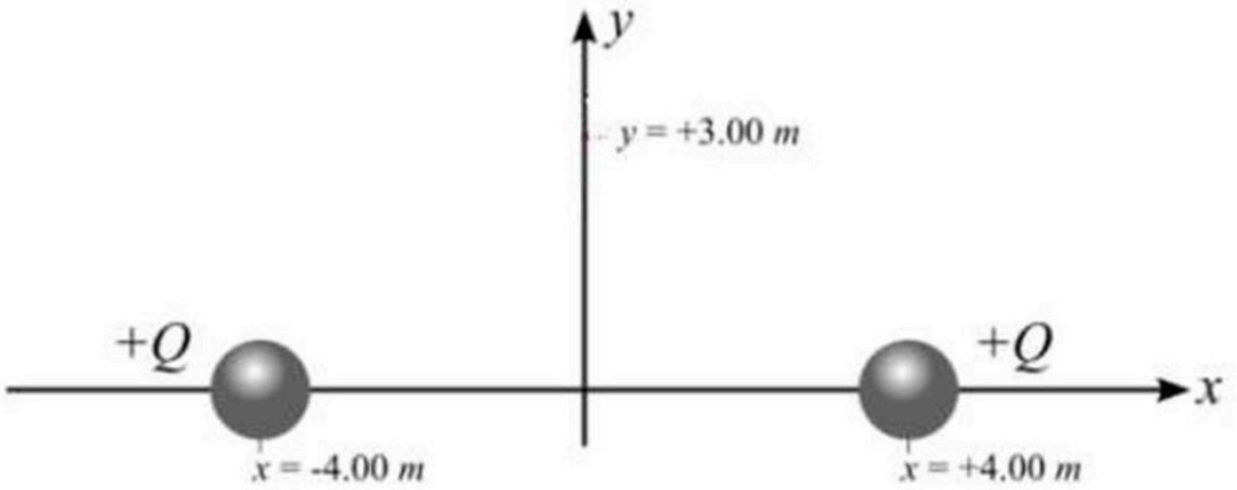
1. **(1.25 point)** Two point charges of the same charge $Q = 3.00\ \mu C$, are located on the $x - axis$ (as shown in the figure). One is at $x = 4.00\ m$, and the other is at $x = -4.00\ m$. Determine the electric field magnitude (in V/m) on the $y - axis$ at $y = 3.00\ m$.

   a) 864

   b) 1296

   c) 1728

   d) 2160



Past exams questions

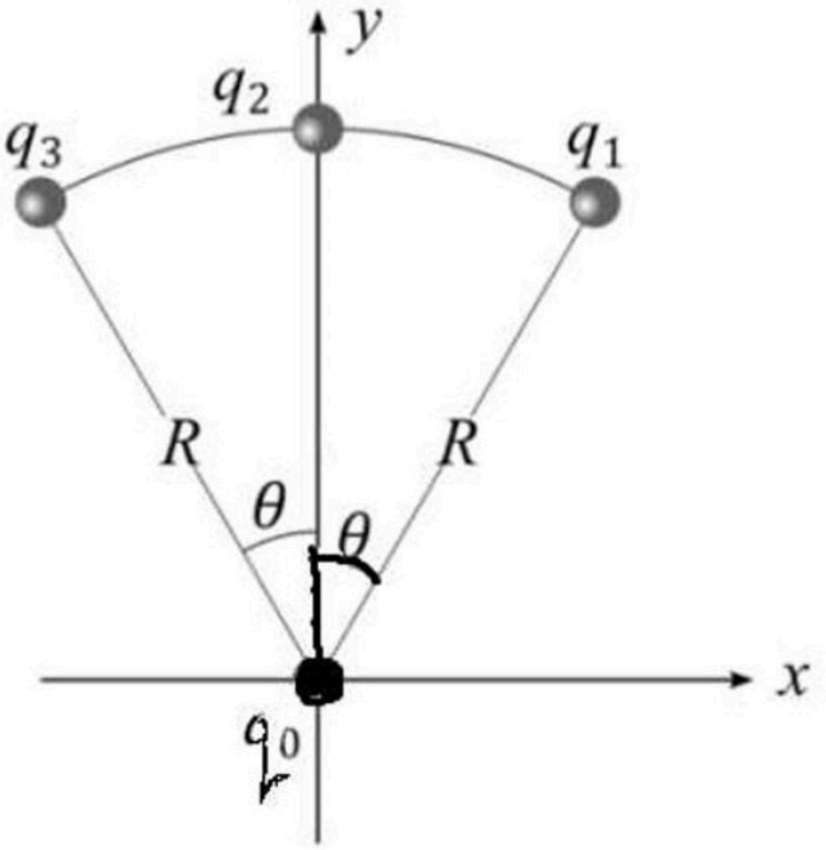
2. **(1.25 point)** Three point charges $q_1 = q_3 = +3\ nC$, and $q_2 = -2\ nC$ are located on a circular arc or radius $R = 4\ cm$, as show in the figure. If the angle $\theta = 30°$, then what is the electric force (in μN) that would be excreted on a point charge $q_0 = -5\ nC$ placed at the arc's center point?

a) $+89.9\ \hat{\imath}$

b) $-89.9\ \hat{\imath}$

c) $+89.9\ \hat{\jmath}$

d) $-89.9\ \hat{\jmath}$

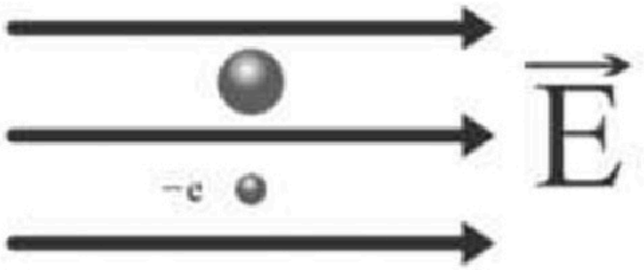


Past exams questions

3. **(1.25 point)** An electron and a neutron are inside a uniform electric field. If the two particles are released from rest, then the electron will accelerate to the left and the neutron to the right.

a) False

b) True



Past exams questions

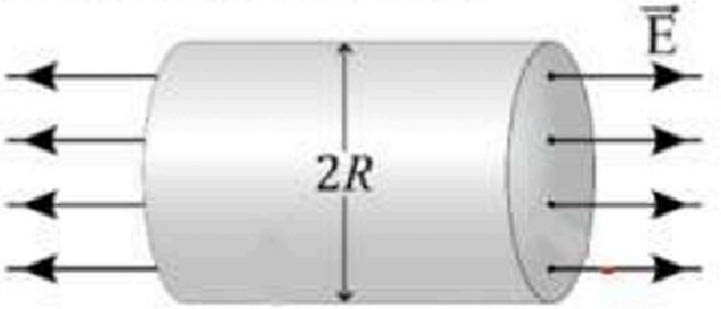
4. **(1.25 point)** The net electric charge enclosed by the cylindrical surface shown in the following figure is,

