PHYS UN1602 Recitation Week 3 Worksheet

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Problem 1

An infinitely long cylinder of radius R and total charge per unit length λ has a charge density that varies as a function of radius r as $\rho(r) = \frac{C}{r}$.

a) Calculate the coefficient C in terms of λ. To do this, set up and carry out an appropriate integral over the radius with the proper radial weighting.

b) Evaluate the electric field produced by the charged distribution for both $r < R$ and $r > R$.

c) Evaluate the electric potential (e.g. using $\Delta\phi = -\int \vec{E} \cdot d\vec{r}$) as a function of r, assuming $\phi(0) = 0$.

Problem 2

An electrically neutral atom consists of a nucleus that is a point particle with positive charge Q at the center of the atom and an electron of volume charge density modeled by:

$$\rho(r) = -\frac{\beta}{r^2}e^{-r/a}$$

for $r < a$ and 0 for $r > a$.

a) Use Gauss' law to derive an expression for the electric field.

b) Graph the electric field as a function of radius.