Grader: Cungeng Yang

Physics 2220
Spring 2002
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SECOND MIDTERM

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Name:_____

Discussion Instructor (circle): Andrade El-Gendy Mimoto Owen

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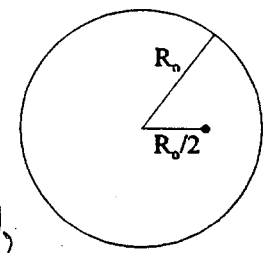
SHOW ALL WORK!!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

A sphere of non-conductor of radius R_o is uniformly negatively charged with a total charge - Q.



(a) Calculate the magnitude of the electric potential difference between the point $R_o/2$ and R_o.
(b) Obtain the sign of $V(R_o) - V(R_o/2)$, and clearly explain how you got it.
(c) With the usual choice of V = 0, calculate the potential at $R_o/2$.

(a) for $r \le R_o$, $4\pi r^2 E = \frac{-Q}{\frac{4}{3}\pi R_o^3} \cdot \frac{4\pi}{3} r^3 \cdot \frac{1}{\varepsilon_0} \Rightarrow E = \frac{-Q}{4\pi\varepsilon_0 R^3} r$ (5)

for $r \ge R_o$, $E = \frac{-Q}{4\pi\varepsilon_0 R^2}$ (+5)

$V(R_o) - V(\frac{R_o}{2}) = -\int_{\frac{R_o}{2}}^{R_o} E\,dr = \int_{\frac{R_o}{2}}^{R_o} \frac{Q}{4\pi\varepsilon_0 R^3} r\,dr = \frac{3Q}{32\pi\varepsilon_0 R_o}$ (5)

(b) $V_\infty = 0$, $V_{\frac{R_o}{2}} < V_{R_o}$, thus the sign of $V(R_o) - V(R_o/2)$ is "+". (5)

(c) $V(\frac{R_o}{2}) = V(R_o) - \frac{3Q}{32\pi\varepsilon_0 R_o} = -\frac{Q}{4\pi\varepsilon_0 R} - \frac{3Q}{32\pi\varepsilon_0 R_o} = \frac{-11Q}{32\pi\varepsilon_0 R}$ (10)