Physics-305
Homework Set (3)

This homework set is due on Thursday, 24st of Dhul-Hijjah, 1436 (Oct. 8th, 2015) at 10.00 p.m. [slip under my Office (15-3100) door, if needed].

For this homework set <u>feel free to discuss with your colleagues</u>, but make sure that your submission is <u>your</u> *own*, rather than copying from someone else's work!

Start each question on a <u>new page</u>. Please solve fully and *clearly*, state assumptions, <u>circle final answers</u>, and comment wisely (when applicable).

Question #1:
A thin rod of length (L) is uniformly charged ($\lambda = \lambda_o$) with one end at the origin lies in the horizontal (x-y) plane. The rod makes an angle +30° with the +ve x-axis.

You are interested in finding the electric field at points on the y-axis.
   a- Sketch the problem.
   b- Find integral expressions for the x- and y- components of the electric field at a general point (0, η) on the y-axis.
   c- Compute the electric field for the (special) case $\eta = L$; that is, at the point (0,L).
   d- Use symmetry arguments to confirm that the results found in part-c are as expected, by looking at the electric field on the normal bisector of a uniformly charged rod.

Hint: feel free to use computer packages to calculate integrals, if needed. In fact, you are encouraged to do so.

Question #2:
Calculate the electrostatic potential inside and outside a uniformly charged spherical shell.

Hint: read the example in your textbook.

Question #3:
Calculate the Madelung constant for an infinite (1-D) chain consisting of alternative charges ($\pm$ q) with spacing (a).

Hint: you first need to figure out what a Madelung constant is.

Question #4:
What is the force of repulsion between the northern hemisphere and the southern hemisphere of a metal sphere of radius R that carries a total charge Q?

Question #5:
Textbook: chapter-2 problem-32

Question #6:
Textbook: chapter-2 problem-39