P27:

Conservation of charge

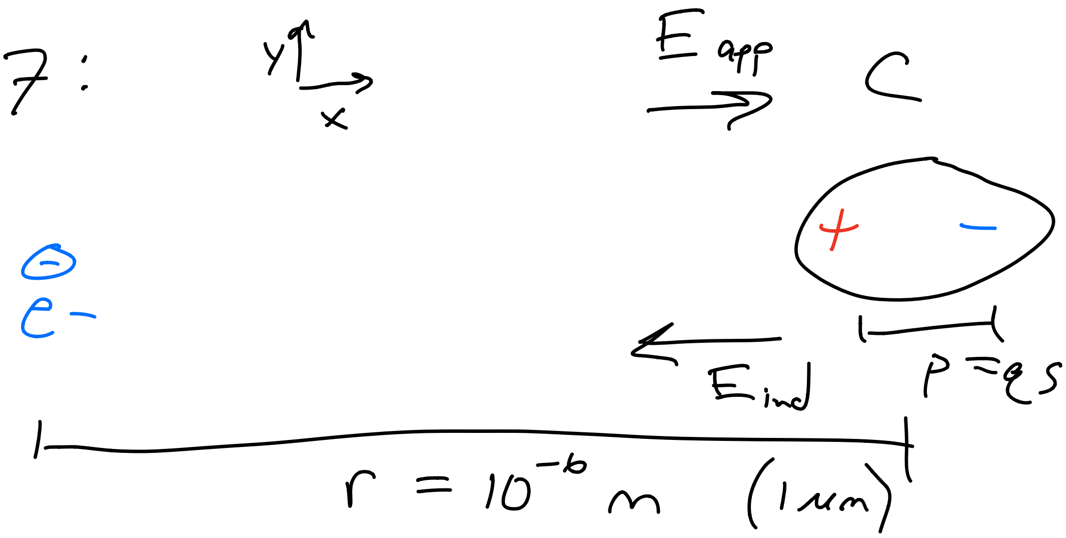
$$\Delta Q = 0$$

$$\Delta Q_{comb} + \Delta Q_{hair} = 0$$

$$\Delta Q_{hair} = -\Delta Q_{comb} = 4 \times 10^{-10} C$$

P30: 2 and 3 are both possible. Attraction could be due to opposite charge or polarization of neutral matter.

P37:



$$\vec{F}_e = q\vec{E}_{ind} = -e\vec{E}_{ind}$$

Force on electron due to induced field

$$\vec{E}_{ind} = \vec{E}_{dipole,\,on\,axis} = \frac{1}{4\pi\epsilon_0}\frac{2p}{r^3}(-\hat{x})$$

$$p = \alpha\left|\vec{E}_{app}\right| = \frac{1}{4\pi\epsilon_0}\frac{\alpha e}{r^2}\hat{x}$$

$$\vec{E}_{ind} = -\left(\frac{1}{4\pi\epsilon_0}\right)^2\frac{2\alpha e}{r^5}\hat{x}$$

$$\vec{F}_e = \left(\frac{1}{4\pi\epsilon_0}\right)^2\frac{2\alpha e^2}{r^5}\hat{x}$$

$$\vec{a} = \frac{\vec{F}_e}{m_e}$$

All #'s in base SI units

$$\vec{a} = \left(9\times10^{9}\right)^{2} \frac{2\left(1.96\times10^{-40}\right)\left(1.6\times10^{-19}\right)^{2}}{\left(10^{-6}\right)^{5}\left(9.11\times10^{-31}\right)} \hat{x}$$

$$\boxed{\vec{a} = 894 \ m/s^{2} \ \hat{x}}$$

$$\vec{a} \propto \frac{1}{r^5}$$

$$|\vec{a}_1| \propto \frac{1}{R^5} \ , \ |\vec{a}_2| \propto \frac{1}{(2R)^5}$$

$$\frac{|a_2|}{a_1} = \frac{R^5}{(2R)^5} = \frac{1}{2^5} = \frac{1}{32}$$

$$\boxed{a_2 = \frac{1}{32} a_1}$$

P41:

Since $\vec{E}=0$ inside the sphere, there is no polarization (c)

P44:

$$v = u E$$

$$E = \frac{v}{u} = \frac{3.7\times10^{-7}}{8.1\times10^{-8}} = 4.57\,\frac{N}{C}$$

