Physics 302
Winter Quarter 1992
February 7, 1992
George Williams

2

SECOND MIDTERM

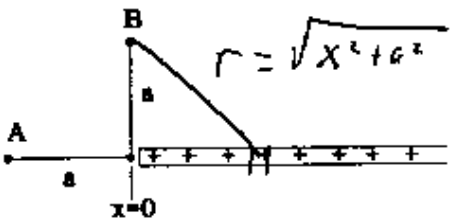
Name (print) Guilkey Name (signed) 13.2

Discussion Instructor (circle): Condella Godfrey-Smith Guilkey Leong Nott Paul

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 semi-infinite line of charge of density $+\lambda$ c/m. The line begins at $x = 0$, and extends to infinity along the x axis. Calculate the electric potential difference between points A and B ($V_A - V_B$). (Hint: Instead of infinity, use a large value of x, and see what happens.)



5 $V_A = K\int_0^\infty \frac{dq}{r} = K\int_0^\infty \frac{\lambda dx}{x+a}$

$= K\lambda \ln(x+a)\Big|_0^\infty$

5 $V_B = K\int_0^\infty \frac{\lambda dx}{\sqrt{x^2+a^2}} = K\lambda \ln\left[x+\sqrt{x^2+a^2}\right]\Big|_0^\infty$

$V_A - V_B = \lambda k\left[\ln(x+a)\Big|_0^\infty - \ln\left(x+\sqrt{x^2+a^2}\right)\Big|_0^\infty\right]$

10 $= \lambda k \lim_{x\to\infty}\left[\ln(x+a) - \ln a - \ln\left(x+\sqrt{x^2+a^2}\right) + \ln a\right]$

$= \lambda k \lim_{x\to\infty} \ln\frac{x+a}{x+\sqrt{x^2+a^2}}$

20

$= \lambda k \ln\frac{1}{2}$