(1)

Problem 1: (11-05-50)

Na Cl

Singly charged, what force is between the ions

$d = 2.82 \cdot 10^{-10}\, m = 2.82\ \mathring{A}$

$e = 1.602 \cdot 10^{-19}\ C$

$k_e = 8.99 \cdot 10^{9}\ \frac{N \cdot m^2}{C^2}$

$$F = |\vec{F}| = \frac{1}{4\pi\epsilon_0} \frac{e^2}{d^2} = k_e \frac{e^2}{d^2}$$

$\rightarrow F = 2.901 \cdot 10^{-9}\ N \approx 2.90\ nN$

Problem 2: (11-05-66)

Two forces on a dust particle

$\vec{E} = 100\ N/C \left(= 100\ V/m \right)$

$\downarrow$ $\downarrow w$

$F_g = mg\ ,\ F_E = eE$

$m = 2.0 \cdot 10^{-15}\ g = 2.0 \cdot 10^{-18}\ kg$

$F_g = 1.96 \cdot 10^{-17}\ N$

$F_E = 1.602 \cdot 10^{-17}\ N$ } Comparable for e

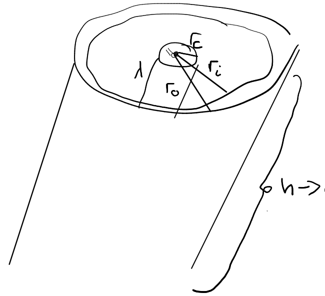
(2)

If charged $-e$

$$\rightarrow a = -g + \frac{e}{m} E = -9.81 + \frac{1.602 \cdot 10^{-19}}{2.0 \cdot 10^{-18}} 100$$

$$= -1.8\ m/s^2$$

Problem 3: (11-06-52)

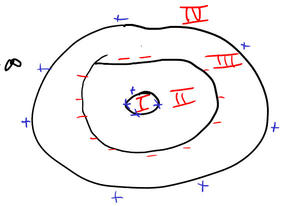


$r_o = 3.0\ cm$

$r_i = 2.0\ cm$

$r_c = 1.0\ cm$

$\lambda = \frac{4\,pC}{m}$



Use Gauß

$$\oint_S \vec{E} \cdot \hat{n}\, dA = \frac{q_{enc}}{\epsilon_0}$$

The symmetry of the cylinder makes the electrical field only to have a radial component

$$2\pi r E_r \cdot h = \frac{\lambda h}{\epsilon_0}$$

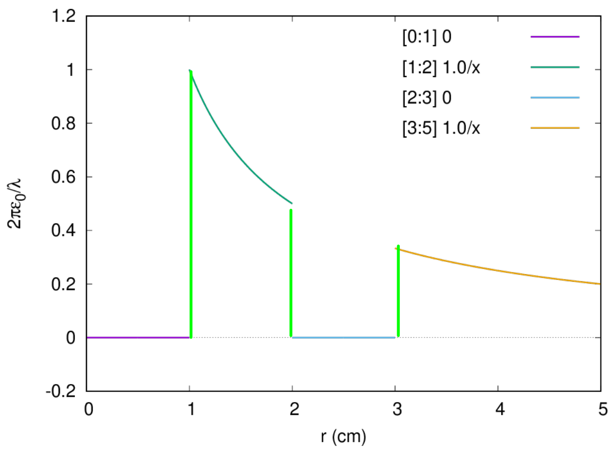
(3)

$\rightarrow$ (I) : $\vec{E} = 0$

(III) : $\vec{E} = 0$

In (II) and (IV) we have

$$\vec{E} = \frac{\lambda \hat{r}}{2\pi\epsilon_0 r}$$

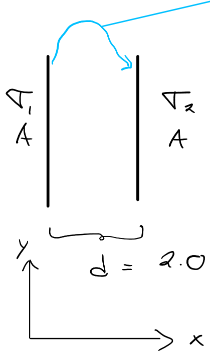


The green vertical lines are only to indicate the discontinuity of the electrical field at the metal surfaces, that are caused by the surface charge there

(4)

Problem 4: (11-06-68)

Two parallel plates



move $N_e = 1.0 \cdot 10^{12}$ electrons

Initially $\sigma_1 = \sigma_2 = 0$, but after the move of N_e

a) $\sigma_1 = + N_e \frac{e}{A}$

$\sigma_2 = - N_e \frac{e}{A}$

$$\rightarrow \vec{E} = \frac{\sigma_1}{\epsilon_0} \hat{x}$$

$$= - \frac{1 \cdot 10^{12} \cdot 1.602 \cdot 10^{-19}}{8.85 \cdot 10^{-12} \cdot 400 \cdot 10^{-4}} \hat{x}\ N/C$$

$$= -4.53 \cdot 10^{5}\, \hat{x}\ N/C = -4.53 \cdot 10^{5}\, \hat{x}\ V/m$$