   a) $Zero$

   b) $\pi R^2 \varepsilon_0 E$

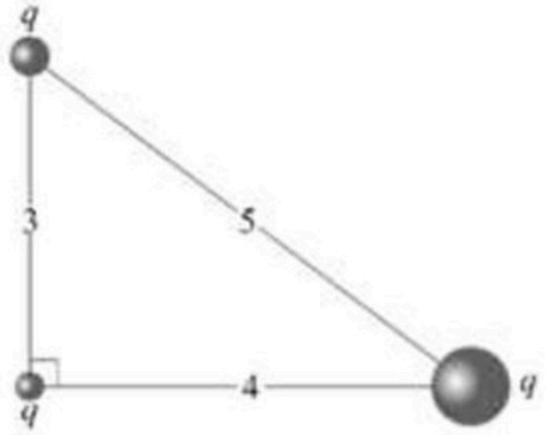
   c) $-2\pi R^2 \varepsilon_0 E$

   d) $2\pi R^2 \varepsilon_0 E$



Past exams questions

5. **(1.25 point)** Three identical point charges are located at the vertices of a $3-4-5$ triangle, as shown in the figure. The electric potential energy of the system is



a) $\frac{47}{60}kq^2$

a) $\frac{13}{36}kq^2$

b) $\frac{8}{15}kq^2$

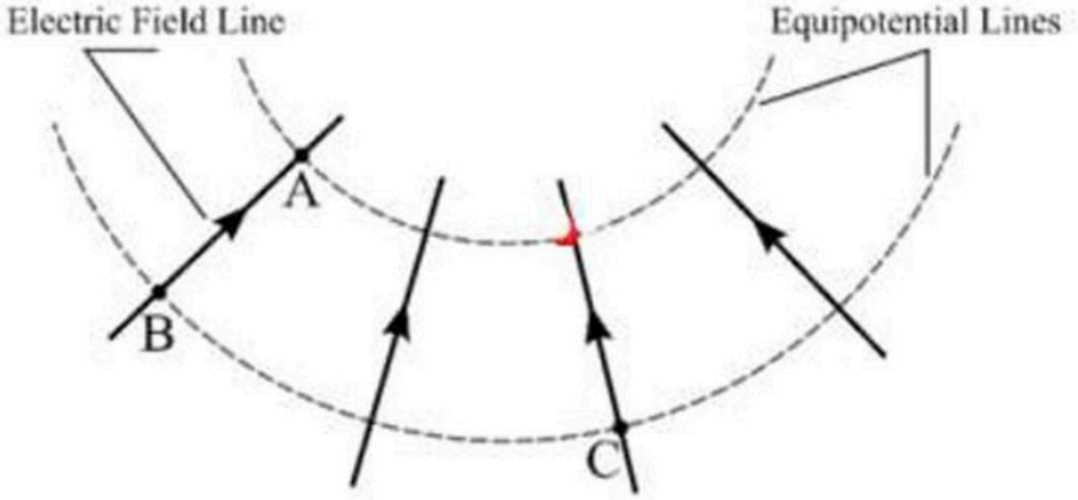
c) $\frac{769}{3600}kq^2$

Past exams questions

6. **(1.25 point)** When an electron moves from point A to point B along an electric field line (as shown in the figure), the work done on it is $3.86 \times 10^{-19} J$. Calculate the following electric potential differences,

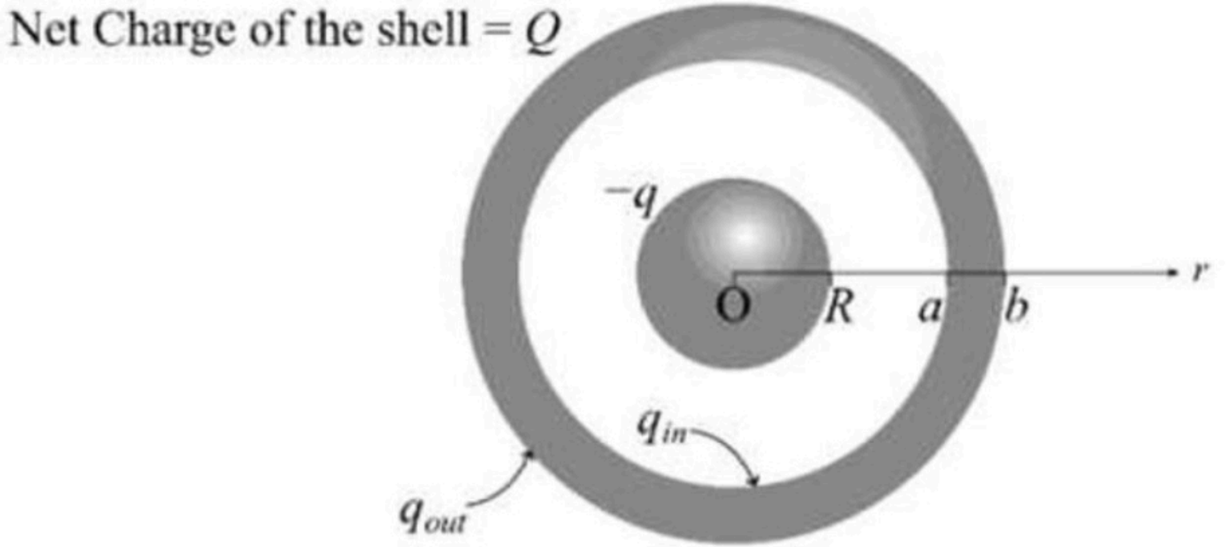
a) $V_C - V_A =$

b) $V_B - V_C =$



Past exams questions

An insulating sphere of a net charge $-q$ and radius $R = 1.5\ cm$, is concentric with a conducting shell of net charge $Q = 3q = 9\ nC$ and Radii $a = 3.0\ cm$ and $b = 3.5\ cm$, as shown in the figure.



1. **(1.5 point)** Find the values of the charges q_{out} at the outer surface and q_{in} at the inner surface of the shell.

Past exams questions

2. **(1.5 point)** Find the surface charge densities σ_{in} and σ_{out}, on the inner and outer surface of the shell, respectively.

Past exams questions

3. **(2 points)** Find the equations of the electric field magnitude for the following intervals of the radial direction shown in the figure above:

