EXAM I Physics 208 SPRING 2011

Name.....Section Number.....

USEFUL INFORMATION

For two point particles

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

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

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

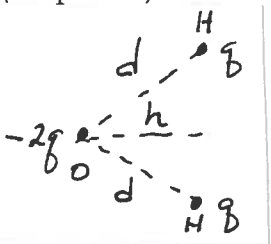
$$d\vec{r} = dx\vec{i}_x + dy\vec{i}_y$$

$$d\vec{r} = dr\vec{i}_r + rd\theta\vec{i}_\theta$$

PLEASE DO NOT SPEND TIME DOING NON-TRIVIAL INTEGRALS

Only integrals like $\int kx^n dx$ are considered trivial

1. (25 points) A model of a water molecule is shown below.

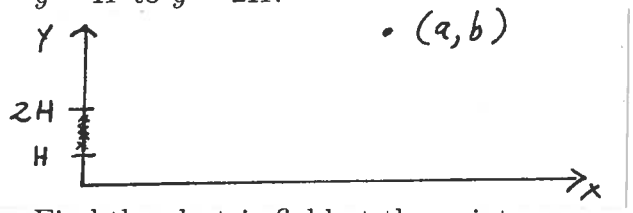


Here the hydrogen atoms have known charge q and the oxygen atom has charge $-2q$. The distance d is known and the distance from the oxygen to the middle of the hydrogens, h, is also known.

a. Find the total electric force exerted on the oxygen atom.

b. Find the total electric force exerted on the upper hydrogen atom.

2. (25 points)An amount of charge Q is uniformly distributed along the y axis from $y = H$ to $y = 2H$.



Find the electric field at the point $x = a$, $y = b$.

3. (25 points)

a. Find the difference in the electric potential, $V(a,b) - V(0,0)$, if

$$\vec{E} = \alpha x^2 \vec{i}_x + \beta y^3 \vec{i}_y,$$

where α and β are known constants.

b. Find the electric field at any point (x, y) if the electric potential is given by

$$V(x,y) = c_1 x^2 + c_2 y^2$$

where c_1 and c_2 are known constants.

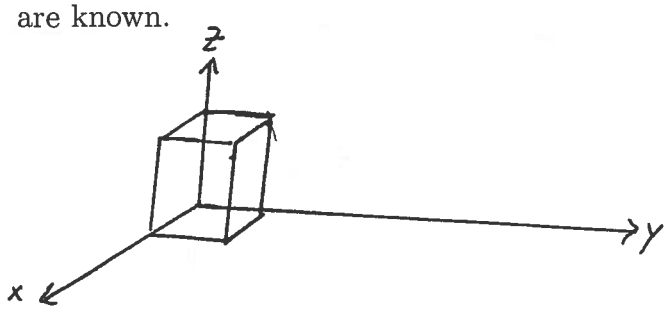
c. Suppose there was an electric field that only had a radial component and was given by

$$\vec{E}(\vec{r}) = 0 \qquad if \qquad r < R$$

$$\vec{E}(\vec{r}) = \frac{c}{r^2}\vec{i}_r \qquad if \qquad r \geq R.$$

Find the difference in the electric potential between a point at the origin and a point $2R$ away from the origin.

4. (25 points)A cube with sides of length a is at the origin. The constants c_1, c_2, and c_3 are known.



Evaluate the flux of $\vec{E}$ through the top surface of the cube if

a. The electric field is given by $\vec{E} = c_1\vec{i}_x + c_2\vec{i}_y$.

b. The electric field is given by $\vec{E} = c_1 x\vec{i}_x + c_2 y\vec{i}_y + c_3 z\vec{i}_z$.

c. The electric field is given by $\vec{E} = c_1 xz\vec{i}_z$.