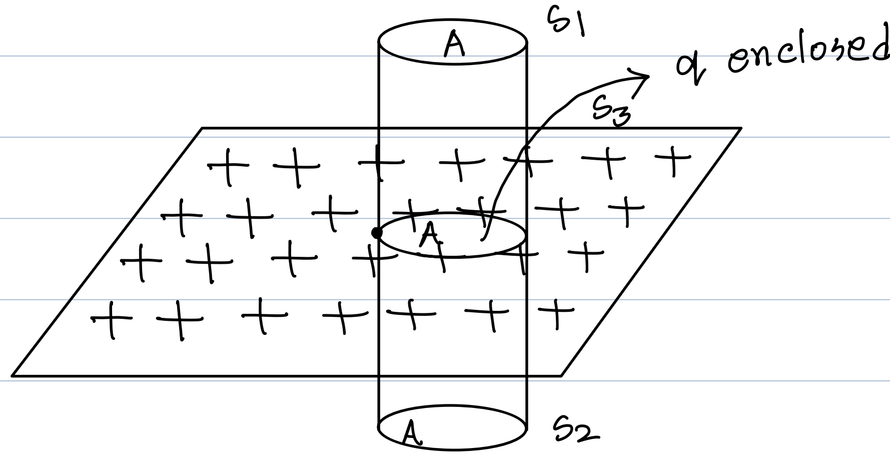


A positively charged infinite plane of sheet has charge density $\sigma = 2\times10^{-3}\ c/m^2$. What is the electric field at a height $z = 20\ cm$ from the surface of the infinite plane. (using Gauss law)

1) closed surface
2) Symmetric surface

$$\sigma = \frac{q_{closed}}{A}$$

$$\Rightarrow q_{closed} = \sigma A$$

$$\oint_S \vec{E}\cdot d\vec{A} = \frac{q_{closed}}{\epsilon_0}$$

$$\Rightarrow \int_{S1} \vec{E} \cdot \vec{dA} + \int_{S2} \vec{E} \cdot \vec{dA} + \int_{S3} \vec{E} \cdot \vec{dA}$$

$$= \frac{\sigma A}{\epsilon_0}$$

$$\Rightarrow \int_{S1} E dA + \int_{S2} E dA = \frac{\sigma A}{\epsilon_0}$$

$$\Rightarrow E \int_{S1} dA + E \int_{S2} dA = \frac{\sigma A}{\epsilon_0}$$

$$\Rightarrow EA + EA = \frac{\sigma A}{\epsilon_0}$$

$$\Rightarrow A(E+E) = \frac{\sigma A}{\epsilon_0}$$

$$\Rightarrow 2E = \frac{\sigma}{\epsilon_0}$$

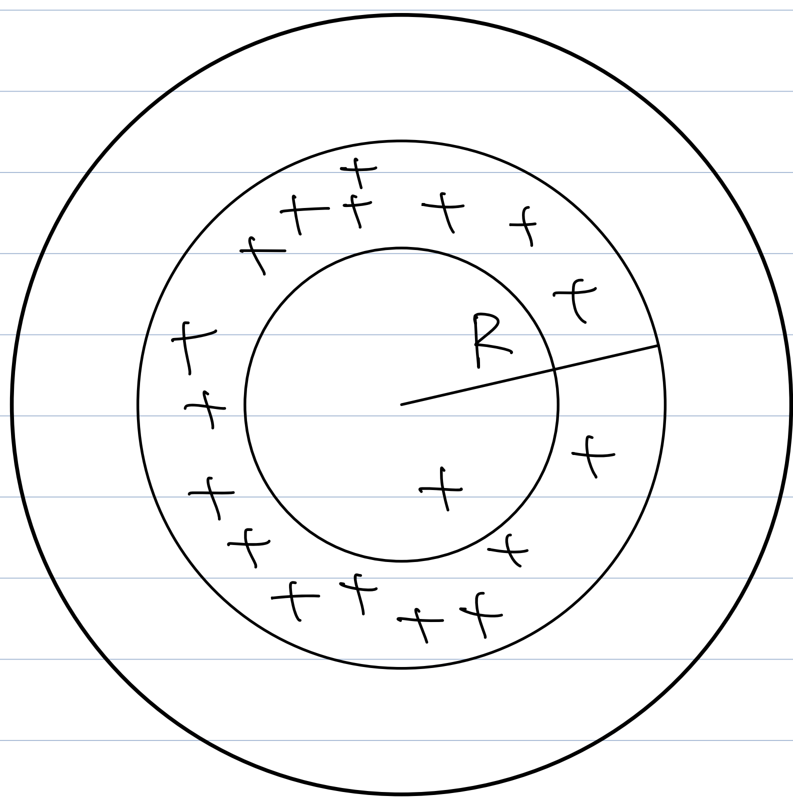
$$\therefore E = \frac{\sigma}{2\epsilon_0}$$

$$= 112943302.5$$

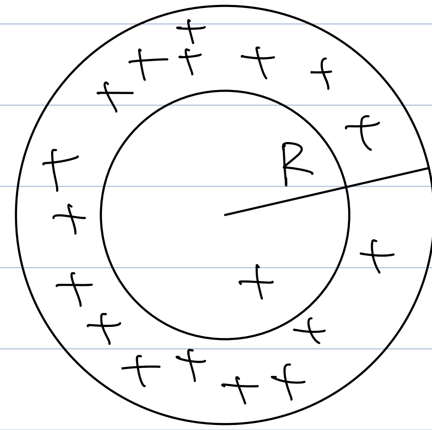
A sphere of radius 5 cm is filled with positive charges. The charges are uniformly distributed with a density $\rho = 3 \times 10^{-3}\ C/m^3$. What is the electric field at a) $r = 2\,cm$ from the center of a sphere?

