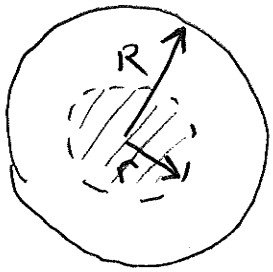
NAME: KEY

Quiz 3, Physics 9C, Winter 2016

General Instructions: This quiz is closed book. Only a calculator is allowed. Please show all your work, and give units for all answers and on all graphs. Credit will only be given for complete solutions. The constant k in Coulomb's law is $k = 9 \cdot 10^9$ Nm^2/C^2.

Charge $Q = +8.0\,\mu C$ is distributed uniformly over the volume of an insulating sphere that has radius $R = 7.0$ cm. What is the potential difference between the center of the sphere and the surface of the sphere? **Important:** A complete solution to this problem will provide the following steps:
(a) Write down Gauss' Law.
(b) Apply Gauss' Law to get the electric field inside the sphere ($r < R$). Explain clearly how you get the charge enclosed that you use in your equation.
(c) Write the equation which tells you how to get V from E.



a) $\Phi_E = 4\pi k Q_{enclosed}$

b) $4\pi r^2 E$ (because E same every where on surface and $\vec{E} \parallel \hat{n}$)

$\rho V = \frac{Q}{\frac{4}{3}\pi R^3} \quad \frac{4}{3}\pi r^3 = \frac{Q r^3}{R^3}$

$V_{enclosed}$

V of whole sphere

$\Rightarrow \quad E = kQr/R^3$

c) $V_a^b = -\int_a^b E\,dr$

$V_R^0 = -\int_R^0 \frac{kQr}{R^3}\,dr = +\int_0^R \frac{kQr}{R^3}\,dr$

$= \frac{kQ}{R^3}\,\frac{1}{2}r^2\Big|_0^R = \frac{kQ}{2R}$.

numerical value

$V_R^0 = \frac{(9\cdot 10^9)(8\cdot 10^{-6})}{2(.07)} = 514000$ volts