TEST QUESTIONS (EXAM 1) 2nd INSTALLMENT.

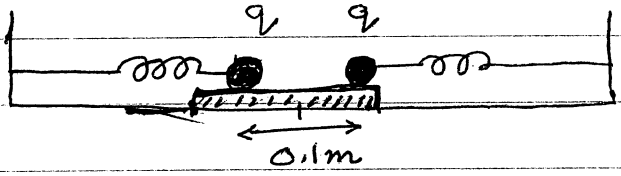
1. Show that the Equation

$$\vec{F}_E = k_e \frac{Q_1 Q_2}{r^2} \hat{r}$$

is consistent with Newton's 3rd Law of Motion.

2. A charge of $1\mu C$ is located at $x=0$ and a charge of $25\mu C$ is located at $x = 6m$. Where would you place a charge of $-5\mu C$ so that it experiences no force?

3. The picture shows two equal (q) charges attached to two identical springs with spring constants $10^3 N/m$. They are in equilibrium when they are 0.1 m apart and each spring is squeezed by the same amount. Calculate q. (Neglect friction)

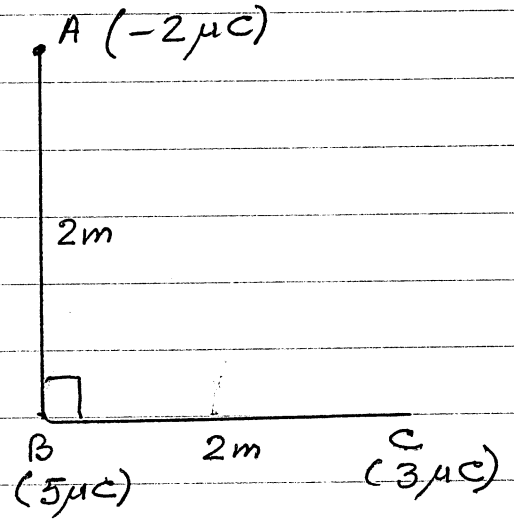


4. How would your answer to prob 2 change if the third charge was $+5\mu C$?

5. A charge of $+20\mu C$ is sitting at rest at $r=0$. A particle carrying a charge $-q$ is going around it in a circular orbit of radius r. What is the speed of the $-q$ particle if its mass is m?

6. Which $\underset{\rightarrow}{E}$ field is larger: $\underset{\rightarrow}{E}$ which is at a point 3m from a charge of $9\mu C$ or one at a point 1m from a charge of $-1\mu C$? Why?

7. The picture shows three charges fixed at A, B and C. What is the total force on the charge at A?



8. Two equal charges Q are located at $(-a, 0)$ and $(+a, 0)$. Show that if a charge q is placed at $(0, y)$ it will experience a force only in the y-direction.

9. For prob 8 the precise formula for the force on q is

$$\vec{F}_E = \frac{2qQy}{(a^2+y^2)^{3/2}}\hat{y}$$

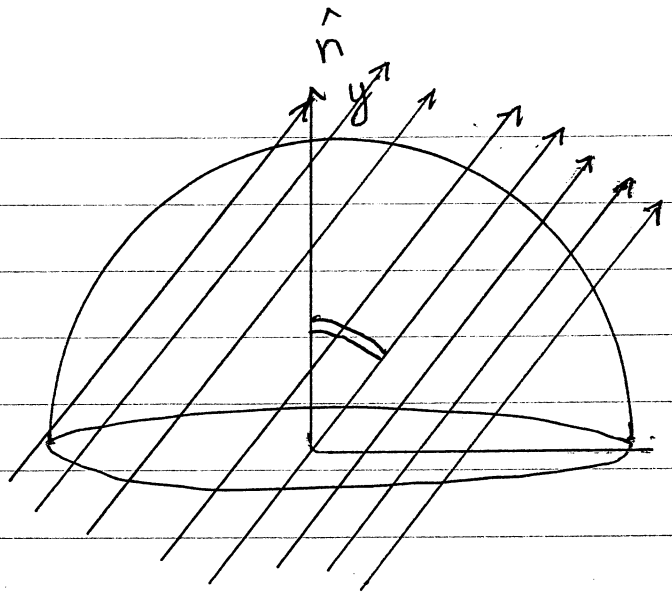
If now you replace q by $-q$ and make $y \ll a$ what will be the motion of the charge $-q$ [Neglect gravity]?

10. The electron and proton both carry the same charge $-$ or $+$ 1.6×10^{-19}C. Which force will be larger: a) force between two electrons or b) force between an electron and a proton when the separation is the same in both cases.

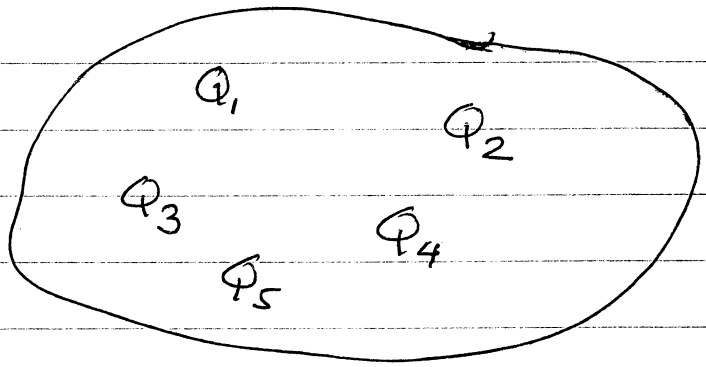
11. You are asked to design a whistle to produce sound at 500Hz in its fundamental mode. If the speed of sound is 340m/s what is the length of the whistle?

12. State Gauss' Law in your own words.

13. The picture shows a hemisphere of radius 2m and the lines represent an $\vec{E}$ field of 100 N/C inclined at 60° with respect to the y-axis. What is the flux of $\vec{E}$ through the dome (curved top) of the sphere? [$\hat{n} \parallel \hat{y}$].



14 The picture shows a closed surface the charges inside being $Q_1 = 1\mu C$, $Q_2 = 2\mu C$, $Q_3 = -3\mu C$, $Q_4 = 10\mu C$, $Q_5 = -10\mu C$. What is the total flux of the $\vec{E}$-field through the surface? What can you say about the $\vec{E}$-field on the surface? Justify your answers.



15. How do your answers to Prob 14 change if $Q_5 = -5\mu C$? Why?