General Physics 204, Section ... Monday, Jan 26, 2015
Quiz #1 Coulomb's Law & Electric Field

Name:

1) CLASS(3)
Francis Hauksbee puts two small aluminum foil balls, with the same mass $m = 1.0 \times 10^{-3}$ kg, at the end of two pieces of strings with length $l = 10$ cm. He then hangs them from somewhere, then charges them, touching by a charged plastic rod. He observes that the balls move away from each other and stop. He then measures the distance between them $d = 12$ cm. See fig. 1.

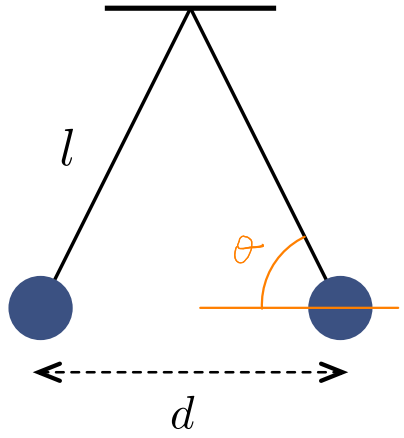
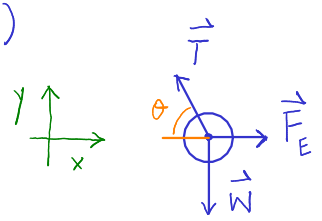


Figure 1: Charged balls of aluminum foil.

a) Draw a free body diagram for the ball on the right. Name the forces with letters, and in a table explain what each letter represents. **[3 pts]**
b) Use your knowledge from mechanics. Calculate each one of the forces. **[3 pts]**
c) Can you find the charge on each foil? Find the multiplication of the charges; the unit is C^2.**[4 pts]**

a)



$\vec{T}$: tension force
$\vec{W}$: weight force
$\vec{F}_E$: Electric force

b) The directions are as above.
We call the magnitudes T, W, F_E (no $\vec{\cdot}$ sign).

$W = mg = 1.0 \times 10^{-3}\ kg \times 10\ m/s^2 = 1.0 \times 10^{-2}\ N.$

equilibrium $\Rightarrow \vec{F} = 0 \rightarrow$
$\hat{x}: F_E - T\cos\theta = 0$ (i)
$\hat{y}: T\sin\theta - mg = 0$ (ii)

(ii) $\rightarrow T = \frac{mg}{\sin\theta} = \frac{5}{4}mg$ (ii')

(i), (ii') $\rightarrow F_E = mg\cot\theta = \frac{3}{4}mg.$

c) No. We can only say $F_E = k\frac{Q_1 Q_2}{d^2}$,

$\rightarrow Q_1 Q_2 = \frac{F_E d^2}{k} = \frac{3}{4}\frac{mgd^2}{k}$
$= 1.6 \times 10^{-14}\ C^2.$

2) PHORUM(weekend)
Make a narrow water stream. Charge a plastic rod and bring it close to the stream.
a) Water is neutral. How come? Explain it to me. I only understand Coulomb's Law. [Resolved]
b) To show our theory is correct, give me an estimation of the charge on the rod. Model the rod as a point charge and each water molecule as a dipole. What information do you need? What measurements you need to do?