QUIZ8- CHAPTER 23
DATE: 26/03/20

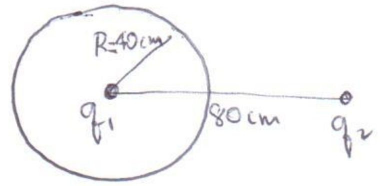
Name: Key Id#: Sect.#: 28 Serial#:

1. A point charge is at the center (0,0) of a conducting spherical shell with a radius of 40 cm. Another point charge of 2μC is located at r =80 cm. If the net flux through the surface of the sphere is –360 Nm^2/C, calculate the sign and value of the charge inside the sphere.

$$\Phi_{sphere} = \frac{q_{encl}}{\varepsilon_0} = \frac{q_1}{\varepsilon_0}$$

$$q_1 = \Phi_{sphere} * \varepsilon_0 = -360 \times 8.85 \times 10^{-12}$$

$$= \boxed{-3.2 \times 10^{-9}\ C}$$



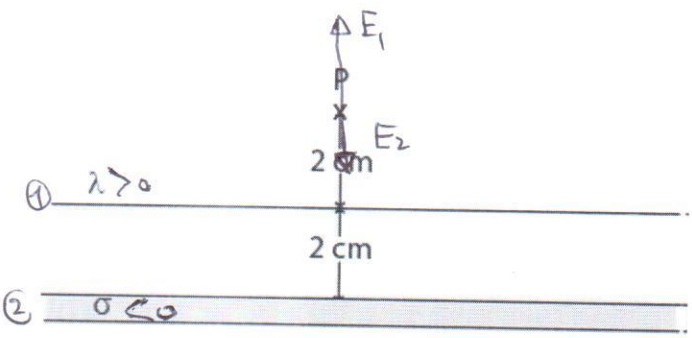
The charge q_2 has no effect in this question because it is NOT enclosed by the surface of the shell.

2. Consider an infinitely large non-conducting flat sheet carrying a uniform charge density σ = – 10 nC/m^2 and a long thin wire carrying a uniform charge density λ = +5.0 nC/m arranged as shown in the figure. Calculate the magnitude and direction of the net electric field due to these two charge distributions at point.

$$E_{net} = E_1 - E_2$$

$$|E_1| = \frac{2k\lambda}{r}$$

$$= \frac{2 \times 9 \times 10^9 \times 5 \times 10^{-9}}{0.02} = 4500\ \frac{N}{C}$$



$$|E_2| = \frac{\sigma}{2\varepsilon_0} = \frac{10 \times 10^{-9}}{2 \times 8.85 \times 10^{-12}} = 565\ \frac{N}{C}$$

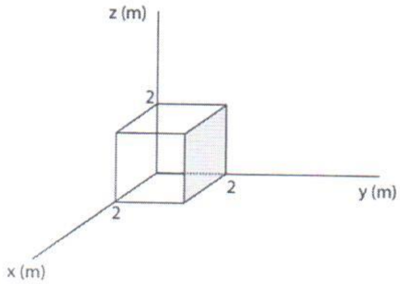
$$E_{net} = 4500 - 565 = \boxed{3935\ \frac{N}{C}}$$

positive y-axis.

QUIZ8- CHAPTER 23
DATE: 26/03/20

Name: Key Id#: Sect.#: 29 Serial#:

1. For the electric field **E** = (10 i + 20 y j) N/C, what is the electric flux through the top right (shaded) of the cube shown in the figure?



$$\phi = \int \vec{E} \cdot d\vec{A}$$

$$d\vec{A} = dx\,dz\,\hat{j}$$

$$\vec{E} \cdot d\vec{A} = (10\hat{i} + 20y\hat{j}) \cdot dx\,dz\,\hat{j}$$

$$= 20y\,dx\,dz$$

$$y = 2\,m \Rightarrow \vec{E} \cdot d\vec{A} = 40\,dx\,dz$$

$$\phi = 40 \int_0^2 dx \int_0^2 dz = 40 \times x\Big|_0^2 \times z\Big|_0^2 = 40 \times 2 \times 2$$

$$= \boxed{160\ \frac{N}{C} \cdot m^2}$$

2. A solid non-conducting sphere, of radius 4.0 cm, has a uniform charge density. What is the ratio of the magnitude of the electric field at a distance 2.0 cm from the center to the magnitude of the electric field at a distance of 10 cm from the center of the sphere E(2)/E(10)?

