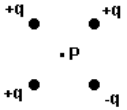
PHYS-207(4) (Kaldon-20447) **Name** _____
WMU-Fall 2000
Exam 1 - 100,000 points + 20,000 ☆ points **Book Title** _____
09/20/2000•Rev.1

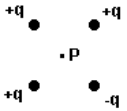
State Any Assumptions You Need To Make – Show All Work – Circle Any Final Answers
Use Your Time Wisely – Work on What You Can – Be Sure to Write Down Equations
Feel Free to Ask Any Questions ☐☆2a ☐☆2b ☐☆2c ☐☆2e

"Dr. Phil, Dr. Phil—I'm Still Seeing Spots In Front Of My Eyes!" (50,000 pts.)

1.) Four charges, $|q| = 7.00 \times 10^{-6}$ C, are rigidly arranged in a square (L = 10.0 cm = 0.100 m) as shown.
(a) Using symmetry, draw a simpler system that would have the same electric field vector at P, but fewer charges (less things to calculate).

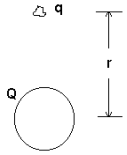


(b) Find the electric field vector, $\vec{E}_{total}$, at the center of the square of charges at point P.



(c) A small bit of dust, mass = 1.38×10^{-6} kg, has 13,800,000 extra electrons on it. Find the charge q.

(d) Our little piece of dust with charge q is $r = 1.54$ *cm* above a spherical metal conductor with charge Q as shown. Find the value of Q such that the piece of dust does not fall (or rise).

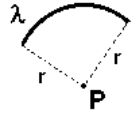


(e) If the potential V is zero, must the electric field, E, be zero as well? *Short answer.*

Another Stupid Star Problem (50,000 points)

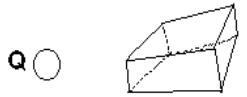
2.) ☆(a) A cylindrical insulator of radius R and length L has a total charge Q evenly distributed throughout the cylinder. Use Gauss' Law to find the magnitude of the E-field at a radius r, where $r < R$. *NOTE: You may evaluate the integrals by using the known equations for things like the surface area and volume of a cylinder.*

☆(b) Use direct integration to find the magnitude of the potential V for a quarter-circle line of charge of radius $r = 1.00$ *m* and $\lambda = 1.00 \times 10^{-4}$ C/m, at a point P at the center of the circle. *V=0 at infinity.*



☆(c) An electric potential is given by $V_a = (1.38\,V) + (1.38 V/m)\,x + (1.38 V/m^2)\,x^2 + (1.38 V/m^3)\,y^3$.
Find E_x .

(d) A charge Q sits on a small conducting sphere. Nearby is a wedge shaped Gaussian surface designed so that the E-field from Q only goes through the left and right sides at radius $r = a$ and $r = b$, respectively. What is the total electric flux, Φ_E , through the Gaussian surface?



☆(e) An electron is 5.00 cm from a sheet of charge ($\sigma = 1.38 \times 10^{-5}$ C/m²). Find the work due to the electric force to move the electron to only 2.50 cm from the sheet of charge, by integrating $\int_a^b F_E(x)\,dx$.