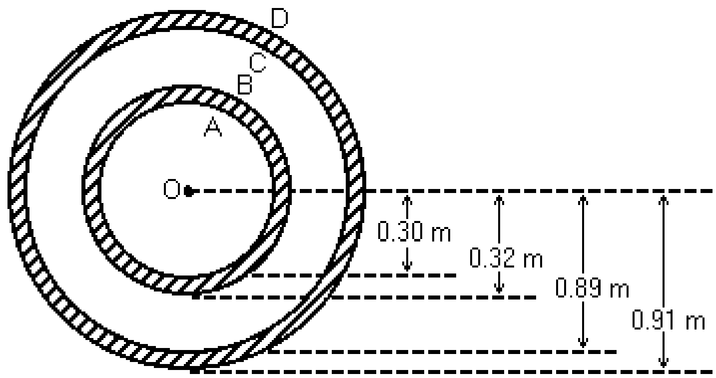
Physics 2B, Electricity and Magnetim -- Spring 2009 Instructor: B. Grinstein
Quiz # 2

INSTRUCTIONS: Fill, tear and return the bottom strip of the front page with your scantron. Keep the top portion of the front page and the rest of the quiz. Use a pencil #2 to fill your scantron. Write your code number and bubble it in under "EXAM NUMBER". Bubble in the quiz form (see letter A--D at bottom of page) in your scantron under "TEST FORM"

Useful numbers: $K = 9.0 \times 10^9\ Nm^2/C^2$, $\varepsilon_o = 8.85 \times 10^{-12}\ C^2/Nm^2$, $e = 1.60 \times 10^{-19}$ C, $m_e = 9.11 \times 10^{-31}$ kg
$\mu_o = 4\pi \times 10^{-7}$ T m/A

1) Two hollow conducting spheres have a common center O. The dimensions of the spheres are as shown. A charge of -270 nC is placed on the inner conductor and a charge of +60 nC is placed on the outer conductor. The inner and outer surfaces of the spheres are respectively denoted by A, B, C, and D, as shown:



The charges on surfaces C and D respectively, in nC, are closest to:
A) +270 and -210
B) +270 and +60
C) +60 and 0
D) +60 and -210
E) 0 and +60

2) A 5.0 C point charge is placed at the center of a cube. The absolute value of the electric flux in $N{\cdot}m^2/C$ through one side of the cube is closest to
A) 5.6×10^{11} B) 9.4×10^{10} C) 7.1×10^{10} D) 0 E) 1.4×10^{11}

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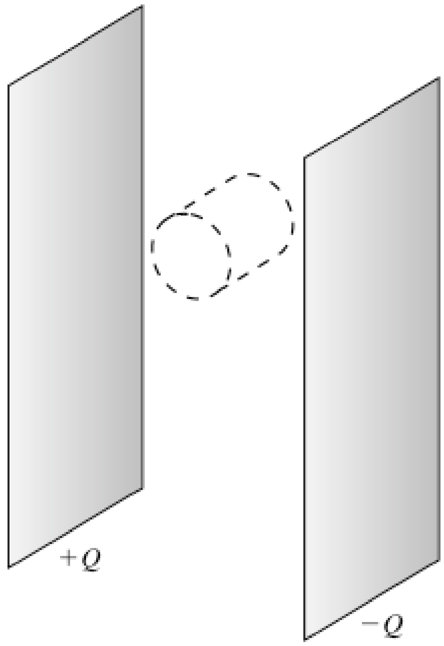
3) A Gaussian cylindrical pillbox is situated inside a parallel plate capacitor (with one plate positively charged and one plate negatively charged), as shown below. The axis of the cylindrical pillbox is parallel to the plates of the capacitor, so that the plane caps of the cylinder are perpendicular to the plates. The height of the cylider is L and the radius of the caps is R. The surface charge density of the positively charged plate is η.



The net electric flux through the pillbox is

A) zero.