$r_1 = 2cm$ $\quad E_1 = \frac{kQ}{R^3} r_1$ $\quad$ inside the sphere

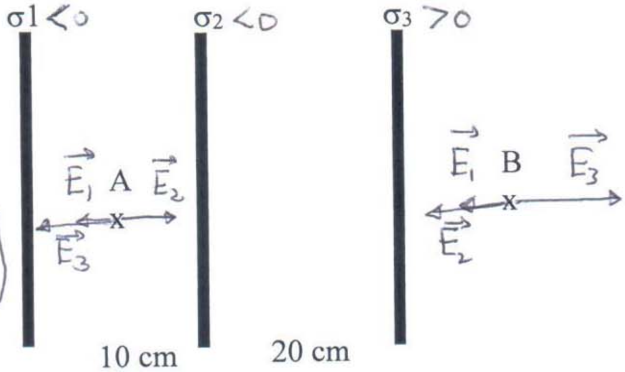
$r_2 = 10\,cm$ $\quad E_2 = \frac{kQ}{r_2^2}$ $\quad$ outside the sphere

$$\frac{E(2)}{E(10)} = \frac{kQ}{R^3} r_1 \times \frac{r_2^2}{kQ} = \frac{r_1 r_2^2}{R^3} = \boxed{3.1}$$

QUIZ8- CHAPTER 23
DATE: 26/03/20

Name: Key   Id#:   Sect.#: 30   Serial#:

1. Three large non-conducting sheets of charge densities, $\sigma_1 = -2\ \mu C/m^2$, $\sigma_2 = -5\ \mu C/m^2$ and $\sigma_3 = 10\ \mu C/m^2$ are shown in the figure. What is the **magnitude and direction** of the net electric field at point A midway between plate 1 and 2 and B 10 cm on the right of plate 3?



Point A: $E_{net} = E_2 - E_1 - E_3$

$$= \frac{|\sigma_2|}{2\varepsilon_0} - \frac{|\sigma_1|}{2\varepsilon_0} - \frac{|\sigma_3|}{2\varepsilon_0}$$

$$E_{net} = \frac{1}{2\times 8.85\times 10^{-12}}(-2+5-10)\times 10^{-6}$$

$$= -\frac{7\times 10^{-6}}{2\times 8.85\times 10^{-12}} = \boxed{-3.9\times 10^{5}\ \frac{N}{C}}$$

to the left

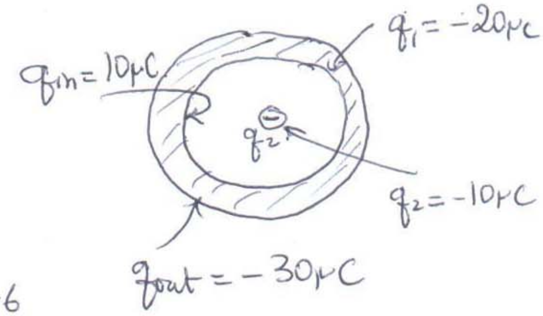
Point B: $E_{net} = E_3 - E_1 - E_2$

$$= \frac{|\sigma_3|}{2\varepsilon_0} - \frac{|\sigma_1|}{2\varepsilon_0} - \frac{|\sigma_2|}{2\varepsilon_0} = \frac{1}{2\times 8.85\times 10^{-12}}(10-2-5)\times 10^{-6}$$

$$E_{net} = \frac{3\times 10^{-6}}{2\times 8.85\times 10^{-12}} = \boxed{+1.7\times 10^{5}\ \frac{N}{C}}$$

to the right

2. A conducting spherical shell with a net charge -20 μC has an outer radius 10 cm and an inner radius 8 cm. A point charge -10 μC is placed at the center of the shell. What are the surface charge densities on the **inner** and **outer** surfaces of the shell?



$$\sigma_{in} = \frac{q_{in}}{4\pi R_{in}^2} = \frac{10\times 10^{-6}}{4\pi * (0.08)^2}$$

$$= \boxed{1.24\times 10^{-4}\ C/m^2}$$

$$\sigma_{out} = \frac{q_{out}}{4\pi R_{out}^2} = \frac{-30\times 10^{-6}}{4\pi * (0.1)^2}$$

$$= \boxed{-2.39\times 10^{-4}\ C/m^2}$$