a) $0 \leq r \leq R$ **(0.5 point)**

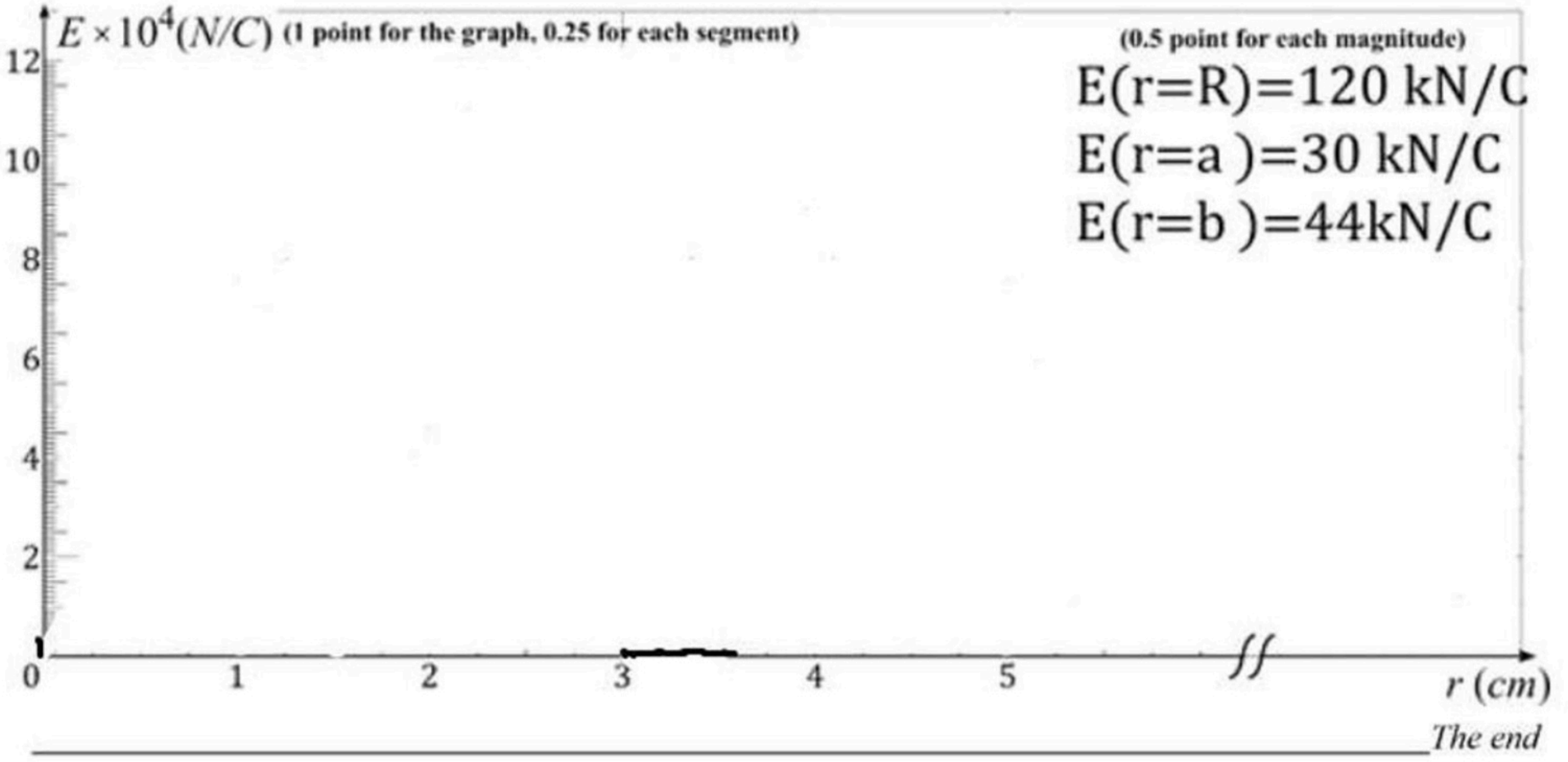
b) $R \leq r \leq a$ **(0.5 point)**

c) $a < r < b$ **(0.5 point)**

d) $r \geq b$ **(0.5 point)**

Past exams questions

4. **(2.5 point)** Draw the electric field magnitude as function of the radial direction r. (Calculate the electric field magnitudes at $r = R$, $r = a$ and $r = b$)



(0.5 point for each magnitude)

$E(r=R)=120\ kN/C$

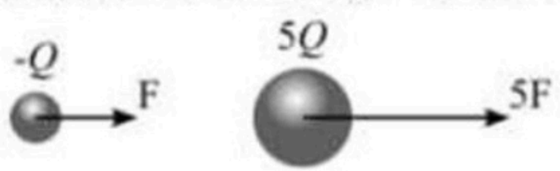
$E(r=a)=30\ kN/C$

$E(r=b)=44 kN/C$

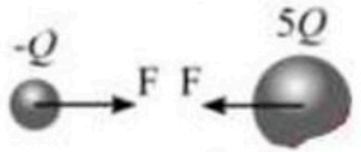
The end

Past exams questions

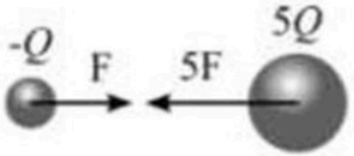
1. Which force diagram represents the **correct** magnitudes and directions of the electric forces (F) on the two point-charges one of charge $-Q$ and the other of charge $+5Q$?



a)



b)



c)

d)

e)

Past exams questions

2. If $q_2 = q_3 = q_4 = 1$ nC and $a = 1$ m, then find the **magnitude** of q_1 (in nC) so that the net electric force acting on q_4 is zero.

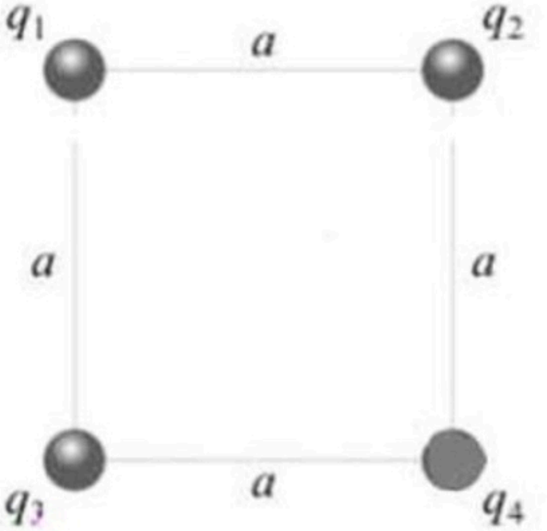
a) 2.83

b) 5.66

c) 8.49

d) 11.3

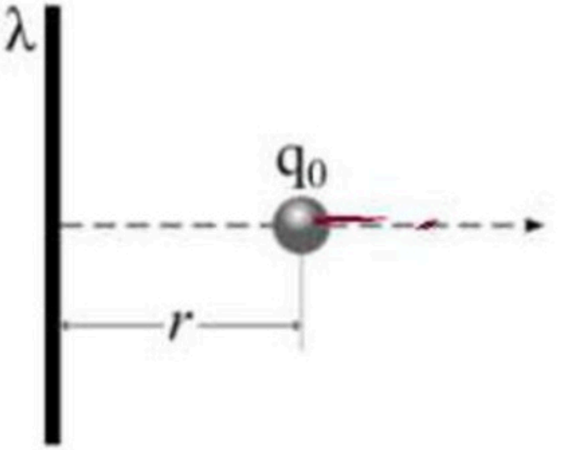
e) 14.1



Past exams questions

3. An infinite charged line carries a uniform charge density $\lambda = 8\ \mu C/m$. A charged particle of charge $q_0 = 7\ nC$ is placed at a distance $r = 0.3\ m$ from the line as shown. The magnitude of the electric force (in mN) on the particle is

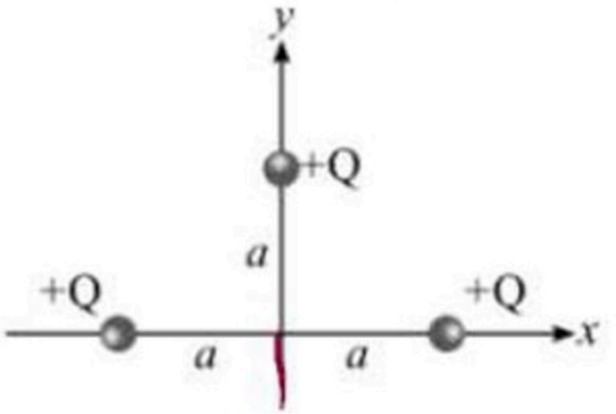
a) 1.44
b) 1.92
c) 2.40
d) 2.88
e) 3.36



Past exams questions

4. Three identical point charges $+\mathbf{Q}$ are placed each at a distance $\boldsymbol{a}$ from the origin as shown in the figure. The net electric field $\vec{E}$ at the origin is:

a) $-2k\frac{Q}{a^2}\hat{i}$ b) $-2k\frac{Q}{a^2}\hat{j}$ c) $+k\frac{Q}{a^2}\hat{j}$ d) $-k\frac{Q}{a^2}\hat{j}$ e) Zero



Past exams questions

5. An electron is placed between two parallel infinite charged sheets, one with uniform surface charge density +σ and the other with -σ as shown in the figure. At which point the electric force on the electron is **largest**?