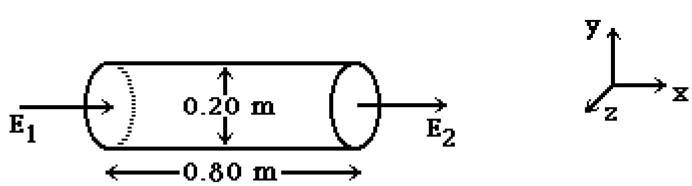
B) $(2\pi R^2 + 2\pi R L)\,\eta/\varepsilon_0$

C) $\pi R^2\,\eta/\varepsilon_0$

D) $2\pi R^2\,\eta/\varepsilon_0$

E) $2\pi R L\,\eta/\varepsilon_0$

4) A nonuniform electric field is directed along the x-axis at all points in space. This magnitude of the field varies with x, but not with respect to y or z. The axis of a cylindrical surface, 0.80 m long and 0.20 m in diameter, is aligned parallel to the x-axis. The electric fields E_1 and E_2, at the ends of the cylindrical surface, have magnitudes of 4000 N/C and 7000 N/C respectively, and are directed as shown:



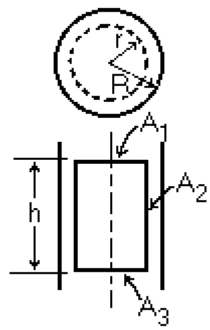
The charge enclosed by the cylindrical surface is closest to:

A) 3.6 nC B) -3.6 nC C) 0.83 nC D) -0.83 nC E) 1.8 nC

5) A flat 1.0 m^2 surface is vertical at $x = 2.0$ m and parallel to the yz–plane. What is the flux through the surface if it is located in a uniform electric field given by $\vec{E} = 21.0\,\hat{i} + 42.0\,\hat{j} + 62.0\,\hat{k}$ N/C?

A) 110 N•m^2/C B) 45 N•m^2/C C) 66 N•m^2/C D) 21 N•m^2/C

6) Consider an infinitely long cylindrical distribution of charge with constant density ρ and radius R.



In attempting to find the electric field at a point inside the cylinder a distance r from the axis (r < R) the calculation might go as sketched here:

$$\int_A \vec{E} \cdot d\vec{A} = \frac{1}{\varepsilon_o} \int_o^r \rho 2\pi r h dr \qquad (1)$$

$$\int_A \vec{E} \cdot d\vec{A} = \int_{A_1} \vec{E} \cdot d\vec{A} + \int_{A_2} \vec{E} \cdot d\vec{A} + \int_{A_3} \vec{E} \cdot d\vec{A} \qquad (2)$$

$$= \int_{A_2} \vec{E} \cdot d\vec{A} \qquad (3)$$

$$= \vec{E} \int_{A_2} d\vec{A} \qquad (4)$$

We are able to go from equation (2) to equation (3) because

A) E is perpendicular to $d\vec{A}$ over A_1 and A_3.
B) E is constant over the surface A_2.
C) E is zero on A_1 and A_2.
D) there is no charge on surfaces A_1 or A_3.
E) the contributions from the integrals over A_1 and A_3 although non-zero have equal magnitude but opposite sign and thus cancel.

7) A 100.0 m long rod with a diameter of 3.0 mm has a charge of 1049.0 C. What is the approximate electric field 2.0 mm from the surface of the rod, not near either end? ($\hat{r}$ is a unit vector pointing radially away from the axis of the rod)

A) $-9.4 \times 10^{11}\ \hat{\mathbf{r}}$ N/C
B) $9.4 \times 10^{13}\ \hat{\mathbf{r}}$ N/C
C) $9.4 \times 10^{11}\ \hat{\mathbf{r}}$ N/C
D) $5.4 \times 10^{13}\ \hat{\mathbf{r}}$ N/C
E) $-5.4 \times 10^{13}\ \hat{\mathbf{r}}$ N/C

8) Charge Q is distributed uniformly throughout an insulating sphere of radius R. The magnitude of the electric field at a point $R/3$ from the center is closest to

A) $\frac{Q}{12\pi\varepsilon_0 R^2}$

B) $\frac{3Q}{4\pi\varepsilon_0 R^2}$

C) $\frac{Q}{\pi\varepsilon_0 R^2}$

D) $\frac{Q}{3\pi\varepsilon_0 R^2}$

E) none of the above

Answer Key
Testname: QZ2

1) A
2) B
3) A
4) C
5) D
6) A
7) D
8) A

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