EXAM I Physics 207 Fall 2019

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

USEFUL INFORMATION

For two point particles

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

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

Possibly useful integrals, omitting additive constants

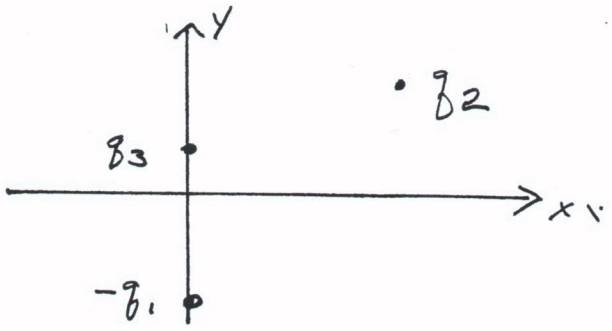
$$\int \frac{dx}{(x^2+c)^{\frac{3}{2}}} = \frac{x}{c(x^2+c)^{\frac{1}{2}}} \qquad \int \frac{xdx}{(x^2+c)^{\frac{3}{2}}} = \frac{-1}{(x^2+c)^{\frac{1}{2}}}$$

$$\int \frac{dx}{(x^2+c)^{\frac{1}{2}}} = ln\left[(x^2+c)^{\frac{1}{2}} + x\right]$$

Suggestion: Since the majority of credit will be given for physics, not calculus, do not spend too much time on integration.

1.
2.
3.
4.

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



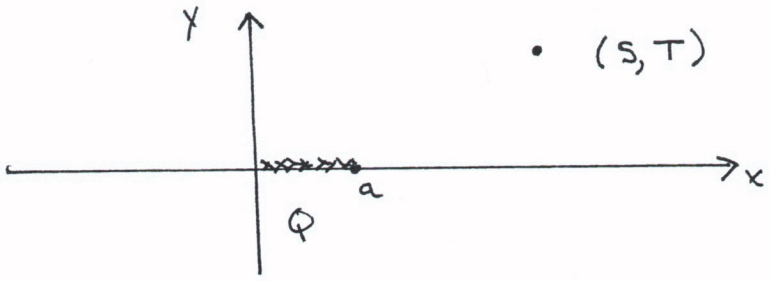
The charge at $x = 0, y = -B$ is known and negative, $-q_1$. The charge at $x = A$, $y = 2H$ is known and positive, q_2. Find the force that would be exerted on the known, positive charge q_3 located at $x = 0, y = H$.

Law

Application

Result

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



Law

Application

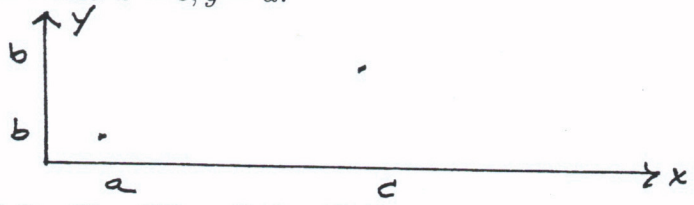
Result

3. (25 points) There are two parts to this problem. In both, α and β are known constants.

a. Suppose the force exerted on a point test charge q_0 is given by

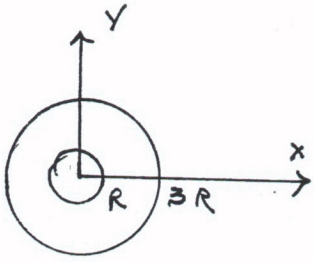
$$\vec{F} = q_0 \alpha x^3 \vec{i}_x + q_0 \beta y \vec{i}_y$$

Find $V(c,d) - V(a,b)$, the difference in the electric potential function between the point $x = a, y = b$ and $x = c, y = d$.



b. Find $V(r = 3R, \theta = 0) - V(r = 0, \theta = 0)$ if

$$\vec{E}(r,\theta) = 0 \quad for \quad r < R \qquad \vec{E}(r,\theta) = \frac{\alpha}{r^2}\vec{i}_r \quad for \quad r > R$$



Law

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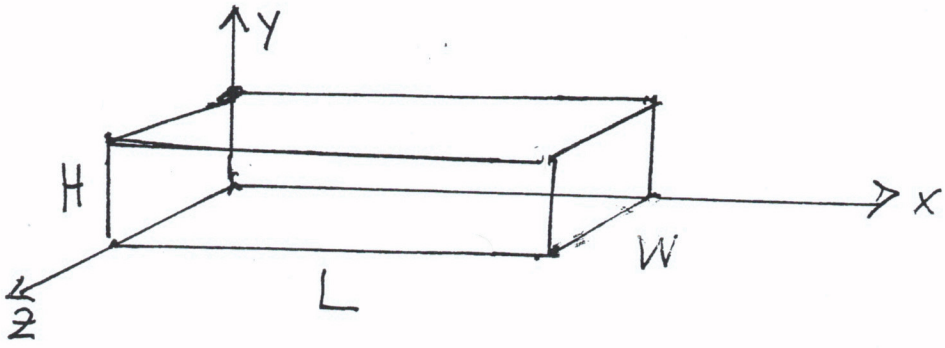
4. (25 points)A surface which has the shape of a block is located with one corner at the origin. The dimensions of the surface are shown below. Find the flux of $\vec{E}$ through each of the six faces of the surface of the block if the electric field is given by

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

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



Law

Application

Result