PHY2061
9-23-04

Name:_____ ___
H-ITT or pseudonym: _____

Exam 1

Closed book exam. A calculator is allowed.
Exam is worth 100 points, 25% of your total grade.

UF Honor Code: "On my honor, I have neither given nor received unauthorized aid in doing this exam."

$$K=\frac{1}{4\pi\varepsilon_0}=9\times10^{9}\ \mathrm{N\,m^2/C^2} \qquad \varepsilon_0=8.8542\times10^{-12}\ \mathrm{C^2/N\,m^2} \qquad e=1.6022\times10^{-19}\ \mathrm{C}$$

$$\mathbf{F}=K\frac{q_1q_2}{r^2}\hat{\mathbf{r}}_{12} \qquad \Phi_E=\oint \mathbf{E}\cdot d\mathbf{A}=\frac{q_{enc}}{\varepsilon_0} \qquad \rho=\frac{r}{\varepsilon_0} \qquad \mathbf{E}=-\nabla V$$

$$V=\frac{U}{q_0} \qquad \mathbf{E}=\frac{\mathbf{F}}{q_0} \qquad W=-\Delta U=\int \mathbf{F}\cdot d\mathbf{s} \qquad \Delta V=-\int \mathbf{E}\cdot d\mathbf{s}$$

$$\nabla=\hat{x}\frac{\partial}{\partial x}+\hat{y}\frac{\partial}{\partial y}+\hat{z}\frac{\partial}{\partial z}$$

$$Q=C\Delta V \qquad U=\frac{1}{2}C(\Delta V)^2=\frac{Q^2}{2C}$$

$$\mathbf{F}=grad(f)=\nabla f$$

$$\nabla\cdot\mathbf{F}=div(\mathbf{F})=\frac{\partial F_x}{\partial x}+\frac{\partial F_y}{\partial y}+\frac{\partial F_z}{\partial z} \qquad \iiint dV=\int\int\int dx\,dy\,dz$$

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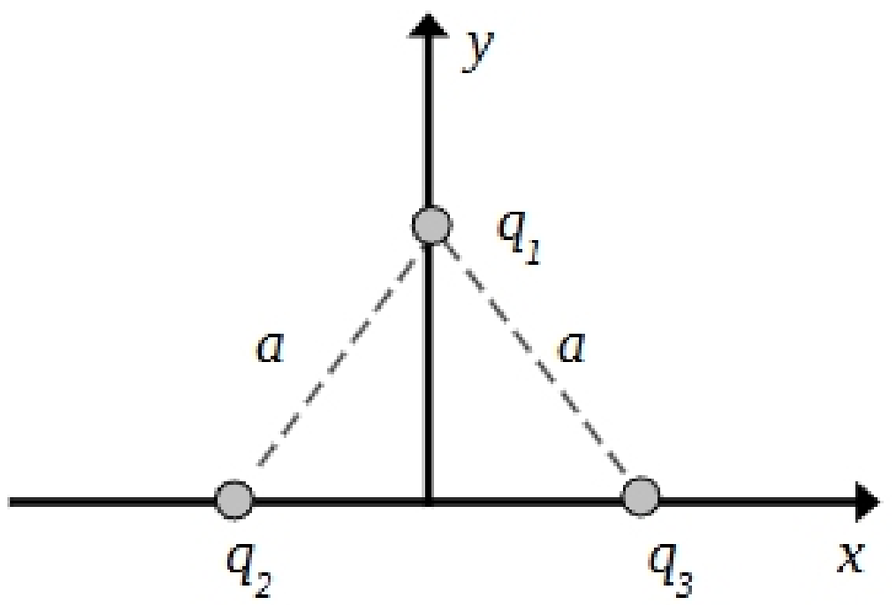

1. Consider 3 point particles with electrical charge arranged in the form of an equilateral triangle as shown. The side length is a = 5 cm, and the top particle has charge q_1 = +2□C while the bottom two particles have charge $q_2 = q_3$ = +1 □C (1m□C = 10^{-6} C).

   (a) [4 points] What is the direction of the force acting on particle 1 (the one at $x = 0$ and $y > 0$)?

   (b) [8 points] Calculate the magnitude of the force acting on particle 1.

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1. Continued:

(c) [6 points] Calculate the electric field at the location of particle 1 arising from particles 2 and 3 ?

(d) [6 points] Does a position exist where a fourth charge can be added to put the triangle in electrostatic equilibrium? If so, sketch where it would lie approximately, and write down an equation for its charge in terms of: the distance d from particle 1, the side length a, and the magnitude of the other charges (in other words, you don't have to solve for d).