EXAM I Physics 208 SPRING 2017

Last Name.....First.....Section Number.....

USEFUL INFORMATION

For two point particles

$$\vec{F} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}\hat{r}$$

$$Volume \quad of \quad a \quad sphere = \frac{4}{3}\pi r^3$$

$$Area \quad of \quad a \quad sphere = 4\pi r^2$$

$$d\vec{r} = dx\vec{i}_x + dy\vec{i}_y \qquad d\vec{r} = dr\vec{i}_r + rd\theta\vec{i}_\theta$$

The following integrals may prove useful

$$\int \frac{dx}{(x^2+c)^{\frac{3}{2}}} = \frac{x}{c(x^2+c)^{\frac{1}{2}}}$$

$$\int \frac{xdx}{(x^2+c)^{\frac{3}{2}}} = \frac{-1}{(x^2+c)^{\frac{1}{2}}}$$

Grading

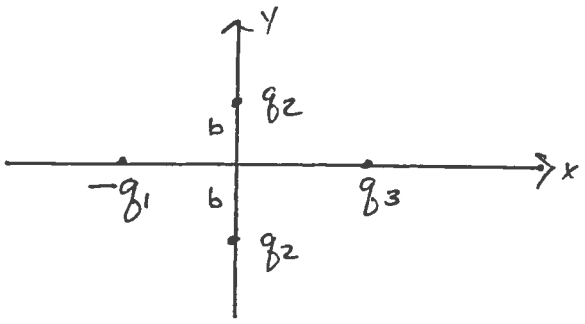
1.

2.

3.

4.

1. (25 points) Four charges are fixed at the positions shown.



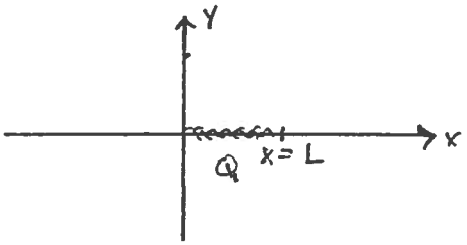
The distances a and b are known. The charge at $x = -a$ is negative, $-q_1$. The charges on the y axis are both positive, q_2. The charge at $x = +a$ is positive, q_3. Find the force that would be exerted on the charge q_3. For what value of q_1 would the force be zero?

Law

Application

Result

2. (25 points) There is a charge Q_1 uniformly distributed along the x axis from the origin to $x = L$. Find the electric field at the point $x = 0, y = H$.



Law

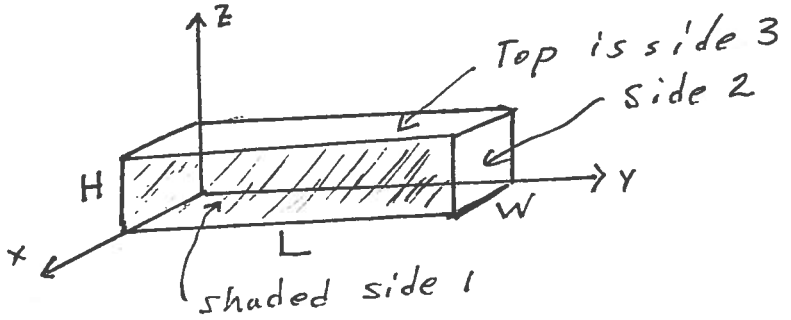
Application

Result

3. (25 points)A surface which has the shape of a block is located with one corner at the origin. The dimensions of the surface are shown below. Find the flux of $\vec{E}$ through the three sides of the surface, labelled 1,2 and 3, if the electric field is given by

$$\vec{E} = \alpha x^2 \vec{i}_x + \beta \vec{i}_y + \gamma x z \vec{i}_z$$

where α , β and γ are known constants.



Law

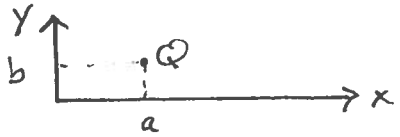
Application

Result

4. (25 points) Suppose the force exerted on a point test charge q_0 by a point charge Q was given by

$$\vec{F} = C\frac{q_0 Q}{r^6}\hat{r}$$

where, just like in the Coulomb force, r is the distance between the points, $\hat{r}$ is along the line from one point to the other and C is a positive, known constant. The force is repulsive for these two positive charges. Find the electric potential function corresponding to this force if the charge Q were located at the origin and the electric potential function as a function of x and y if the charge Q were located instead at $x = a$, $y = b$.



Law

Application

Result