b) $r = 5\,cm$

c) $r = 10\,cm$



$$\rho = \frac{Q}{4/3 \pi R^3}$$



$$\Rightarrow Q = \rho \, 4/3 \, \pi r^3$$

$R = 5 \, cm$

$$\oint_{S1} \vec{E} \cdot \vec{dA} = \frac{q_{closed}}{\epsilon_0}$$

$$\Rightarrow \int_{S1} E dA = \frac{Q r^3}{\epsilon_0 R^3}$$

$$\Rightarrow E \int_{S1} dA = \frac{Q r^3}{\epsilon_0 R^3}$$

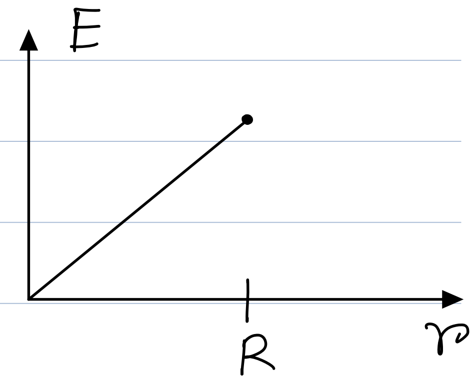
$$\Rightarrow E \cdot 4\pi r^2 = \frac{Q r^3}{\epsilon_0 R^3}$$

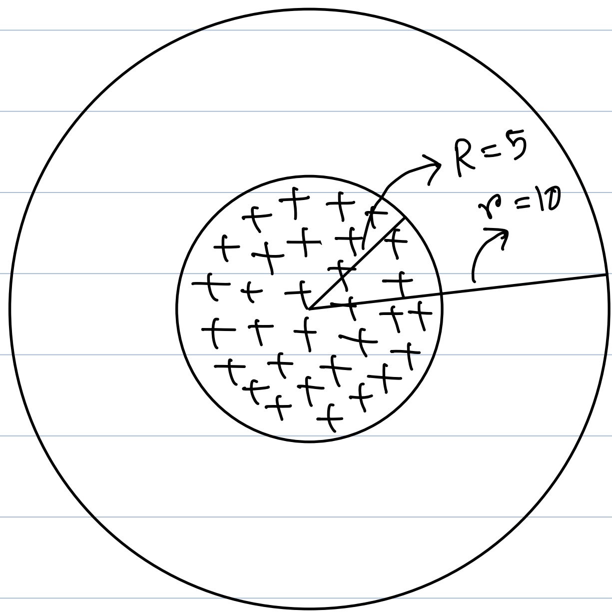
$$\Rightarrow E = \frac{Q r}{4\pi \epsilon_0 R^3} \quad r \leq R$$

$$\rho = \frac{Q}{4/3 \pi R^3} = \frac{q_{closed}}{4/3 \pi r^3}$$

$r = 2 \, cm$

$$\Rightarrow q_{closed} = \frac{Q r^3}{R^3}$$





S2

$$\int_{S2} E\,dA = \frac{Q}{\epsilon_0}$$

$$\Rightarrow E\int_{S} dA = \frac{Q}{\epsilon_0}$$

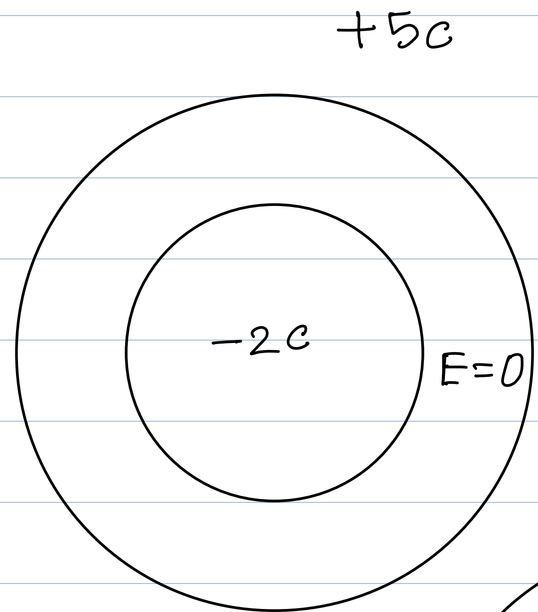
$$\Rightarrow E \cdot 4\pi r^2 = \frac{Q}{\epsilon_0}$$

