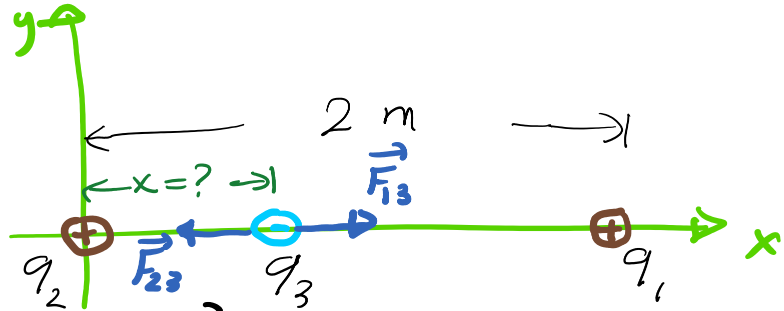
Lecture 5 (12-1)

Thursday, March 4, 2021 12:01 PM

Ex 23.3: $q_1 = 15\,\mu C$

$q_2 = 6\,\mu C$

$\vec{F}_3 = 0$



$$\vec{F}_3 = 0 \Rightarrow \vec{F}_3 = \vec{F}_{13} + \vec{F}_{23} = 0$$

$$\Rightarrow \vec{F}_{13} = -\vec{F}_{23} \Rightarrow |\vec{F}_{13}| = |\vec{F}_{23}|$$

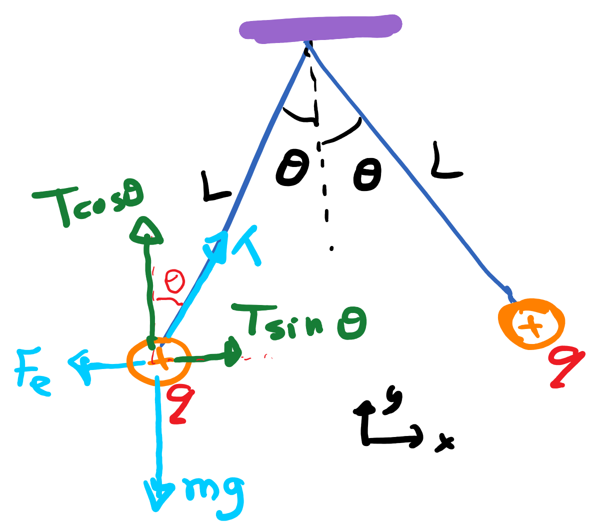
$$\Rightarrow \cancel{k_e}\frac{|q_1|\cancel{|q_3|}}{(2-x)^2} = \cancel{k_e}\frac{|q_2|\cancel{|q_3|}}{x^2} \Rightarrow \dots \Rightarrow \boxed{x = 0.775\ m}$$

Ex 23.4: $m = 3\times10^{-2}$ kg

$L = 0.15$ m

$\theta = 5^\circ$

$|q| = ?$



Equilibrium $\Rightarrow$

$\hookrightarrow \sum F_x = \sum F_y = 0$

$$\sum F_x = 0 \Rightarrow T\sin\theta - F_e = 0 \Rightarrow T\sin\theta = F_e \rightarrow (1)$$

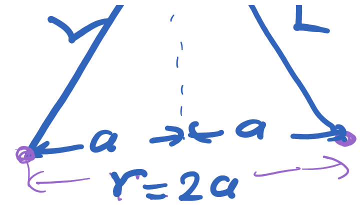
$$\sum F_y = 0 \Rightarrow T\cos\theta - mg = 0 \Rightarrow T\cos\theta = mg \rightarrow (2)$$

$$\frac{Eq(1)}{Eq(2)} \Rightarrow \tan\theta = \frac{F_e}{mg} \rightarrow (3)$$

$F_e = ?$

$$F_e = k_e\frac{|q||q|}{r^2} \quad , r = ?$$

$F_e = k_e \frac{|q||q|}{r^2}$, $r = ?$



But $\sin\theta = \frac{a}{L} \Rightarrow a = L\sin\theta$

$\Rightarrow r = 2a = 2L\sin\theta$

$$\boxed{F_e = k_e \frac{|q|^2}{4L^2\sin^2\theta}}$$

into eqn (3)

$$\Rightarrow \tan\theta = k_e \frac{|q|^2}{4mgL^2\sin^2\theta} \Rightarrow \cdots \Rightarrow \boxed{|q| = 4.42\times10^{-8}C}$$

$\boxed{T = ?} \rightarrow T\cos\theta = mg \Rightarrow T = \frac{mg}{\cos\theta}$

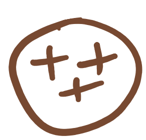
$$\Rightarrow \boxed{T = 29.5\times10^{-2}N}$$

23.4 Electric Field

Remember → Gravitational Field

$$\vec{F_g} = m\vec{g} = -mg\hat{j}$$

Q



source charge

q_0 → test charge (+)

$\vec{E}$ → electric field

The electric field at a point is the electric force acting on a positive test charge (q_0) placed at that point divided by q_0.

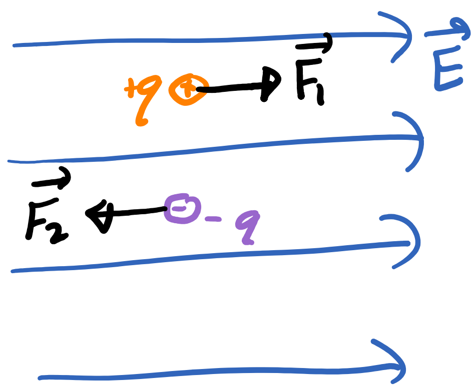
$$\Rightarrow \vec{E} = \frac{\vec{F_e}}{q_0}$$

by q_0. $\Rightarrow \vec{E} = \frac{\vec{F_e}}{q_0}$

• Assume we have an arbitrary point charge q placed near a source charge instead of q_0. $\Rightarrow \vec{E} = \frac{\vec{F_e}}{q}$

$\Rightarrow \boxed{\vec{F_e} = q\vec{E}}$

$\vec{F_g} = m\vec{g}$



• If q is $(+) \Rightarrow \vec{F_e}$ same direction of $\vec{E}$

• If q is $(-) \Rightarrow \vec{F_e}$ opposite to $\vec{E}$