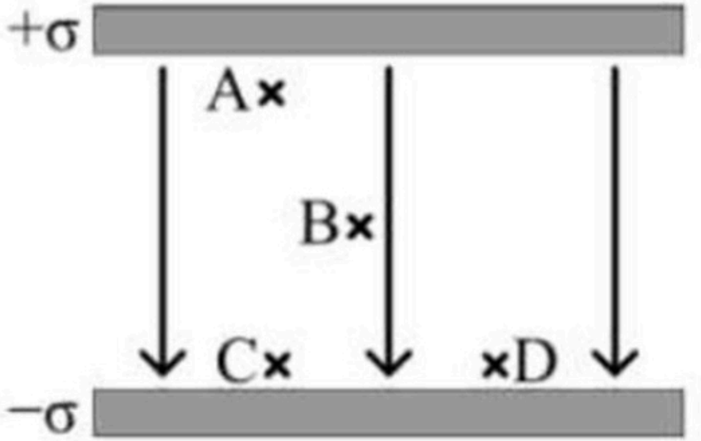
a) The force is same at all points.

b) At point (A) close to positive plate.

c) At point (B) midway between the two plates.

d) At point (C), close to negative plate.

e) At points (C) and (D).



Past exams questions

6. A thin charged ring of radius $r = 0.04$ m carries a uniform charge density $\lambda = 26.55$ nC/m, placed inside a cubic surface of side length $L = 1.5$ m. Find the net flux (in Nm^2/C) through the cubic surface.

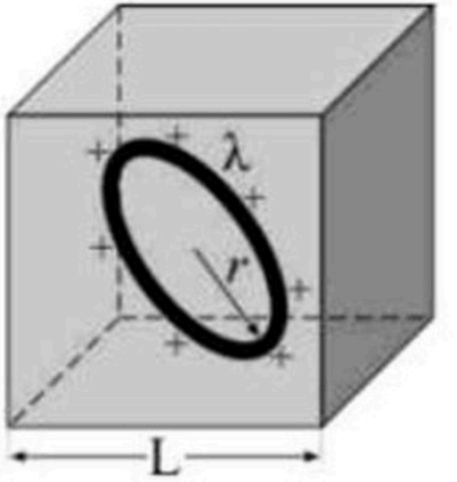
a) 377.0

b) 565.5

c) 754.0

d) 942.5

e) 1131



Past exams questions

7. A conducting sphere has a net charge $+70\ \mu C$ is concentric with a thick-walled conducting spherical shell with net charge $-200\ \mu C$. The charge on the inner and outer surface of the thick shell are:

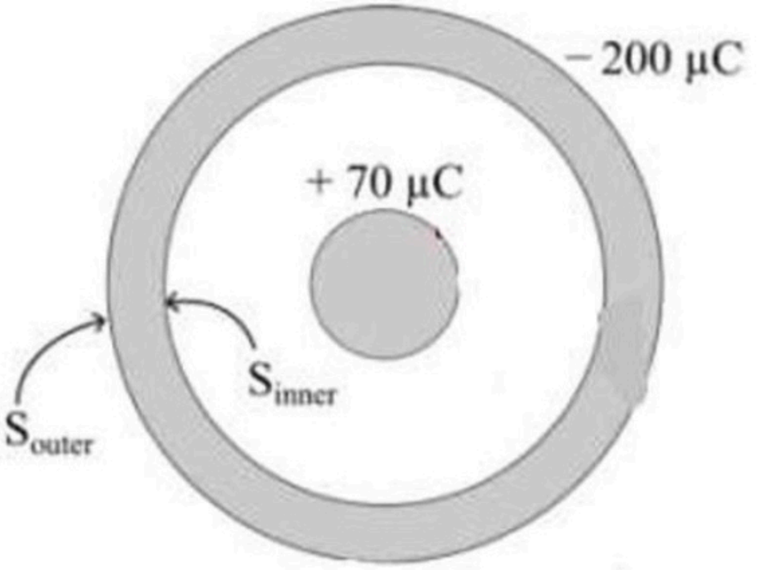
a) $Q_{inner} = -130\ \mu C$ and $Q_{outer} = -200\ \mu C$

b) $Q_{inner} = 0$ and $Q_{outer} = -200\ \mu C$

c) $Q_{inner} = -70\ \mu C$ and $Q_{outer} = -270\ \mu C$

d) $Q_{inner} = +70\ \mu C$ and $Q_{outer} = -130\ \mu C$

e) $Q_{inner} = -70\ \mu C$ and $Q_{outer} = -130\ \mu C$



Past exams questions

8. The electric field at all points on a closed spherical surface is 226 N/C outwards. If the area of the surface is 4.2 m^2, what is the net charge (in nC) enclosed inside the surface?

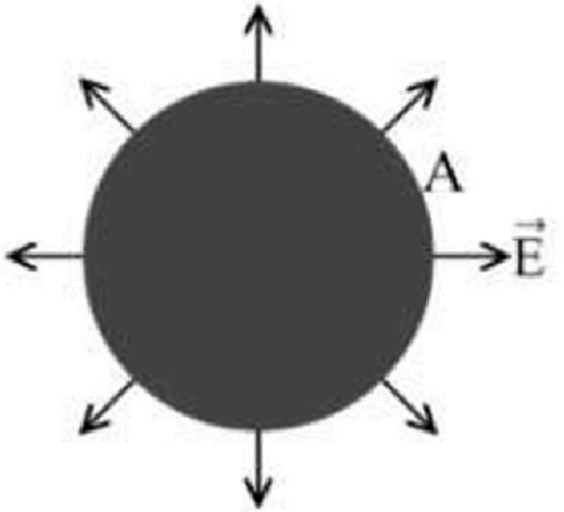
a) 4.00

b) 8.40

c) 12.4

d) 14.4

e) 16.0



Past exams questions

9. Two conducting thin concentric shells, charged with uniform surface densities $+\sigma$ and $-\sigma$ respectively. The inner shell of radius (a) and the outer of ($2a$). The magnitude of the electric field E at point (A) a distance (r) from the center is:

