Physics 202 MWF10:20 Spring 2006 (Ford)

Name (printed) With Answers

Name (signature as on ID)_____

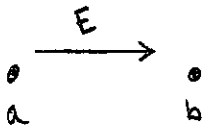
Lab Section_____

Exam I Chapts. 18–19 in Cutnell and Johnson 6e

Multiple choice questions. Circle the correct answer. No work need be shown and no partial credit will be given.

(4 pts) 1. Points a and b are in a region of uniform electric field. The electric field is directed to the right and point b is 20 cm to the right of point a. The potential difference $V_a - V_b$ between points a and b is

b (a) zero ($V_a = V_b$)
(b) positive ($V_a > V_b$)
(c) negative ($V_a < V_b$)



(4 pts) 2. A hollow spherical conductor has inner radius r_a and outer radius r_b. (That is, the conductor is a sphere of radius r_b and has a hollow cavity at its center that has radius r_a.) The conductor has net charge $-3q$ and there are no other charges present. Let V_b be the electric potential at the outer surface and let V_a be the potential at the inner surface. The potential difference $V_b - V_a$ between the outer and inner surfaces of the conductor is

a (a) zero ($V_a = V_b$)
(b) positive ($V_b > V_a$)
(c) negative ($V_b < V_a$)

(4 pts) 3. A hollow spherical conductor has inner radius r_a and outer radius r_b. (That is, the conductor is a sphere of radius r_b and has a hollow cavity at its center that has radius r_a.) The conductor has net charge $-3q$. This is in addition a point charge $+5q$ that is at the center of the hollow space (at $r = 0$). The total charge on the outer surface of the conductor is

(a) zero
(b) $-2q$
(c) $-3q$
(d) $-5q$
(e) $-8q$
f (f) $+2q$
(g) $+3q$
(h) $+5q$
(i) $+8q$

(4 pts) 4. A parallel-plate, air-filled capacitor is charged by connecting it to a battery. The capacitor is disconnected from the battery but the charge remains on the plates. After it is disconnected from the battery, the plates are pulled apart so that the distance between the plates is doubled. While this is being done the charge on the plates of the capacitor doesn't change. When the plates are pulled apart, the energy stored in the capacitor

a (a) increases
(b) decreases
(c) stays the same

On the following problems show all your work. Partial credit will be given if earned. Write your answers in the blanks provided.

(16 pts) 5. A particle with charge $-2\ \mu$C moves along the x axis in a region of uniform electric field that is directed along the x axis. When the particle is at $x = 0.30$ m the electrical potential energy of the particle is 4.0×10^{-4} J and when it is at $x = 0.40$ m the electrical potential energy of the particle is 6.0×10^{-4} J. What are the magnitude and direction ($+x$ or $-x$) of the constant electrical field in this region?

Ans. magnitude 1000 V/m

direction +x direction

(16 pts) 6. A small sphere with charge $+3\ \mu$C is held fixed at the origin. A second small sphere with charge $-5\ \mu$C is released from rest on the x axis at $x = +5.0$ m.

a) How much work is done on the sphere with $-5\ \mu$C charge by the electrical force as this sphere moves from $x = 5.0$ m to $x = 3.0$ m? Is this work positive or negative?

Ans. magnitude 0.018 J

sign positive

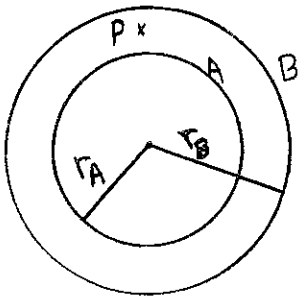
b) What is the kinetic energy of the sphere with $-5\ \mu$C charge when it reaches the point $x = 3.0$ m?

Ans. 0.018 J

(16 pts) 7. Two thin spherical shells have a common center. Shell A has radius $r_A = 0.080$ m and charge $+3.0$ μC spread uniformly over its surface. Shell B has radius $r_B = 0.120$ m and charge -5.0 μC spread uniformly over its surface. Point P is at a distance of 0.100 m from the common center of the two shells, so is in the air space midway between the two shells. Calculate the magnitude and direction (inward or outward) of the net electric field at point P.

Ans. $E =$ 2.7×10^6 N/C

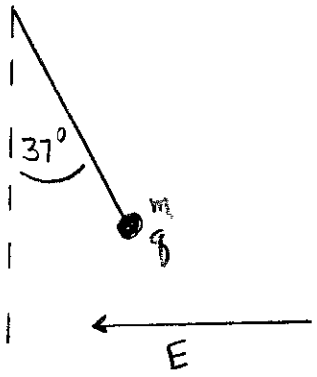
direction outward



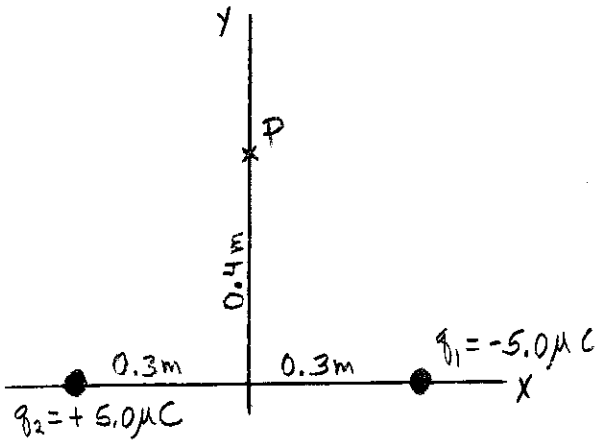
(16 pts) 8. A small sphere with mass 4.0×10^{-4} kg and charge q is suspended by an insulated thread. There is a uniform electric field $E = 8.0 \times 10^4$ N/C that is directed to the left. At equilibrium the thread makes an angle of 37° to the right of the vertical, as shown in the sketch. What is the magnitude of q and is it positive or negative?

Ans. $q =$ 3.7×10^{-8} C

positive or negative? negative



(20 pts) 9. Two point charges q_1 and q_2 are placed on the x axis. $q_1 = -5.0\ \mu$C and is at $x = +0.30$ m. $q_2 = +5.0\ \mu$C and is at $x = -0.30$ m. Point P is on the y axis, at $y = 0.40$ m.



a) What are the x and y components at point P of the resultant electric field that is produced by q_1 and q_2?

Ans. $E_x =$ $+2.16 \times 10^5$ N/C

$E_y =$ 0

b) What is the net electric potential V at point P that is produced by q_1 and q_2?

Ans. 0