

TEST QUESTIONS (EXAM 1)

1. Show that the Equation

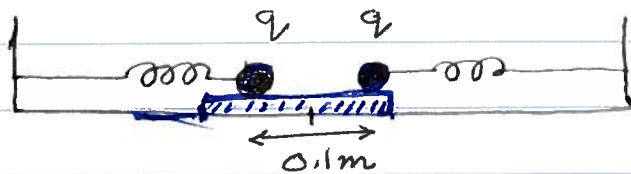
$$\vec{F}_E = k_e \frac{q_1 q_2}{r^2} \hat{r}$$

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

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



3. The picture shows two equal (q) charges attached to two identical



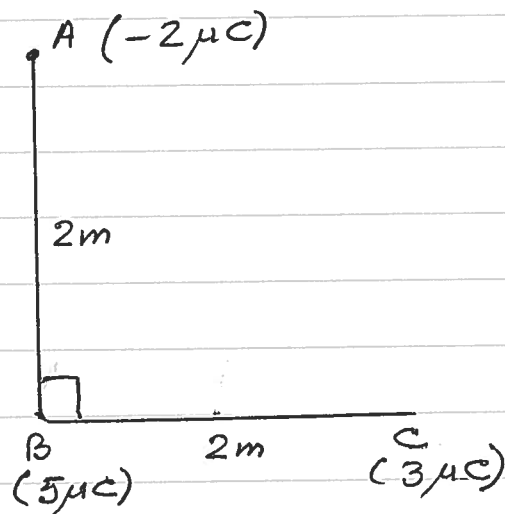
to two identical springs with spring constant 10^3N/m . They are in equilibrium when they are 0.1m apart and each spring is squeezed by the same amount. Calculate q . (Neglect friction)

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

5. A charge of $+20\mu\text{C}$ 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 \vec{E} field is larger: \vec{E} which is at a point 3m from a charge of $9\mu\text{C}$ or one at a point 1m from a charge of $-1\mu\text{C}$? 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 $+ 1.6 \times 10^{-19} \text{C}$. 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 500 Hz in its fundamental mode. If the speed of sound is 340 m/s what is the length of the whistle?

12. State Gauss' Law in your own words.

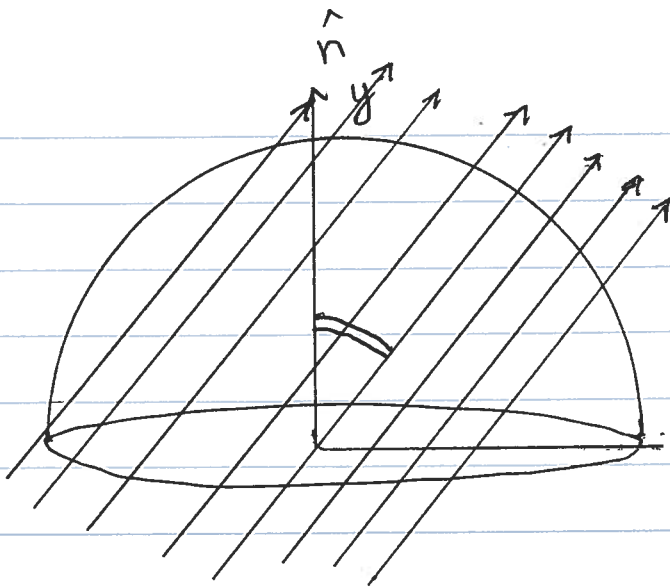
13. The picture shows a hemisphere

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

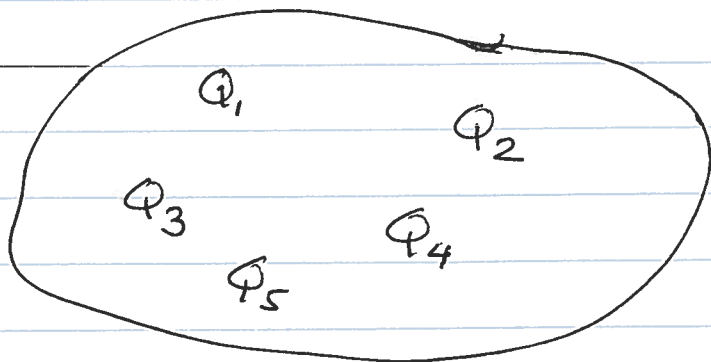
being $Q_1 = 1\mu\text{C}$,

$Q_2 = 2\mu\text{C}$, $Q_3 = -3\mu\text{C}$

$Q_4 = 10\mu\text{C}$, $Q_5 = -10\mu\text{C}$.

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 $Q_5 = -5\mu\text{C}$? Why?