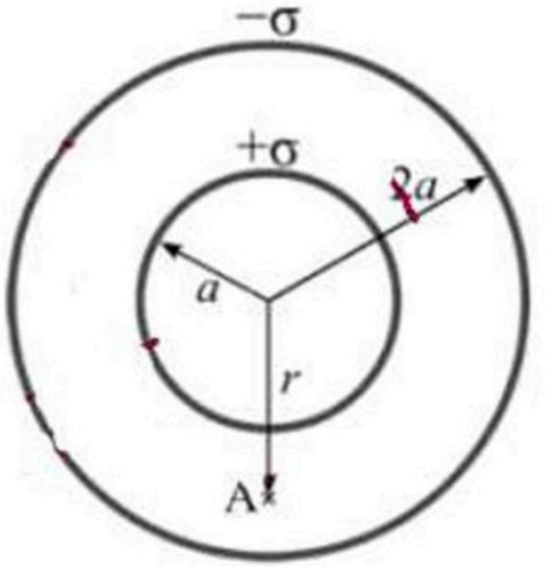
a) $E = 0$

b) $E = \frac{2\sigma a}{\varepsilon_0 r^2}$

c) $E = \frac{\sigma a^2}{\varepsilon_0 r^2}$

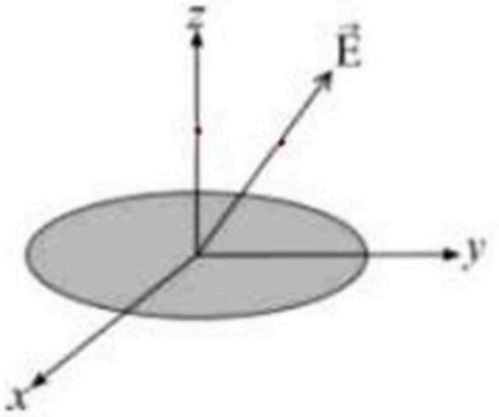
d) $E = \frac{2\sigma a}{\varepsilon_0 r}$

e) $E = \frac{\sigma(4\pi a^2)}{r^2}$



Past exams questions

10. A uniform electric field $\vec{E} = (12\,\hat{j} + 16\,\hat{k})$ N/C penetrates a circular surface of area 3.2 m^2 lies in the x-y plane as shown. The electric flux Φ_E (in N. m^2/C) through this surface is:



a) 51.2 b) 70.4 c) 89.6 d) 99.2 e) 128

Past exams questions

11. Two points (M) and (P) separated by 1.3 m in a uniform electric field E = 820 V/m directed along the *x-axis* as shown. The electric potential difference $(V_M - V_P)$ (in Volts) is

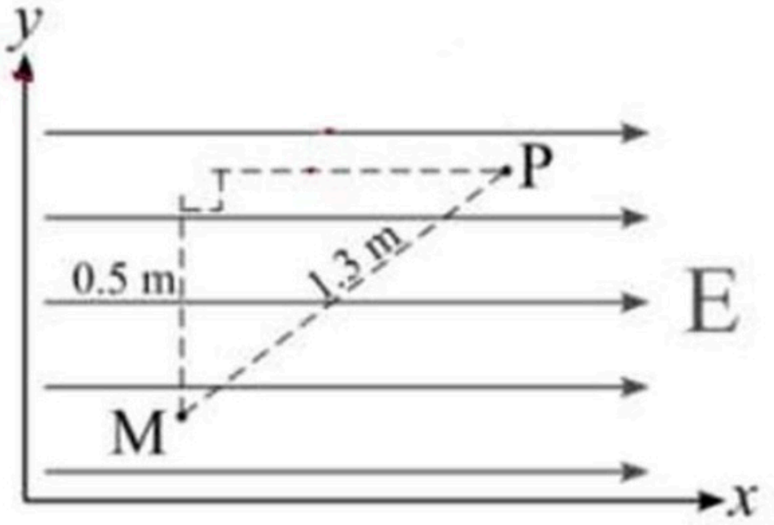
a) 396

b) 588

c) 696

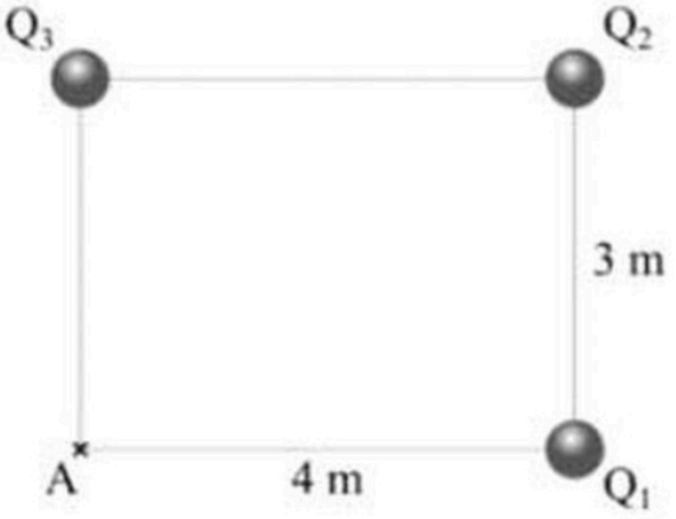
d) 852

e) 984



Past exams questions

12. Three-point charges $Q_1 = -16\ \text{nC}, Q_2 = +5\ \text{nC}$, and $Q_3 = +30\ \text{nC}$ are placed at the corners of the shown rectangle. The net electric potential (in V) at point (A) is:



a) 36 b) 45 c) 54 d) 63 e) 72

Past exams questions

13. A thin rod of length **2L** carries a uniform linear charge density +λ lies along the x-axis with its midpoint centered at the origin as shown. The **electric potential V** at point (A) a distance (**L**) from its right end, can be found by solving one of the following integrals:

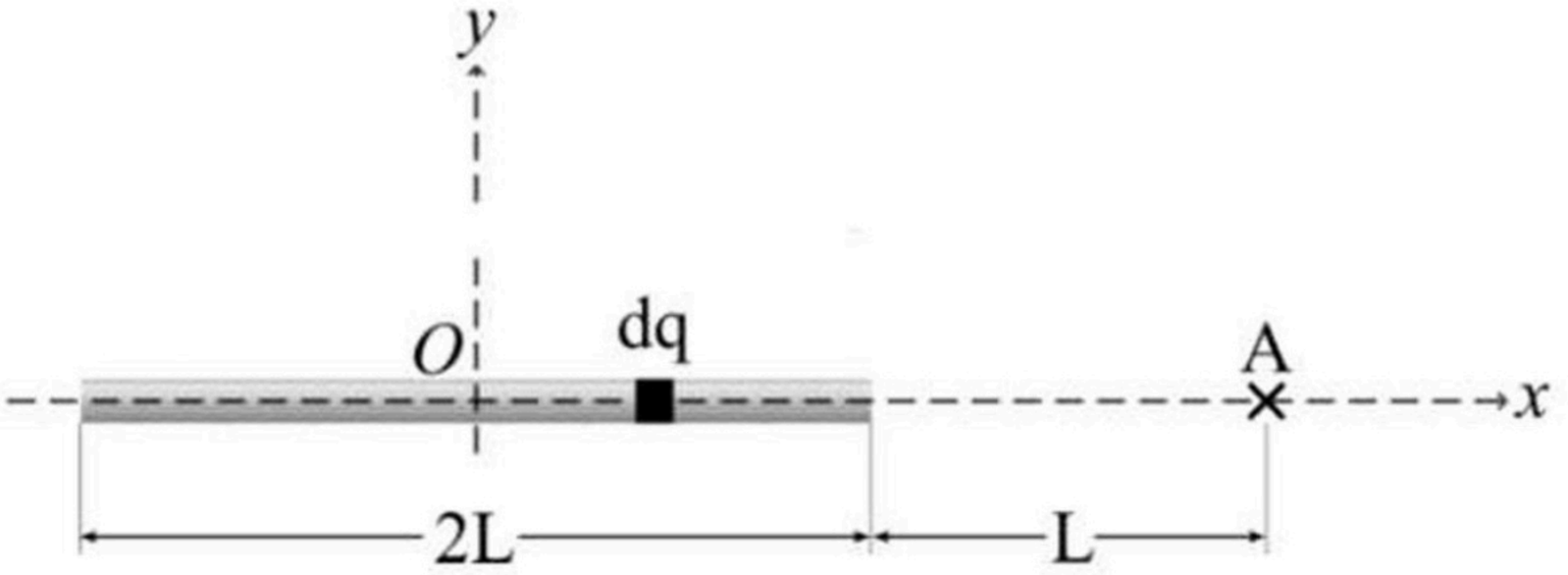
a) $V = \int_{L}^{3L} k \frac{\lambda dx}{(x+L)}$

