EXAM I Physics 208 Fall 2018

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

USEFUL INFORMATION

For two point particles

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

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

Do not spend time trying to evaluate integrals more complicated than

$$\int U^n dU.$$

For Grader

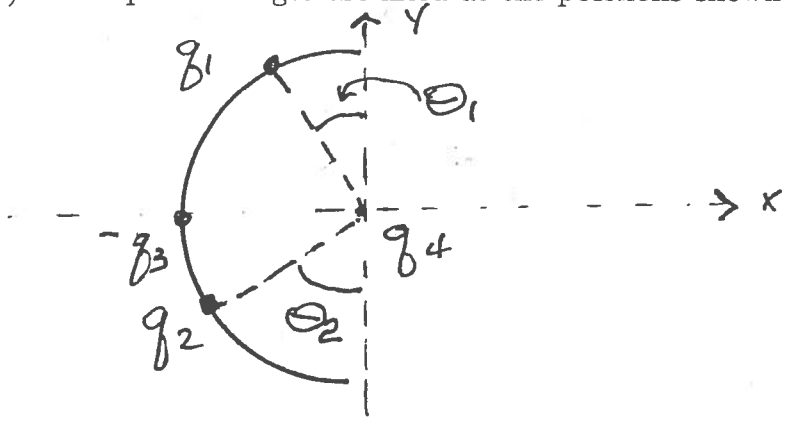
1.

2.

3.

4.

1. (25 points) Three point charges are fixed at the positions shown on a semi-circle of radius R.



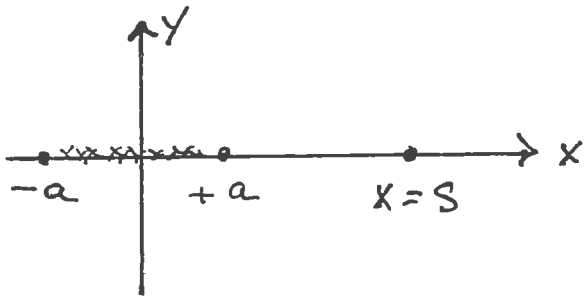
The charge at θ_1 is q_1. The charge at θ_2 is q_2. Both q_1 and q_2 are known and positive. The charge on the x-axis is known and negative, $-q_3$. Find the force that would be exerted on the known, positive charge q_4 located at the center of the semi-circle.

Law

Application

Result

2. (25 points) There is a charge Q uniformly distributed along the x axis from $x = -a$ to $x = +a$. Find the electric field at the point $x = S, y = 0$, where S is larger than a.



Law

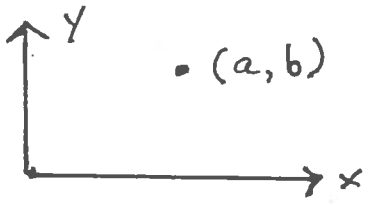
Application

Result

3. (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 $V_1(\vec{r})$, the electric potential function corresponding to this force as a function of x and y if the charge Q_1 were located at the origin. Find $V_2(\vec{r})$, the electric potential function as a function of x and y if the charge Q_2 were located at $x = a$, $y = b$. Find the total electric potential function if both charges are present.



Law

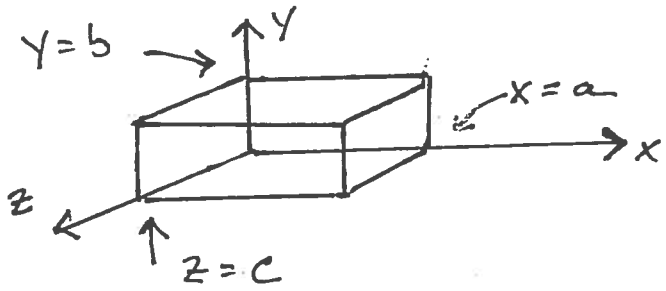
Application

Result

4. (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 surface of the block if the electric field is given by

$$\vec{E} = \alpha x \vec{i}_x + \beta y \vec{i}_y$$

where α and β are known constants. If there is no charge contained within the block, how must α and β be related, assuming they are non-zero?



Law

Application

Result