Name: _____ **Date:** _____ **Period:** _____

AP Physics C
Electrostatics HO29

1.) Consider a uniform electric field in the +x-direction with magnitude $E = 5.00 \times 10^3$ N/C. (UP 23-4)

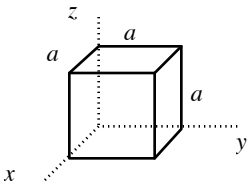
a.) A cube that is 0.0800 m on a side is placed in this field. What is the magnitude of the electric flux through one face of the cube if the normal to that face makes an angle of 53.1° with the field direction?

b.) What is the total electric flux through all sides of the cube?

2.) A cube has sides of length $a = 0.200$ m. It is placed, with one corner at the origin, in a uniform electric field given by $\mathbf{E} = (2.50 \text{ N/C})\mathbf{i} - (4.20 \text{ N/C})\mathbf{j}$. (UP 23-5)

a.) Find the electric flux through each of the six cube faces.

b.) Find the electric flux through the entire cube.



Problem 2

3.) A closed surface encloses a net charge of 4.80 μC. What is the net electric flux through the surface? (UP 23-7)

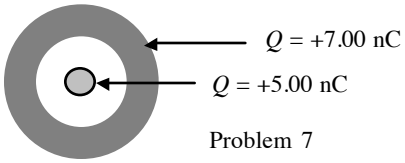
4.) A point charge $q = 3.60$ nC is at the center of a cube with sides of length 0.200 m. What is the electric flux through one of the six faces of the cube? (UP 23-9)

5.) A point charge $q_1 = 5.00$ nC is located at the origin, and a second point charge $q_2 = -3.00$ nC is on the x-axis at $x = 1.00$ m. What is the total electric flux due to these two point charges through a spherical surface centered at the origin and with radius
a.) 0.500 m? b.) 1.50 m? c.) 2.50 m? (UP 23-10)

6.) A solid metal sphere of radius 0.600 m carries a net charge of 0.150 nC. Find the magnitude of the electric field. (UP 23-14)

a.) at a point 0.100 m outside the surface of the sphere

b.) at a point inside of the sphere, 0.100 m below the surface.



Problem 7

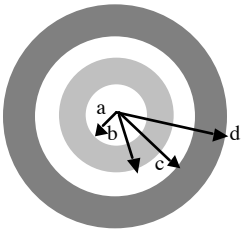
7.) A spherical conductor with an inner cavity, carries a charge of +7.00 nC. The charge within the cavity, insulated from the conductor, is +5.00 nC. How much charge is on (UP 23-18)

a.) the inner surface of the conductor? b.) the outer surface of the conductor?

8.) A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d. The inner shell has total charge $+2q$, and the outer shell has charge $+4q$. (UP 23-29)

a.) Calculate the electric field in terms of q and distance r from the common center of the two shells for
i.) $r < a$ ii.) $a < r < b$ iii.) $b < r < c$ iv.) $c < r < d$ v.) $r > d$.

b.) What is the total charge on the i.) inner surface of the small shell; ii.) outer surface of the small shell; iii.) inner surface of the large shell; iv.) outer surface of the large shell?



Problems 8, 9, and 10

9.) Repeat Problem 8, but now let the outer shell have a charge of $-2q$ and the inner shell a charge of $+2q$. (UP 23-30)

10.) Repeat Problem 8, but now let the outer shell have a charge of $-4q$ and the inner shell a charge of $+2q$. (UP 23-31)

Name: _____ **Date:** _____ **Period:** _____

AP Physics C
Electrostatics HO30

1.) A solid conducting sphere of radius R carries a positive total charge Q. The sphere is surrounded by an insulating shell with inner radius R and outer radius $2R$. The insulating shell has a uniform charge density ρ. (UP 23-32)

a.) Find the value of ρ so that the net charge of the entire system is zero.

b.) If ρ has the value found in part (a), find the electric field in each of the regions $0 < r < R$, $R < r < 2R$, $r > 2R$.

c.) Draw a graph of the electric field magnitude as a function of r.

2.) A solid conducting sphere of radius R that carries positive charge Q is concentric with a very thin insulating shell of radius $2R$ that also carries charge Q. The charge Q is distributed uniformly over the insulating shell. (UP 23-27)

a.) Find that electric-field in each of the regions $0 < r < R$, $R < r < 2R$, $r > 2R$.

b.) Draw a graph of the electric field magnitude as a function of r.

3.) A very long solid cylinder of radius R has positive charge uniformly distributed throughout it, with charge per unit volume ρ. (UP 23-34)

a.) Derive the expression s for the electric field inside and outside the cylinder at a distance r from the axis of the cylinder in terms of the charge density ρ.

b.) Draw a graph of the electric field as a function of r from $r = 0$ to $r = 3R$.

c.) What is the electric field in terms of the charge per unit length λ in the cylinder?

4.) A very long conducting tube (hollow cylinder) has inner radius a and outer radius b. It carries charge per unit length $+\lambda$. A line of charge lies along the axis of the tube. The line of charge also has a charge per unit of $+\lambda$. (UP 23-36)

a.) Calculate the electric field in terms of λ and the distance r from the axis of the tube for i.) $r < a$ ii.) $a < r < b$, iii.) $r > b$. Show your results as a graph of E as a function of r.

b.) What is the charge per unit length on i.) the inner surface of the tube; ii.) the outer surface of the tube.

5.) Repeat Problem 4, but now let the conducting tube have a charge of $-\lambda$. (UP 23-37)

6.) Two infinite parallel surfaces carry uniform charge densities of 0.20 nC/m^2 and –0.60 nC/m^2. What is the electric field at a point between the two surfaces?

7.) Two infinite, uniformly charged, flat surfaces are mutually perpendicular. One of the sheets has a charge density of 60 pC/m^2, and the other carries a charge density of –80 pC/m^2. What is the electric field at any point not on either surface?

8.) Charge is uniformly distributed along the entire x-axis. If each 20 cm length of the x-axis carries 2.0 nC of charge, what is the magnitude of the electric field at the point, $y = 2.0$ m, on the y-axis?

9.) A charge of 6.0 μC is uniformly distributed in a cylindrical region having an inner radius of 2.0 cm and an outer radius of 4.0 cm. The cylinder is 4.0 m long. Consider a 2.0 m long cylindrical surface with a radius of 3.0 cm that is coaxial with the charged cylinder. Determine the electric flux through the surface.

10.) A uniform linear charge density of 4.0 nC/m is distributed along the entire x-axis. Consider a spherical surface with a radius of 5.0 cm centered on the origin. Determine the electric flux through this surface.

11.) A solid nonconducting sphere (radius 12 cm) has a charge of uniform density of 5.0 nC/m^3. Determine the magnitude of the electric field a.) 5.0 cm from its center. b.) 24 cm from its center.