b) $V = \int_{0}^{2L} k \frac{\lambda dx}{x^2}$

c) $V = \int_{-L}^{+L} k \frac{\lambda dx}{(2L-x)}$

d) $V = \int_{L}^{3L} k \frac{\lambda dx}{(x+L)^2}$

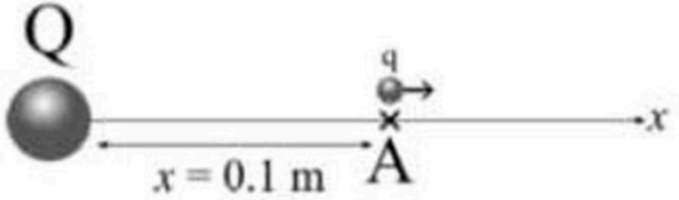
e) $V = \int_{L}^{3L} k \frac{\lambda dx}{x}$



Past exams questions

14. A point charge $Q = +4\ \mu C$ is fixed a distance $x = 0.1$ m from point A as shown in the figure. A charged particle of $q = 64$ nC and mass $m = 2 \times 10^{-7}$ kg is released from rest at point A and moves along *x-axis* to infinity. What is the ultimate speed (in m/s) of the particle at infinity?

a) 300 b) 480 c) 540 d) 600 e) 660

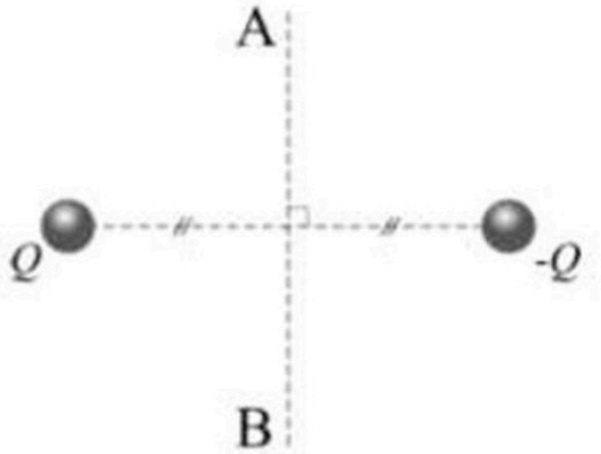


Past exams questions

15. All points on the perpendicular (AB) bisector of the line joining two equal but opposite charges have a potential of zero and Electric field of zero.

a) False

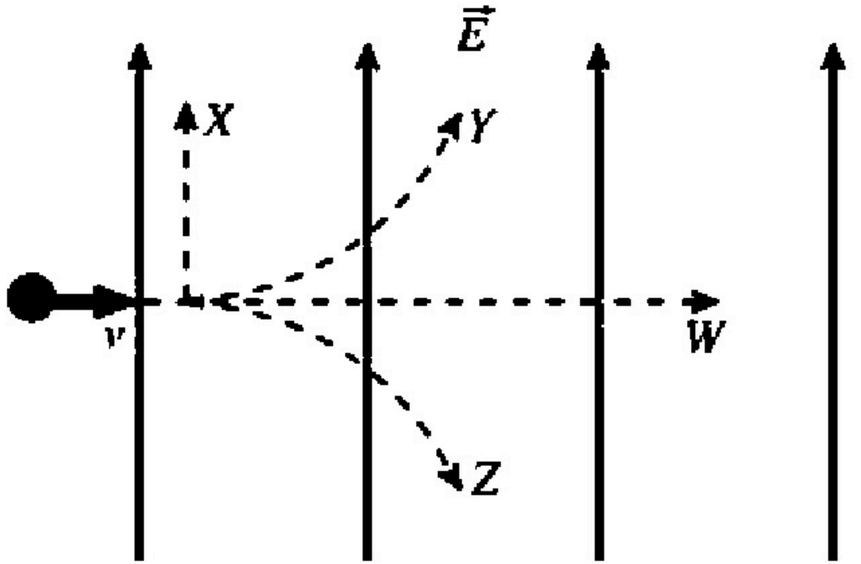
b) True



Past exams questions

1) An electron is initially moving to the right when it enters in **a uniform electric field directed upwards**. Which trajectory shown in the figure will the electron follow?

(a) trajectory W
(b) trajectory Z
(c) trajectory X
(d) trajectory Y
(e) none of them



Past exams questions

2) If two point charges Q_1 and Q_2 are placed inside a closed cubical box of side a. The net outward electric flux through the box is:

(a) $\Phi_E = 0$

(b) $\Phi_E = \frac{(Q_1+Q_2)}{\epsilon_0}$

(c) $\Phi_E = k_e \frac{(Q_1+Q_2)}{\epsilon_0 a^3}$

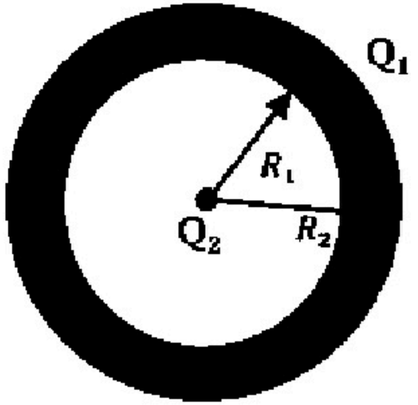
(d) $\Phi_E = k_e \frac{6\,(Q_1+Q_2)}{\epsilon_0}$

(e) $\Phi_E = 6 \frac{(Q_1+Q_2)}{\epsilon_0 a^3}$

Past exams questions

3) As shown in the figure, a conducting spherical shell with total charge $Q_1 = +5\mu C$. The outer and inner radii are R_1 and R_2, respectively. If a point charge $Q_2 = -3\mu C$ is placed at the center of the spherical shell. Which of the following statements is true?

(a) The charge on the outer surface of the spherical shell is $+5\mu C$.
(b) The charge on the inner surface of the spherical shell is $-3\mu C$.
(c) The total net charge of the spherical shell is $+8\mu C$.
(d) The charge on the inner surface of the spherical shell is $+3\mu C$.
(e) The total net charge of the spherical shell $+3\mu C$.



