Physics 302
Winter Quarter 1991
February 8, 1991
George Williams

Mean = 75.6
N = 255

4

SECOND MIDTERM

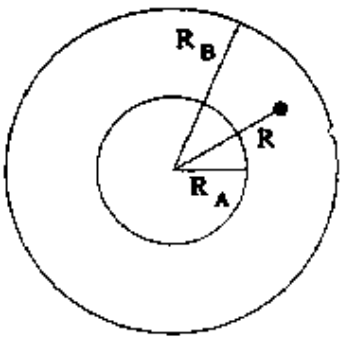
Name (print) Prabasaj Paul Name(signed)_____

Discussion Instructor (circle one): Davis DeTienne Hamed Molina Paul Zhang

Discussion Section #_____

SHOW ALL WORK!!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

Given a long hollow tube of inner radius R_A and outer radius of R_B. The tube is made of a nonconductor and has a charge density of $\rho = AR^{-3}$ between R_A and R_B. ρ is zero everywhere else.



(a) Calculate the electric field at an arbitrary distance R from the axis of the tube where $R_A < R < R_B$.
(b) If the potential at R_A is set at $V = 0$, calculate the potential difference between a point at R_A and a point at R where $R_A < R < R_B$.

(a) $$\frac{q_{enc}}{\epsilon_0} = \frac{l}{\epsilon_0}\int_{R_A}^{R} 2\pi r\,dr \cdot \frac{A}{r^3}$$

$$= \frac{2\pi A l}{\epsilon_0}\int_{R_A}^{R}\frac{dr}{r^2}$$

15 → 10 on the scale

$$= \frac{2\pi A l}{\epsilon_0}\left(\frac{1}{R_A} - \frac{1}{R}\right) = E(R)\cdot 2\pi R l$$

$$\Rightarrow \boxed{E(R) = \frac{A}{\epsilon_0 R}\left(\frac{1}{R_A} - \frac{1}{R}\right)}$$

(b) $$V(R) = -\int_{R_A}^{R} E(r)\,dr = -\frac{A}{\epsilon_0}\int_{R_A}^{R}\frac{1}{r}\left(\frac{1}{R_A} - \frac{1}{r}\right)dr$$

$$\Rightarrow \boxed{V(R) = -\frac{A}{\epsilon_0 R_A}\ln\frac{R}{R_A} + \frac{A}{\epsilon_0}\left(\frac{1}{R_A} - \frac{1}{R}\right)}$$

10

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