University of Bahrain
College of Science
Dept. of Physics

PHYCS 102
Test One

Summer 02/03
Date: 20/7/2003
Time: 50 min.

Name:-- ID no.---------------------------------- Sec.no.--------

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Use: g = 10 m/s^2, $\varepsilon_o = 8.85\times10^{-12} C^2 / N.m^2$, K = 9 x 10^9 N.m^2/C^2

1) A point charge q_1 = 7 μC is located at the origin, and a second point charge q_2 = -5.0(-3.0, -2.0, -9.0) μC is placed at coordinates (30,0) cm. Calculate the magnitude of electric field (in N/C) at the point P, which has coordinates (0,40) cm.

a) 2.71 x 10^5 b) 3.13 x 10^5 c) 3.38 x 10^5 d) 2.36 x 10^5

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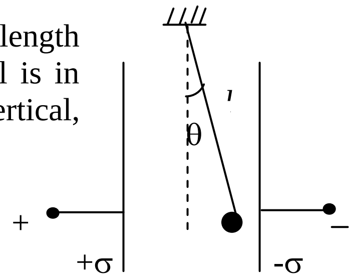
2) A small charged ball of mass 2 g and charge q = 5 nC hang from cord of length *l* = 15 cm is inserted between the two parallel charged plates. If the ball is in equilibrium when the cord makes a 5.0^o(7.0^o,9.0^o,12.0^o) angle with the vertical, what is the charge density (in μC/m^2) of each plate?



a) 3.1   b) 4.3   c) 5.6   d) 7.5

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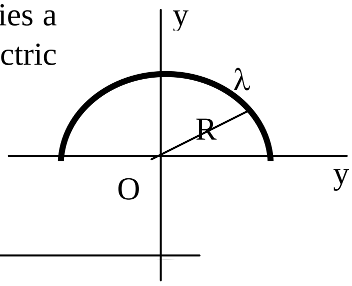
3) A thin rod bent in the shape of half circle of radius *R* = 10 (20,30,45) cm carries a uniform charge per unit length λ = 5 nC/m. Determine the magnitude of electric field (in N/C) at the origin O.



a) 900   b) 450   c) 300   d) 200

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4) Find the electrostatic field (in kN/C) at the surface of a charged insulating sphere of radius 10 cm and density 23.87 (26.58, 29.21, 31.87) μC/m^3.

a) 90   b) 100   c) 110   d) 120

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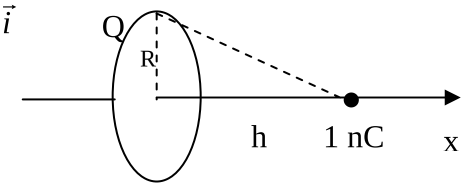
5) The x-axis is the symmetry axis of a uniformly charged ring of radius *R* = 30 cm and charge *Q* = 10 (5, 15, 20) μC. A point charge q = 1 nC and mass m = 0.1 g is placed on the x- axis at a distance h = 40 cm from the center of the ring. Find the acceleration (in m/s^2) of the point charge.

a) 2.88$\vec{i}$ b) 1.44$\vec{i}$ c) 4.32$\vec{i}$ d) 5.76$\vec{i}$



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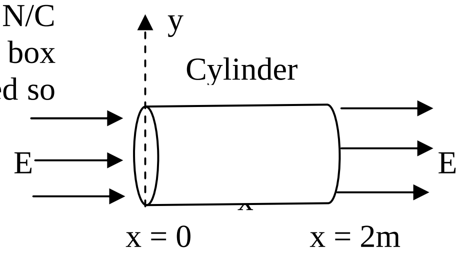
6) The magnitude of electrostatic field in the horizontal x direction increases from E = 800(600, 700, 900) N/C at x = 0 to E = 1000 N/C at x = 2 m. Determine the net charge (in nC) within a cylindrical box of radius 30 cm and length L = 2 m, where the cylinder is oriented so that the curved side is parallel to the field lines (fig.).



a) 0.5 b) 1.0 c) 0.75 d) 0.25

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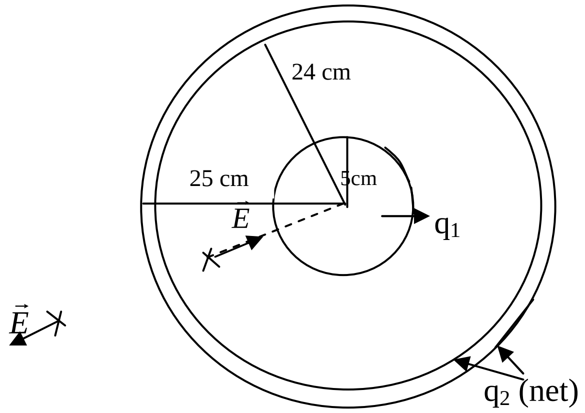
7) A solid, insulating sphere of radius 5.0 cm has a total charge q_1. Concentric with this sphere is a conducting hollow sphere whose inner and outer radii are 24.0 cm and 25.0 cm, respectively. The electric field at a point 10.0 cm from the centre is 3.6 kN/C radially inwards, while the electric field at a point 50 .0 cm from the centre is 0.2(0.1, 0.125, 0.15) kN/C radially outwards. Find the net charge (in nC) on the hollow conducting sphere.