Past exams questions

4) In some region of space if the electric potential is $V(x,y,z) = 50x^2 - 10yz$. The electric field in this region must be:

(a) $\vec{E}(x,y,z) = -100x\hat{\imath} + 10z\hat{\jmath} - 10y\hat{k}$
(b) $\vec{E}(x,y,z) = 100x\hat{\imath} - 10z\hat{\jmath} - 10y\hat{k}$
(c) $\vec{E}(x,y,z) = -100x\hat{\imath} + 10z\hat{\jmath} + 10y\hat{k}$
(d) $\vec{E}(x,y,z) = -100x\hat{\imath} - 10z\hat{\jmath} + 10y\hat{k}$
(e) $\vec{E}(x,y,z) = 100x\hat{\imath} + 10z\hat{\jmath} + 10y\hat{k}$

Past exams questions

5) Consider three point charges located at the corners of a right triangle as shown in the figure below, where $q_1 = q_3 = +8.0\ \mu C$, $q_2 = -5.0\ \mu C$, and $a = 10.0$ cm. The resultant electrostatic force (in N) exerted on q_3 is:

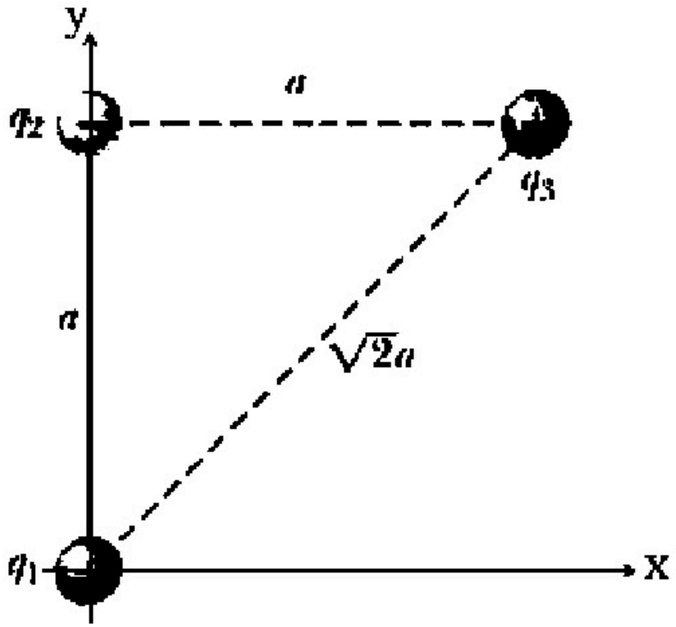
(a) $-15.6\hat{\imath} + 20.4\hat{\jmath}$

(b) $13.2\hat{\imath} + 20.4\hat{\jmath}$

(c) $20.4\hat{\imath} - 15.6\hat{\jmath}$

(d) $-15.6\hat{\imath} - 20.4\hat{\jmath}$

(e) $-20.4\hat{\imath} + 15.6\hat{\jmath}$



Past exams questions

6) Consider two points in a uniform electric field. The potential at point P_1 is $V_1 = -140.0$ V and the potential at point P_2 is $V_2 = 260.0$ V. How much work (in J) is required in moving a charge of -12.0 μC from point P_2 to P_1.

(a) 4.8×10^{-3}

(b) 4.8×10^{-6}

(c) 6.3×10^{-9}

(d) 6.3×10^{-3}

(e) 2.2×10^{-6}

Past exams questions

7) A Positive charge +Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2. A point charge +q is placed at the center of the shell. The magnitude of the electric field at a point outside the shell, a distance $r > R_2$ from the center, is:

(a) $k_e \frac{Q}{(R_1^2 - r^2)}$

(b) $k_e \frac{q}{R_1^2}$

(c) $k_e \frac{Q}{r^2}$

(d) $k_e \frac{(q+Q)}{(R_1^2 - r^2)}$

(e) $k_e \frac{(q+Q)}{r^2}$

Answer: *Based on Gausses Law:* $\Phi_E = \frac{\sum Q_{encl}}{\epsilon_0}$

$$\sum Q_{encl} = Q_1 + Q_2 = Q + q$$

$$\Phi_E = \oint E \cos\theta \, dA = \frac{\sum Q_{in}}{\varepsilon_0}$$

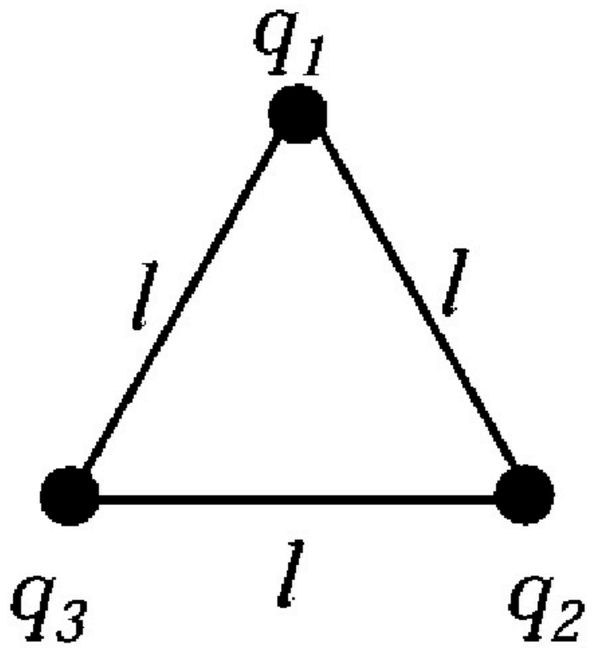
$$E(4\pi r^2) = \frac{q+Q}{\epsilon_0}$$

$$\therefore E = k_e \frac{(q+Q)}{r^2}$$

Past exams questions

8) Three point charges, $q_1 = 2.0\times10^{-9}$ C, $q_2 = 3.0\times10^{-9}$ C, and $q_3 = 4.0\times10^{-9}$ C, are located at the corners of an equilateral triangle with side length of l = 9.0 cm. The **total electrostatic potential energy** (in J) required to assemble the system is:

(a) 10.8×10^{-6}
(b) 1.8×10^{-3}
(c) 2.6×10^{-6}
(d) 12.6×10^{-12}
(e) 23.4×10^{-9}

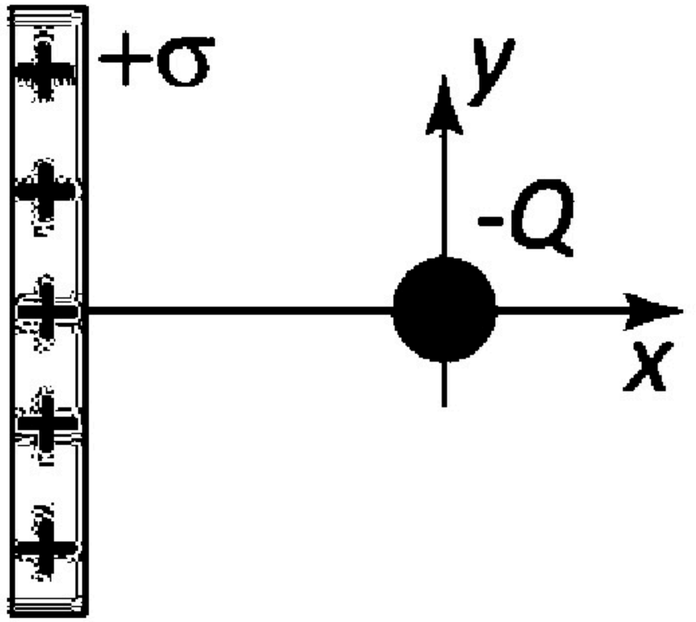


3

Past exams questions

9) An infinite plane sheet with a positive uniform surface charge density $\sigma = +2.0\ \mu C/m^2$ is located at some distance from a negative point charge $Q = -12.0\ \mu C$. At what distance $x > 0$ (measured from the point charge) is the total electric field produced by both charge distributions zero?

