Physics 2220
Spring 2005
George A. Williams

FIRST MIDTERM

3

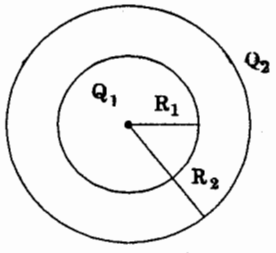
Name: Solutions

Discussion Instructor (circle): Gillman Rodriguez Shepherd Webb

Student ID #:_____

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

A uniformly charged sphere of a nonconductor has a radius R_1 and charge Q_1. It is enclosed in a concentric thin metal spherical shell whose radius is R_2. ($R_2 > R_1$.) The metal shell has a net total charge Q_2.



(a) Calculate the electric field a distance 47.0 cm from the common center of the two spheres. (Numerical answer including sign.)

(b) Calculate the electric field a distance of 13.5 cm from the common center. (Numerical answer including signs.)

(c) Calculate the electric field a distance 3.00 cm from the common center. (Numerical answer including sign.)

$Q_1 = -375\ \mu C$; $Q_2 = +172\ \mu C$
$R_1 = 12.0$ cm; $R_2 = 30.0$ cm

(a) $E = \frac{k(Q_1+Q_2)}{r^2} = \frac{(8.99\times10^9\ Nm^2/C^2)(-375\times10^{-6}+172\times10^{-6}\ C)}{(0.47m)^2}$

$= \boxed{-8.26\times10^6\ N/C}$

(b) $E = \frac{kQ_1}{r^2} = \frac{(8.99\times10^9\ Nm^2/C^2)(-375\times10^{-6}\ C)}{(0.135m)^2} = \boxed{-1.85\times10^8\ N/C}$

(c) $E = \frac{kQ_1 r}{R_1^3} = \frac{(8.99\times10^9\ Nm^2/C^2)(-375\times10^{-6}C)(0.03m)}{(0.12m)^3}$

$= \boxed{-5.85\times10^7\ \frac{N}{C}}$

(equation for part (c) may be derived directly from Gauss' Law)