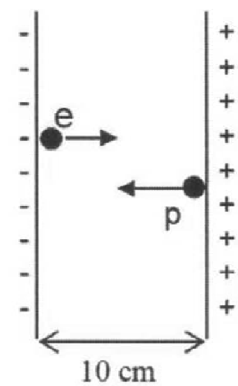
QUIZ7- CHAPTER 22
DATE: 19/03/20

Name: Key   Id#:   Sect.#: 28   Serial#:

1. Two large metal plates are 10.0 cm apart and have a uniform electric field between them as shown in the figure. An electron is released from rest from the negative plate at the same time a proton is released from rest from the positive plate. Find the ratio of the distance covered by the electron to that of proton when they pass each other (de/dp).



$$d_e = \frac{1}{2} a_e t^2 \qquad d_p = \frac{1}{2} a_p t^2$$

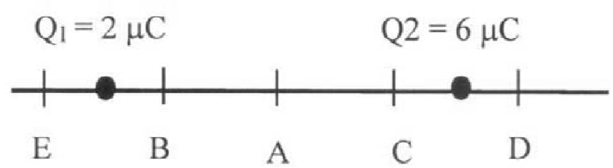
the time is the same for both particles

$$\frac{d_e}{d_p} = \frac{\frac{1}{2} a_e t^2}{\frac{1}{2} a_p t^2} = \frac{a_e}{a_p} = \frac{eE}{m_e} \times \frac{m_p}{eE} = \frac{m_p}{m_e}$$

$$\frac{d_e}{d_p} = \frac{1.67\times10^{-27}}{9.1\times10^{-31}} = \boxed{1835}$$

2. (a) At which point can the electric field due to the two charges shown in the figure be zero? Why? The distance between any two ticks is 10 cm.

Without calculation, the point is close to B. Closer to the smaller charge in magnitude and between the charges.



(b) Calculate the magnitude and direction of the electric field at point A.

At point A: $\overleftarrow{E_2}\ A\ \overrightarrow{E_1}$

$$E_{net} = E_1 - E_2 = \frac{k q_1}{r_1^2} - \frac{k q_2}{r_2^2} = 9\times10^{9}\left(\frac{2\times10^{-6}}{(0.15)^2} - \frac{2\times10^{-6}}{(0.15)^2}\right)$$

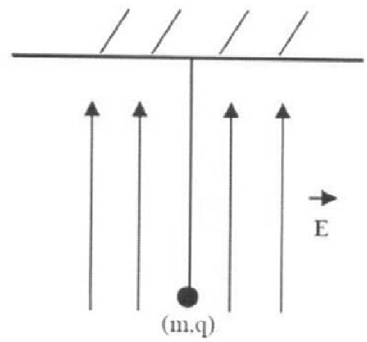
$$= -1.6\times10^{6}\ \frac{N}{C}$$

to the left because $E_2 > E_1$.

QUIZ7- CHAPTER 22
DATE: 12/03/20

Name: Key Id#: Sect.#: 29 Serial#:

1. In the figure, a 0.3 g metallic ball hangs from an insulating string in a vertical electric field of 4000 N/C directed upward as shown. The tension in the string is 0.005 N. What is the magnitude and sign of the charge on the ball?



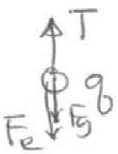
$F_g = mg = 2.94 \times 10^{-3}$ N

$T = 5 \times 10^{-3}$ N

Since $T > F_g \Rightarrow F_e$ is downward

$\Rightarrow \boxed{q < 0}$

Free body diagram



$T - F_g - F_e = 0$

$$F_e = T - F_g = |q|E \Rightarrow |q| = \frac{T - F_g}{E}$$

$$|q| = \frac{(5 - 2.94) \times 10^{-3}}{4000} = \boxed{5.2 \times 10^{-7}\,C}$$ magnitude

$$\boxed{q < 0}$$

2. Consider an electric dipole with charge q of magnitude 16×10^{-18} C, separated by a distance of 1.0×10^{-9} m. The dipole is placed in an electric field of strength 2.4×10^5 N/C. Calculate the required work to rotate the dipole from its stable equilibrium position to the unstable equilibrium position. Who does the work in this case? Why?

stable equil. $\theta_i = 0$
unstable equilib. $\theta_f = 180°$

~~$\vec{\tau} = \vec{p} \times \vec{E}$ magnitude $\tau = pE\sin$~~ $U = -\vec{p} \cdot \vec{E} = -pE\cos\theta$

$W_{app} = \Delta U = U_f - U_i = pE(\cos\theta_i - \cos\theta_f)$

$W_{app} = qdE(\cos\theta_i - \cos\theta_f) = 16 \times 10^{-18} \times 1 \times 10^{-9} \times 2.4 \times 10^5 \times (\cos 0 - \cos 180°)$

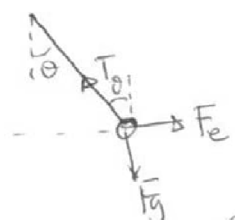
$$\boxed{W_{app} = 7.68 \times 10^{-21}\,J}$$

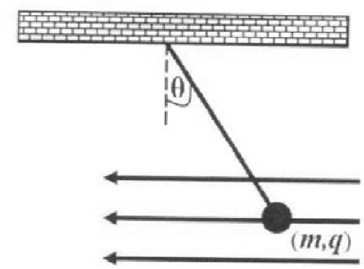
Since $W_{app} > 0$ the work is done by external

QUIZ7- CHAPTER 22
DATE: 19/03/20

Name: Key Id#: Sect.#: 30 Serial#:

1. The figure shows a charged ball of mass $m = 1.0$ g suspended by a light string in the presence of a uniform electric field of magnitude 3.0×10^5 N/C. In this field, the ball is in equilibrium at $\theta = 37^0$. What is the value and sign of the charge q?





equilibrium: $T \sin\theta - F_e = 0$ $\quad T \sin\theta = |q|E$

$T \cos\theta - F_g = 0$ $\quad T \cos\theta = mg$

$$\tan\theta = \frac{|q|E}{mg} \Rightarrow |q| = \frac{mg\tan\theta}{E} = \boxed{2.46 \times 10^{-8}\ C}$$

the charge is negative because it moved in a direction opposite to $\vec{E}$.

2. Consider an electric dipole with charge q of magnitude 16×10^{-19} C, separated by a distance of 1.0×10^{-9} m. The dipole is placed in an electric field of strength 2.4×10^5 N/C. Calculate the magnitude of the torque exerted on the dipole when the dipole moment makes and angle of 60^0 with the direction of the field.

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

magnitude $\tau = pE\sin\theta$ and $p = qd$

$$\tau = qdE\sin\theta = 16\times10^{-19} \times 1\times10^{-9} \times 2.4\times10^{5} \times \sin 60^\circ$$

$$= \boxed{3.33 \times 10^{-22}\ N\cdot m}$$