a) 9.56 b) 6.78 c) 7.47 d) 8.17



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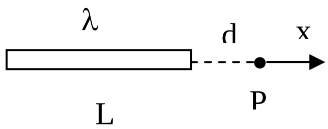
8) A rod of length L = 50 cm lies along the x-axis has a uniform charge density λ = 100 nC/m. Calculate the electric potential V (in volts) at the point "P" on the x-axis at a distance d = 10(15,20,25) cm from the rod's end.



a) 1612.5 b) 1319.7 c) 1127.5 d) 988.7

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9) A conducting sphere of radius 25 cm and charge 8 (10, 12, 14)nC. Find the potential difference (in volt) between the centre of the sphere "O" and point P at a distance 40 cm from "O".

a) 108 b) 135 c) 162 d) 189

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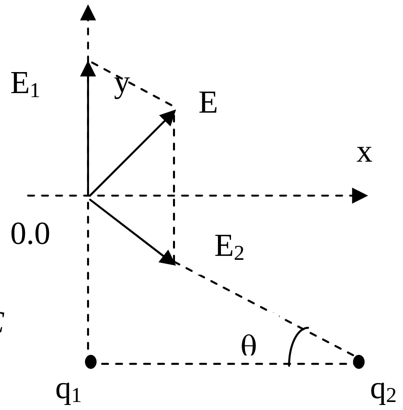
10) A 6 μC and –10 μC charges are placed 10 (12, 14, 18)cm apart. Find the position (in cm) from the positive charge where the potential is zero.

a) 3.75 b) 4.5 c) 5.25 d) 6.75

Good Luck

Solution for Test 1 **Summer 21-07-2003**

1)
$$E_1 = K\frac{q_1}{r_1^2} = 3.93\times10^5\,N/C$$
$$E_2 = K\frac{q_2}{r_2^2} = 1.80\times10^5\,N/C$$
$$\overrightarrow{E_1} = 3.93\times10^5\,\vec{j}\;\;N/C$$
$$\overrightarrow{E_2} = (1.08i - 1.44\vec{j})10^5\;N/C$$
$$\vec{E} = \overrightarrow{E_1} + \overrightarrow{E_2} = \left(1.08\vec{i} + 2.49\vec{j}\right)10^5\,N/C$$
$$\therefore E = 2.71\times10^5\,N/C$$



2)
$$\left.\begin{matrix} T\sin\theta = Eq \\ T\cos\theta = mg \end{matrix}\right\} E = \frac{mg\tan\theta}{q} = 4\times10^6\tan\theta = 3.5\times10^5\,N/C = \frac{\sigma}{E_o}\;\therefore \sigma = 3.1\mu C/m^2$$

3)
$$E = 2K\frac{\lambda}{R} = 1.8\times10^{11}.\lambda$$
$$\therefore E = 900N/C$$

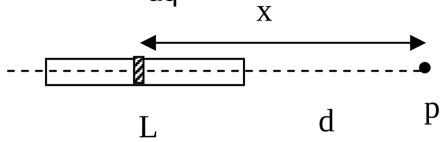
4)
$$E_{out} = K\frac{Q}{R^2},\;\; Q = \frac{4}{3}\pi R^3\;\;\rho = 100nC,\quad E_{out} = 90kN/C$$

5)
$$\vec{E} = K\frac{Qh}{r^3}\vec{i} = 288\times10^3\vec{i}\;\;N/C,\quad \vec{a} = \frac{q\vec{E}}{m} = 2.88\vec{i}\;\;m/s^2$$

6)
$$\phi = \phi_1 + \phi_2 = A\left(-800+1000\right) = \pi\left(0.3\right)^2 200 = 56.5 = \frac{q_{in}}{\varepsilon_o}$$
$$q_{in} = 0.5n\;C$$

7)
$$E_1 = k\;\frac{q_1}{r^2}\;,\; r = 0.1m\;,\;\; q_1 = 4nC\quad \therefore q_1 = -4nC$$
$$E_2 = k\;\frac{q_1+q_2}{r^2}\;,\; r = 0.5,\;\therefore q_1 + q_2 = 5.56\;nC\;\;\therefore q_2 = 9.56\;nC$$

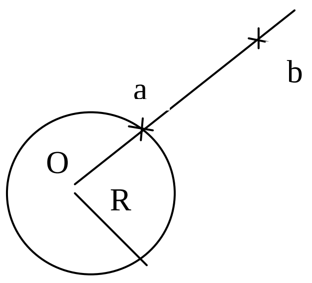
8)
$$V_p = \int_d^{d+L} K\frac{dq}{x} = K\lambda\quad \ell n\frac{L+d}{d}$$



V_p = 1612.5 V

9) $V_o - V_b = V_a - V_b = K\dfrac{Q}{R} - K\dfrac{Q}{r_b}$

= 108V



10) $V_p = k\left(\dfrac{6\mu}{x} - \dfrac{10\mu}{d-x}\right) = 0$

$x = \dfrac{6}{16}d = 3.75\ cm$