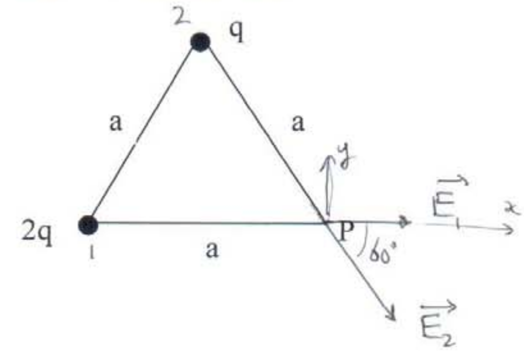
Physics 102Rec
Quiz#7
Chapter 22

Name: Key   Id#: ______   Sect#: ______

Two point charges, q and 2q (where q = 1 μC) are located at the vertices of an equilateral triangle of side a = 5 cm as shown in the figure. Determine the magnitude and direction of the net electric field at point P.



$$E_1 = \frac{k(2q)}{a^2} = \frac{9\times10^9 \times 2\times10^{-6}}{(0.05)^2}$$

$$= 7.2\times10^6 \ \frac{N}{C}$$

$$E_2 = 3.6\times10^6 \ \frac{N}{C}$$

$$E_{net,x} = E_1 + E_2 \cos 60°$$

$$= 7.2\times10^6 + 3.6\times10^6 \times \cos 60° = 9\times10^6 \ \frac{N}{C}$$

$$E_{net,y} = -E_2 \sin 60° = -3.1\times10^6 \ \frac{N}{C}$$

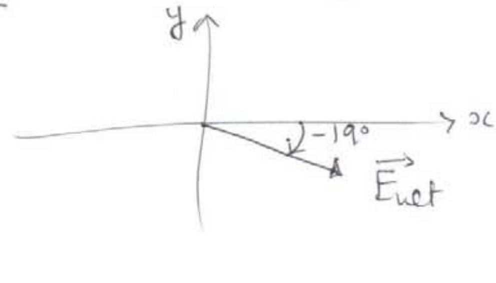
$$\vec{E}_{net} = ~~3.1\times10^6\ \hat{i} + 9\times~~$$

$$= 9\times10^6\ \hat{i} - 3.1\times10^6\ \hat{j} \quad \frac{N}{C}$$

<u>magnitude:</u> $|\vec{E}_{net}| = \sqrt{(9\times10^6)^2 + (-3.1\times10^6)^2}$

$$= 9.5\times10^6 \ \frac{N}{C}$$

<u>direction:</u> $\theta = \tan^{-1}\left(\frac{-3.1}{9}\right) = -19°$



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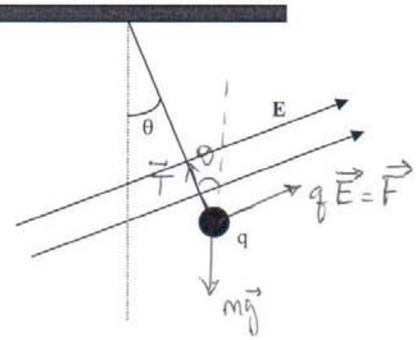
A charged plastic ball of mass 1 g is suspended on a light string in the presence of a uniform electric field given by **E** = (3**i** + 5**j**) x 10^5 N/C. The ball is in equilibrium when $\theta = 40^o$. Find the charge on the ball.



x – axis:

$$qE_x - T\sin\theta = 0$$

$$q \times 3\times10^5 - T\sin 40^\circ = 0 \quad (1)$$

y – axis:

$$qE_y + T\cos\theta - mg = 0$$

$$q\times5\times10^5 + T\cos40^\circ - 0.0098 = 0 \quad (2)$$

$$(1) \Rightarrow T = \frac{3q\times10^5}{\sin 40^\circ} = 466717\,q$$

$$(2) \Rightarrow 5q\times10^5 + 466717\,q \times 0.766 - 0.0098 = 0$$

$$q(857526) = 0.0098$$

$$\Rightarrow \boxed{q = 1.14\times10^{-8}\ C}$$

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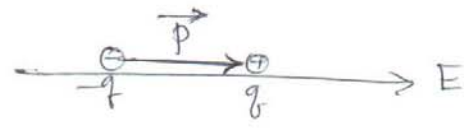
An electric dipole, consisting of charges of magnitude 2.0 μC separated by 6.0 μm, is an electric field of strength 1000 N/C. Initially the dipole is parallel the field.

(a) What is the torque on the dipole in this orientation?

$\vec{\tau} = \vec{p} \times \vec{E}$



magnitude $\tau = pE \sin\theta$, Here $\theta = 0°$

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

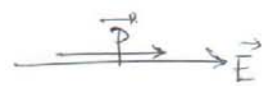
(b) How much work is required to rotate the dipole from parallel to antiparallel to the field?

$W_{app} = \Delta U = U_f - U_i$

$U_f = -pE\cos\theta_f$ $\theta_f = 180°$

$= pE$

$U_i = -pE\cos\theta_i$ $\theta_i = 0°$



$= -pE$

$W_{app} = 2pE = 2 \times qd \times E$

$= 2 \times 2\times10^{-6} \times 6\times10^{-6} \times 1000 = \boxed{2.4\times10^{-8}\ J}$