PHYS-207(2) (Kaldon-21484) **Name** ____

WMU-Fall 1999 **Book Title** ____________________________________

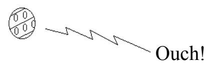
Exam 1 - 100,000 points + 20,000 ☆ points **Section:** **2a** A to G **2b** H to P **2c** R to Z

9/23/99Th Rev.1

State Any Assumptions You Need To Make – Show All Work – Circle Any Final Answers
Use Your Time Wisely – Work on What You Can – Be Sure to Write Down Equations
Feel Free to Ask Any Questions ☐☆1d ☐☆2b ☐☆2c ☐☆2d

Star Wars – The First Movie Which, Uh, Is Now The Fourth Movie… (50,000 points)

1.) Luke Skywalker is practicing to be a Jedi Knight on board the Millennium Falcon. Obi-Wan Kenobi has placed a floating practice ball in the air, which zooms around, while Luke tries to hit it. But the practice ball is about a foot away ($d = 0.305$ m) from Luke when a spark jumps from the ball to Luke. Since the air ionizes at $E = 3.00 \times 10^6$ V/m, what is the potential difference between Luke and the ball? *Assume that E is constant.*



(b) On the other hand, find ΔV by using the equation for V(r) for a point charge, q, at $a = 0.0220$ m and $d = 0.305$ m. Then using $E = 3.00 \times 10^6$ V/m, find the value of q on the practice ball.

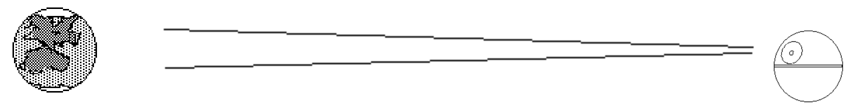
Two charges, $\pm 6.00 \times 10^{-6}$ C, are arranged as shown below. (c) Find the electric field vector, $\vec{E}$, at the point P, which is 0.200 m from $-q$ and 0.400 m from $+q$.

☆(d) Find the work it takes to assemble the two charges in part (c) by integrating $\int_a^\infty F_E\,dx$ as needed, where a is the distance between them.

(e) An electron, $q = -e = -1.602 \times 10^{-19}$ C and $m_e = 9.11 \times 10^{-31}$ kg, is initially moving parallel, at $v_{0x} = 5280$ m/s and $v_{0y} = 0$, some 5.32 cm (0.0532 m) above a huge sheet of charge with $\sigma = 8.61 \times 10^{-12}$ C/m². Write down the x- and y- components of the velocity as a function of time.

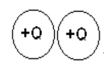
The Death Star Takes on Aldaran (50,000 points)

2.) In the movie *Star Wars*, the Empire's Death Star uses some sort of a beam that results in blowing up the entire planet of Aldaran. Now you can imagine that this is not an easy thing to do. One idea suggested in a science fiction story Dr. Phil once read, was that a weapon might "turn off" the charge on the electron. Then there would only be the positively charged protons, each with charge $e = 1.602 \times 10^{-19}$ C. For every gram of matter, there will be one mole of protons (6.02×10^{23}). The mass of the planet is 6.13×10^{24} kg, and its radius is $R_A = 5.98 \times 10^6$ m. $V_{sphere} = 4/3\,\pi\,r^3$. (a) Find n the number of protons in Aldaran, the total charge on Aldaran, q, and the charge density, ρ.



☆(b) Use Gauss' Law and integrate over a spherical Gaussian surface to find the E-field on the surface of Aldaran. *If you didn't get an answer to (a), see Dr. Phil for values to use for (b) and (c).*

☆(c) Use Gauss' Law and integrate to find the E-field on a spherical Gaussian surface inside Aldaran, R = 1.00 x 10^6 m. *If you didn't get an answer to (a), see Dr. Phil for values to use for (b) and (c).*



☆(d) To illustrate how dangerous this is, imagine that the planet first splits into two planetoids each with half the charge that was on the whole planet, separated by the radius of the planet. Find the change in the potential energy, ΔU, by integrating $\Delta U = -q_1 \int_{R_A}^{\infty} \vec{E} \cdot d\vec{s}$.

Consider a system that involves a line of charge, λ, running down the center axis of cylindrical can of radius a, which has a surface charge $\sigma = \dfrac{-\lambda}{2\pi a}$ (e) Use Gauss' Law to find the E-field at a point P a distance r from the outside of the cylinder.