Physics 2 - HW 2 Solution

Problem 1

(a) Since

$$\tau = PE\sin\theta \quad , \quad \theta = 0^\circ (\text{for parallel})$$

$$\tau = qdE\sin\theta \quad , \quad p = qd$$

$$\tau = (2e)(d)E\sin\theta$$

$$\tau = (2\times 1.6\times 10^{-19})(0.78\times 10^{-9})(3.4\times 10^{6})\sin\theta$$

$$\boxed{\tau = 0}$$

(b)

$$\theta = 90^\circ \quad , \quad \sin 90^\circ = 1$$

$$\tau = (2\times 1.6\times 10^{-19})(0.78\times 10^{-9})(3.4\times 10^{6})$$

$$\boxed{\tau = 8.5\times 10^{-22} N.m}$$

(c)

$$\tau = 0 \quad , \quad since \quad \theta = 180^\circ, \quad \sin 180^\circ = 0$$

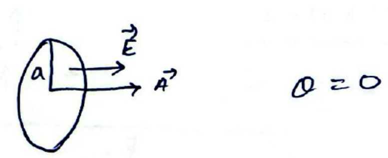
Problem 2

Flur through the entire Surface (net) = Flux through netting + Flux through the circular area.

Since

$$\phi = EA\cos 0^\circ = EA$$

$$\phi = (0.003)(\pi a^2) = 1.1\times 10^{-4}\frac{N.m^2}{C}$$



Flux through the netting must be equal and opposite to flux through the circular disk.

$$\boxed{\Phi_{\text{netting}} = -1.1 \times 10^{-4} \frac{N.m^2}{C}}$$

Problem 3

Since

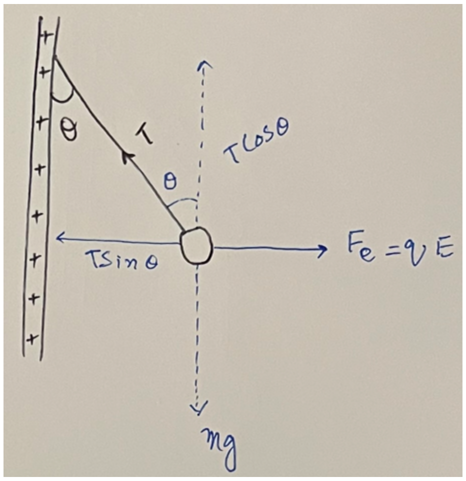
$$\sigma = \frac{q}{A}$$

in this case

$$\delta = \frac{q}{4\pi r^2} = \frac{2 \cdot 4 \times 10^{-6}}{4 \times 3 \cdot 14 \times \left(\frac{1.3}{2}\right)^2}$$

$$\boxed{\sigma = 4 \cdot 5 \times 10^{-7}\,\text{C/m}^2}$$

Problem 4



From the figure

$$E_e = T\sin\theta$$

$$qE = T\sin\theta$$

$$E = \frac{T\sin\theta}{q}$$

$$E = \frac{\delta}{2\epsilon_0}$$

$$\Rightarrow \frac{\delta}{2\epsilon_0} = \frac{T\sin\theta}{q}$$

$$\delta = \frac{2\epsilon_0 T\sin\theta}{q}$$

As

$$T\cos\theta = mg \Rightarrow T = \frac{mg}{\cos\theta}$$

$$\delta = \frac{2\epsilon_0 mg\sin\theta}{q\cos\theta}$$

$$\delta = \frac{2\epsilon_0 mg\tan\theta}{q}$$

$$\delta = \frac{2(8.85\times10^{-12})(1\times10^{-3})(9.8)(\tan 30^\circ)}{2\times10^{-8}}$$

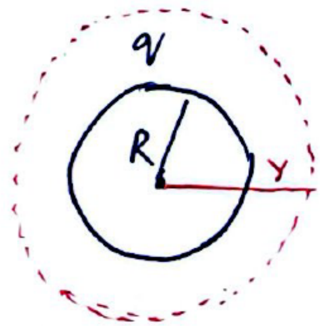
$$\boxed{\delta = 5\times10^{-6}\ \mathrm{C/m^2}}$$

Problem 5

$$\oint E.dA = \frac{q_{enc}}{\epsilon_0}$$

$$E(4\pi r^2) = \frac{q}{\epsilon_0}$$

$$\boxed{E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}}$$



problem 6

a) If the radius of the Gaussian surface get doubled the flux remains the same.

b) Since

$$\Phi = EA$$

$$\Phi = \frac{\kappa q}{r^2} 4\pi r^2$$

$$q = \frac{\Phi}{4\pi\kappa}$$

$$q = -\frac{750}{4 \times 3.14 \times 9 \times 10^9}$$

$$\boxed{q = -6.63 \times 10^{-9} C}$$