PHYS 2201 – Electricity and Magnetism

Homework #3 – Due Oct. 6, 2015 by 3pm
(hand in to drop box outside 3L24)

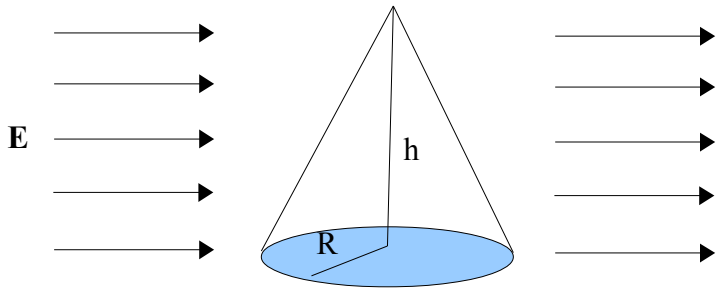
1. Show that the maximum magnitude of electric field along the axis of a uniformly charged ring of radius a occurs at $x = a/\sqrt{(2)}$ and has a magnitude $Q/(6\sqrt{(3)}\pi\epsilon_0 a^2)$.

2. (a) Use the result from class for the electric field due to a uniformly charged ring to derive an expression for the electric field due to a sphere of radius R with charge Q uniformly distributed over its surface, at a point a distance r from its centre (for r>R). Hint: you will be integrating over the angle theta that travels in the xz plane from +x to -x, and the ring position and radius changes with that angle.

(b) What is the field outside a sphere with uniform volume charge?\

3. The electric field in the atmosphere at earth's surface is approximately 160 N/C, directed downward. At 1500 m above the earth's surface, the electric field in the atmosphere is only 18 N/C, again directed downward. What is the average charge density in the atmosphere below 1500 m? Does this consist predominantly of positive or negative ions?

4. A cone with base radius R and height h is located on a horizontal table. A horizontal uniform field E penetrates the cone, as shown in the figure below. Determine the electric flux that enters the left-hand side of the cone.



5. An infinitely long line charge having a uniform charge per unit length λ lies a distance d from point O as shown in the figure below. Determine the total electric flux through the surface of a sphere of radius R centred at O resulting from this line of charge. Consider both cases, where R<d and R>d.