Due: Thursday, 03/19

11. In this problem, we look at two properties of the static electric and magnetic fields that are important for trapping charged particles and paramagnetic atoms (or molecules), respectively.

a) Explain why it is impossible to construct a purely electrostatic trap to hold a charged particle in free space.

b) The states of paramagnetic atoms (molecules) can be classified into *low-field-seeking* and *high-field-seeking* states. Propose a simple magnetic-coil geometry for trapping low-field seekers, and explain why it is impossible to do the same for high-filed seekers.

Hint: for the final part, an analogy of magnetic field with Coulomb or gravitational field may be useful. In particular, the fact that, for empty space, the field in the center of a sphere is the average of the field over the volume or the surface of the sphere could be helpful.

12. In class, we have discussed the Thomas-Fermi (T-F) model for multi-electron atoms. Using this model, calculate and plot the electron density as a function of the distance from the nucleus for the alkali atoms: Na, K, Rb, and Cs. You would probably want to use some program like Mathematica, MatLab, or Excel to do this. Please put all four graphs on the same plot for the ease of comparison. Alternatively, these could be on separate plots, but both the vertical and horizontal scales should be the same, and must be chosen wisely. Please discuss noteworthy features of the electron densities that should be apparent from these plots. The T-F model as we discussed it would not work well for Li and Fr, why?

13. Reading/reviewing assignment.

a) The Instructor will e-mail the text to read/review (no need to e-mail to request).
b) Read the text (which will be partially relevant to the material covered in class).
c) E-mail the Instructor with a review which should be as short as possible; however, would contain whatever critical comments you might have about the text.

Please note: this time, the entire assignment (#4) should be sent to the Instructor by e-mail. Consult the Instructor if you have difficulties solving the problems.