P45:

(1) ✗ ($E=0$ means $v=0$, equilibrium)

(2) ✗ (Not all circumstances, only equilibrium)

(3) ✓ (Equilibrium $\Rightarrow v=0 \Rightarrow E=0$)

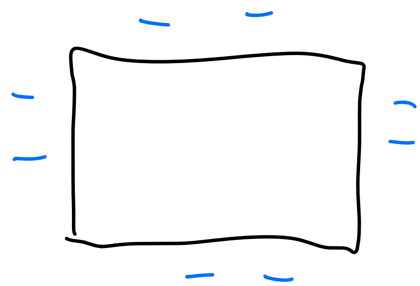
(4) ✗ (The field from the charge is there, but is cancelled by the induced field: $\vec{E}_{tot} = \vec{E}_{app} + \vec{E}_{ind} = 0$)

(5) ✗ (Equilibrium: $v=0$)

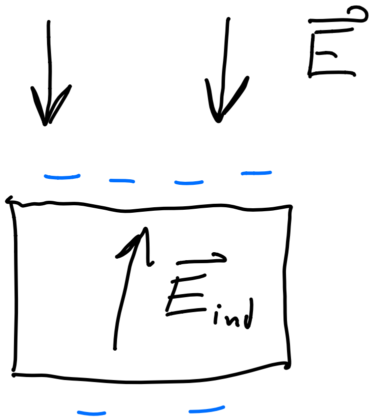
P 47:

initially

1)

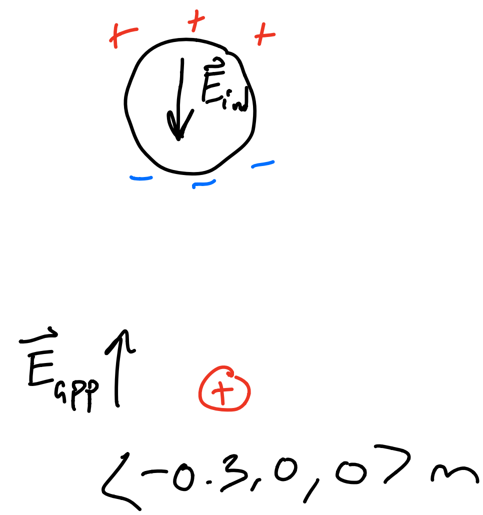


2)



C

P 56:



In equilibrium, $\vec{E}_{net} = \vec{E}_{app} + \vec{E}_{ind} = 0$

so $\vec{E}_{ind} = -\vec{E}_{app}$

$\vec{E}_{app}$ = field of pt charge

$$\vec{E}_{app} = \frac{1}{4\pi\epsilon_0} \frac{q}{|\vec{r}|^2} \hat{r}$$

$$\vec{r} = \langle 0, 0.07, 0 \rangle - \langle -0.3, 0, 0 \rangle$$

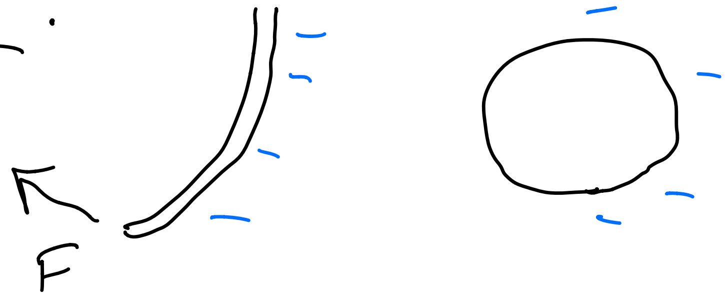
$$\vec{r} = \langle 0.3, 0.07, 0 \rangle$$

$$q = 6 \times 10^{-8}\ C$$

$$\vec{E}_{app} = \langle 5541.35, 1292.98, 0 \rangle \frac{N}{C}$$

$$\vec{E}_{ind} = -\vec{E}_{app} = -\langle 5541.35, 1292.98, 0 \rangle \frac{N}{C}$$

P62:



(1) ✗ electrons can't leave my body, because my shoes are insulators

(2) ✓

(3) ✓

(4) ✗ Cl ions are negative

(5) ✓ Body is a conducting surface

(6) ✗ Same as (4)

(7) ✓

P63:

a) $Q_A = \frac{1}{2} Q = 2.5\,nC$

b) (3) only electrons are mobile