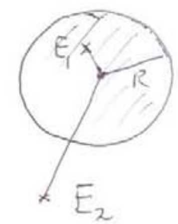
Physics 102Rec
Quiz#8
Chapter 23

Name: Key Id#: Sect#:

A **non-conducting** sphere of radius R = 10 cm carries a uniform charge density $\rho = 20 \times 10^{-4}\ C/m^3$. Find the electric field at

(a) r = 5 cm from the center of the sphere

$$E_1 = \frac{kQ}{R^3} r \qquad Q = \rho V = 20\times10^{-4} \times \frac{4}{3}\pi (0.1)^3 = 8.4 \times 10^{-6} C$$



$$E_1 = \frac{9\times10^9 \times 8.4\times10^{-6}}{(0.1)^3} \times (0.05) = \boxed{3.8 \times 10^6\ N/C}$$

(b) r = 12 cm from the center of the sphere

$$E_2 = \frac{kQ}{r^2} \quad (\text{like a point charge})$$

$$E_2 = \frac{9\times10^9 \times 8.4\times10^{-6}}{(0.12)^2} = \boxed{5.25 \times 10^6\ \frac{N}{C}}$$

(c) Calculate the electric flux through a spherical surface of radius r = 5 cm.

$$\phi = \frac{q_{encl}}{\varepsilon_0} = \frac{\rho V_{encl}}{\varepsilon_0} = \frac{20\times10^{-4} \times \frac{4}{3}\pi (0.05)^3}{8.85\times10^{-12}}$$

$$= \frac{1.05\times10^{-6}}{8.85\times10^{-12}} = \boxed{1.2 \times 10^5\ \frac{N}{C}\cdot m^2}$$

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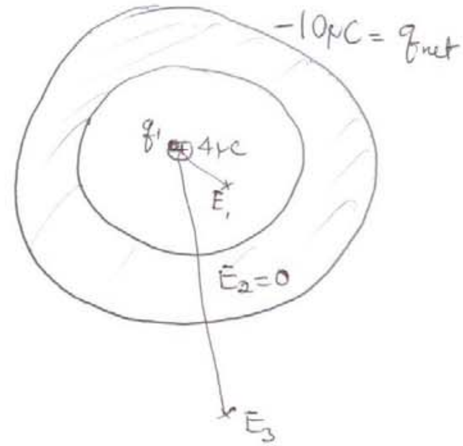
A positive point charge of ($q_1 =$) 4 μC is at the center of a **conducting** spherical shell whose inner radius is 4 cm and outer radius is 7 cm. The conducting shell carries a net charge of (q_2) −10 μC. Calculate;

(a) the magnitude of the electric field at **r = 2cm**, **r = 5cm** and **r = 10 cm** from the center of the center of the spherical shell.

$r_1 = 2cm$

$$E_1 = \frac{k q_1}{r_2} = \frac{9\times10^9 \times 4\times10^{-6}}{(0.02)^2} = 9\times10^8 \ \frac{N}{C} \text{ outward}$$



$r_2 = 5cm$ Inside the conductor

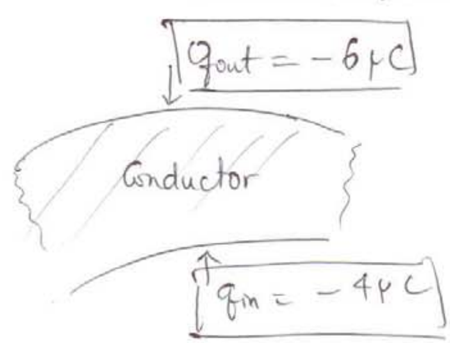
$E = 0$

$r_3 = 10cm$

$$E_3 = \frac{k(q_1+q_2)}{r_3^2} = \frac{9\times10^9 \times (4-10)\times10^{-6}}{(0.1)^2} = -5.4\times10^6 \ \frac{N}{C}$$

inward

(b) the **induced charge** on the inner and outer surfaces of the spherical shell.



$q_{in} + q_{out} = q_{net}$

$-4 - 6 = -10$ ✓

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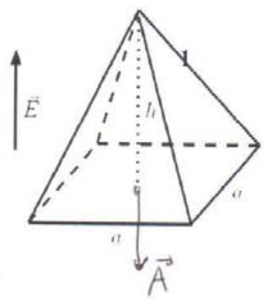
1. The figure shows a pyramid with horizontal square base, a = 4.0 m and a height h = 5.0 m. The pyramid is placed in a vertical electric of magnitude E = 100 N/C. If the pyramid does not include any charge inside, what is the electric flux through face 1?



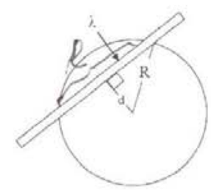
$\Phi_{sides} + \Phi_{base} = 0$ (No charge inside the pyramid)

$\Phi_{sides} = -\Phi_{base} = -(EA\cos 180°)$

$= +EA = +100 \times 16 = +1600\ \frac{N}{C}\cdot m^2$

$\Phi_{side1} = \frac{\Phi_{sides}}{4} = \boxed{400\ \frac{N}{C}\cdot m^2}$

2. The figure shows an infinitely long line charge having a charge density +2.0 μC/m. The line lies at a normal distance d = 3.0 cm from the center of a Gaussian sphere of radius R = 5.0 cm. Determine the total flus through the surface of the Gaussian sphere.



$l = 2\sqrt{R^2 - d^2} = 2 \times 4 = 8\ cm$

$\Phi = \frac{q_{encl}}{\varepsilon_0} = \frac{\lambda l}{\varepsilon_0} = \frac{2\times 10^{-6} \times 8 \times 10^{-2}}{8.85 \times 10^{-12}}$

$= \boxed{1.8 \times 10^{-6}\ \frac{N}{C}\cdot m^2}$