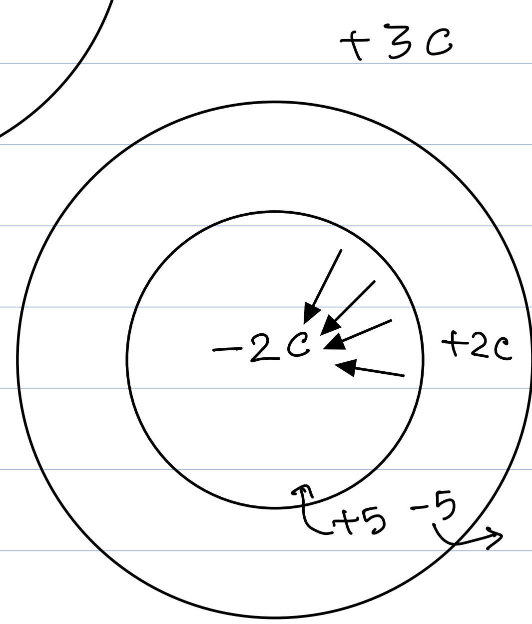
$$\Rightarrow E = \frac{Q}{4\pi\epsilon_0 r^2} \quad r \geq R$$

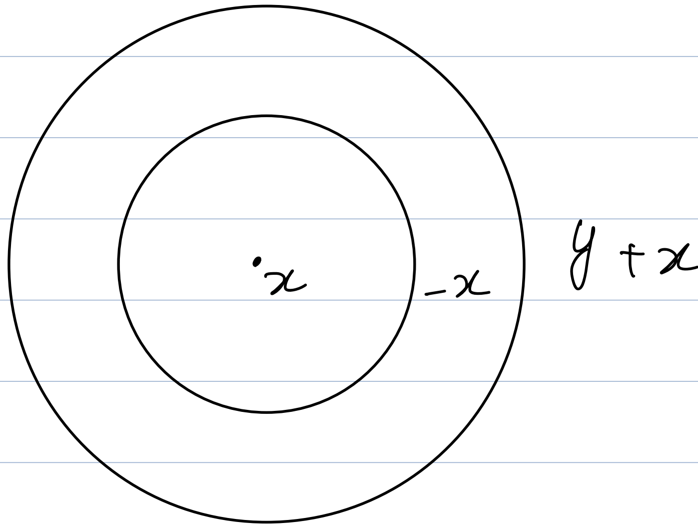
$$E = \frac{1}{4\pi\epsilon_0} \frac{Qr}{R^3} \quad r \leq R$$

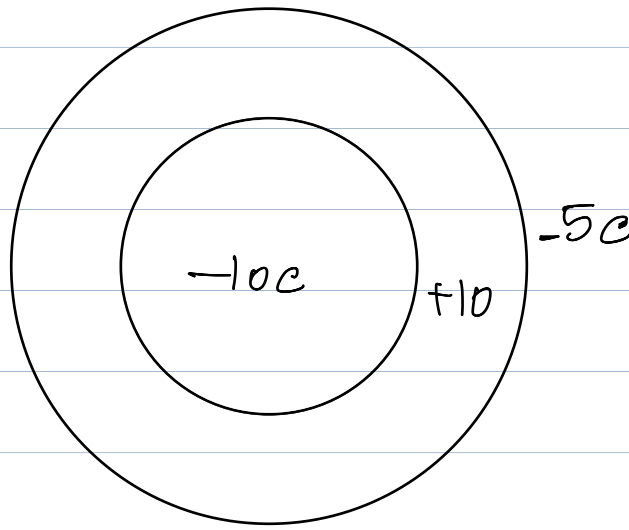
$$E = \frac{1}{4\pi\epsilon_0} \frac{Q}{R^2} \quad r \geq R$$

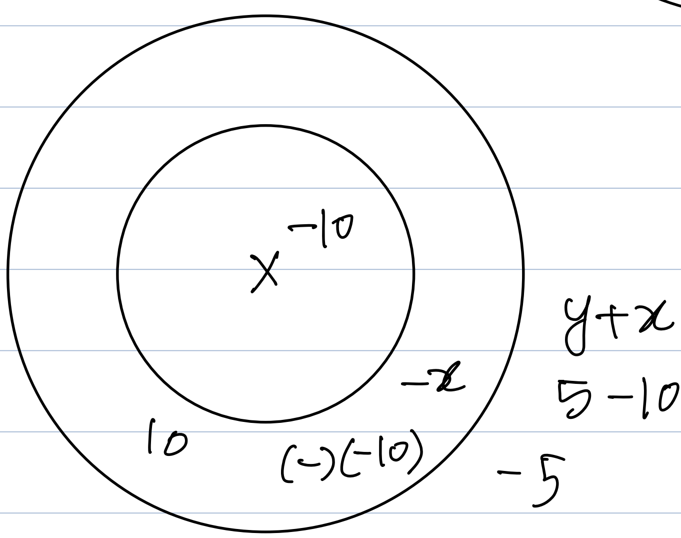
$$E = k_2/r^2$$






x
-x
y + x


-10c
+10
-5c


x⁻¹⁰
-x
10
(-)(-10)
-5
y+x
5-10