Physics 172
Summer Quarter 1984
George Williams

SECOND EXAMINATION

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Name (Print)_____ Name (Sign)_____

Discussion Instructor (CIRCLE ONE): Johnson Spannring Yan

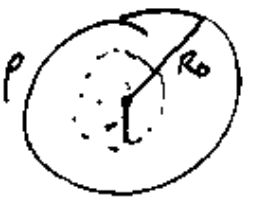
Discussion Section #_____

25 pts

Given a spherical non-conductor, with a uniform charge distribution of density ρ. Calculate (a) the electric field at a point $R_0/2$, where R_0 is the radius of the sphere. (b) The total energy stored in the electric field bewteen $R_0/2$ and R_0.

a) 15 pts

b) 10 pts



a) $\int E \cdot dA = \frac{1}{\epsilon_0}\int \rho\, dV$

$E(4\pi r^2) = \frac{\rho}{\epsilon_0}\int_0^r 4\pi r^2 dr \quad \Rightarrow \quad E = \frac{\rho}{\epsilon_0}\frac{r}{3}$

$E = \frac{\rho r}{3\epsilon_0}$ at $r = \frac{R_0}{2}$ $\quad E = \frac{\rho R_0}{6\epsilon_0}$

b) $U = \int u_E\, dV = \int_{\frac{R_0}{2}}^{R_0} \frac{\epsilon_0}{2}\frac{\rho^2 r^2}{9\epsilon_0^2} 4\pi r^2 dr = \frac{4\pi\epsilon_0\rho^2}{18\epsilon_0^2}\int_{\frac{R_0}{2}}^{R_0} r^4 dr$

$= \frac{2\pi\rho^2}{9\epsilon_0}\left[\frac{R_0^5}{5} - \frac{R_0^5}{5\cdot 2^5}\right] = \frac{31\pi\rho^2 R_0^5}{720\epsilon_0}$

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