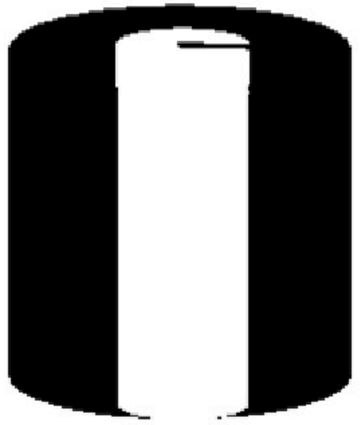
(a) 0.60 m
(b) 0.10 m
(c) 0.30 m
(d) 0.98 m
(e) 1.20 m



Past exams questions

10) A very long non conducting cylinder of radius 4.0 cm has a uniform volume charge density of 25.0 $\mu C/m^3$. What is the magnitude of the electric field (in N/C) at r = 2.0 cm, where r is the distance from the axis of the cylinder?

(a) 2.8×10^4
(b) 5.2×10^6
(c) 1.8×10^3
(d) 2.8×10^2
(d) 0.0



Past exams questions

11) A uniform line of charge of length L lying between x = 0 to x = L is charged with +Q. Which of the following gives the **x component** of the electric field at point P?

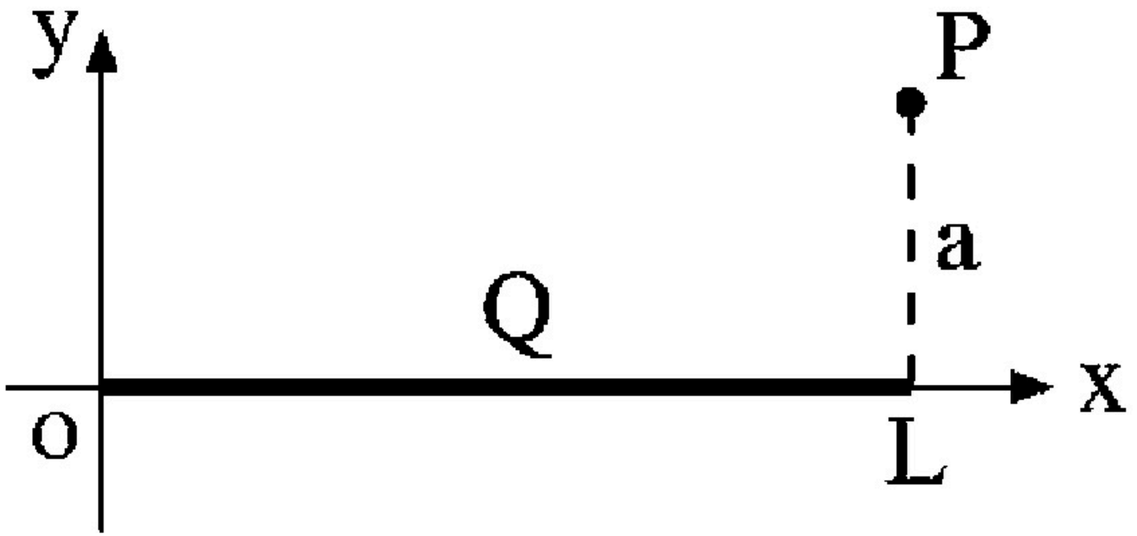
(a) $k_e \frac{Q}{L} \int_0^L \frac{dx}{[(L-x)^2+a^2]^{3/2}}$

(b) $k_e \frac{Q}{L} \int_0^L \frac{(L-x)dx}{[(L-x)^2+a^2]^{3/2}}$

(c) $k_e \frac{Q}{L} \int_0^a \frac{(L-x)dx}{[(L-x)^2+a^2]^{3/2}}$

(d) $k_e \frac{Q}{L} \int_0^L \frac{xdx}{[(L-x)^2+a^2]^{3/2}}$

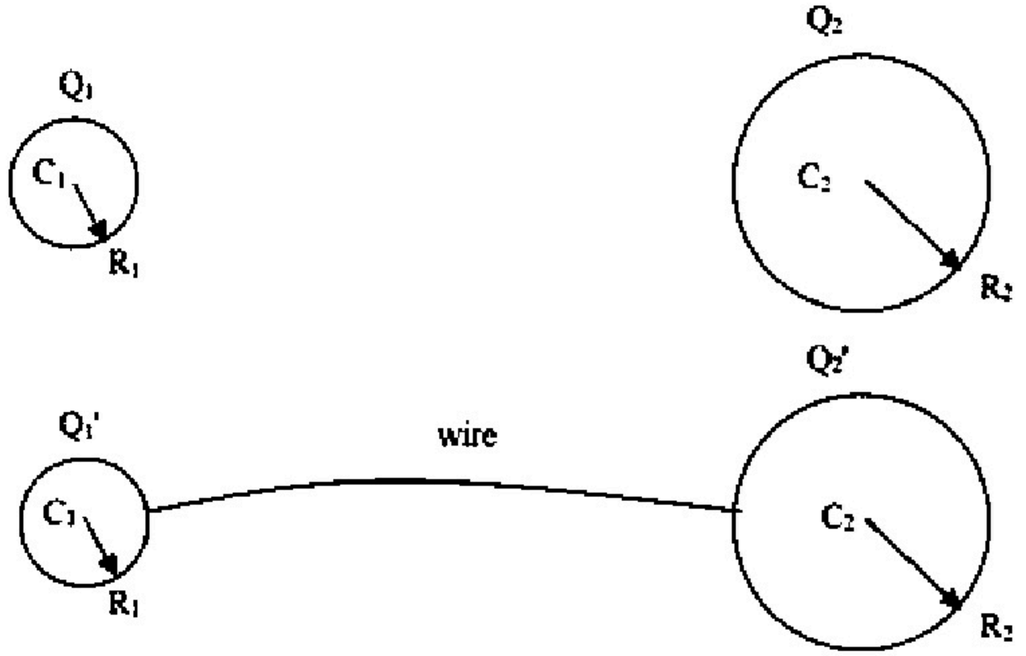
(e) $k_e \frac{Q}{L} \int_0^L \frac{adx}{[(L-x)^2+a^2]^{3/2}}$



Past exams questions

12) A total charge of $Q_1 = 1.2 \times 10^{-6}$ C is placed on a conducting sphere (sphere 1) of radius $R_1 = 3.0$ cm. At very far distance, a second conducting sphere (sphere 2) of radius $R_2 = 6.0$ cm with an initial net charge of zero ($Q_2 = 0$) is connected to sphere 1 using a very long thin metal wire. How much charge flows from sphere 1 to sphere 2 to bring the two spheres into electrostatic equilibrium.

(a) 400×10^{-9} C
(b) 800×10^{-6} C
(c) 400×10^{-9} C
(d) 600×10^{-6} C
(e) 800×10^{-9} C



بالتوفيق والنجاح

By: Sayed Ali Madan