Physics 208

Exam 1

February 17, 2009

Family Name: _____

First Name: _____

Student ID Number: _____

Your Section Number: _____

USEFUL INFORMATION

For two point particles, $\vec{F} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}\hat{r}$

$$\int_{\vec{r}_1}^{\vec{r}_2} \vec{E}\cdot d\vec{r} = -[V(\vec{r}_2) - V(\vec{r}_1)]$$

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

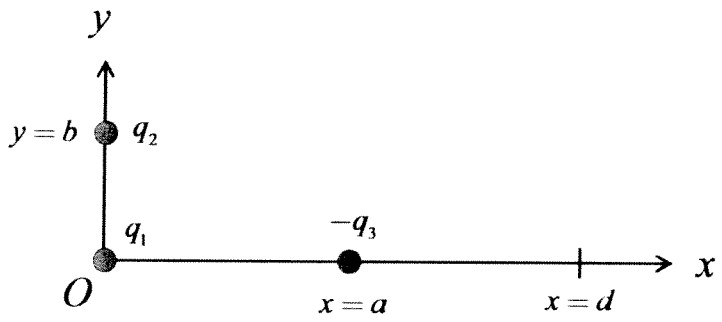
$$E_x = -\frac{\partial V}{\partial x}, \qquad E_y = -\frac{\partial V}{\partial y}$$

DO NOT WASTE TIME ON COMPLICATED INTEGRALS.

Do not write below

Prob. 1	***Prob. 2***	***Prob. 3***	***Prob. 4***	***TOTAL***

[1] (25 points) Three charges are located as shown: two positive charges, q_1 and q_2, and one negative, $-q_3$.



Find the total force that would be exerted by these charges on a fourth, positive charge q_4 if it were located at the point $(x = d, y = 0)$.

[2] (25 points) You are given the electric potential function

$$V(x, y) = \alpha x^2 + \beta y^3.$$

Here α and β are known constants.

(a) For this electric potential function, find the electric field everywhere.

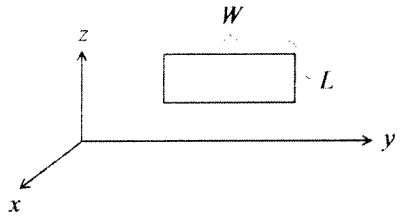
(b) What is the electric force that would be exerted on a charge q_1 by this electric field at the arbitrary point (x, y)?

(c) What work would be done by this electric force if q_1 moved from the origin to the point $(x = a, y = b)$?

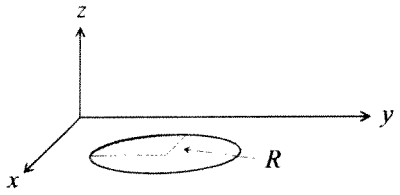
[3] (25 points) Suppose there were an electric field given by

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

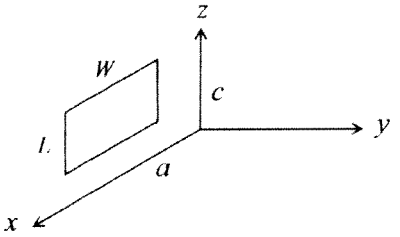
(a) What would be the electric flux through the L by W rectangle if it is the y-z plane.



(b) What would be the electric flux through the shaded quarter of a circle of radius R if the circle is in the x-y plane?



(c) What would be the electric flux through the L by W rectangle if it is in the x-z plane with one corner at $(x = a, z = c)$ as shown?



[4] (25 points) Suppose there is a half circle of radius R that has positive charge, $+Q$, uniformly spread over the top half and negative charge, $-Q$, uniformly spread over the bottom half. Find the electric field at the center of the semi-circle.