

Name (printed) With Answers

Name (signature as on ID) \_\_\_\_\_

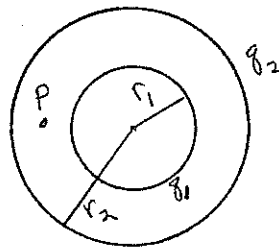
Lab Section \_\_\_\_\_

Exam I Chaps. 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.

(5 pts) 1. Two concentric spherical shells have radii  $r_1 = 0.2$  m and  $r_2 = 0.4$  m. The inner shell has positive charge  $q_1 = 2 \times 10^{-9}$  C distributed uniformly over its surface and the outer shell has negative charge  $q_2 = -6 \times 10^{-9}$  C distributed uniformly over its surface. What is the magnitude of the electric field at point  $P$  that is at  $r = 0.3$  m, midway between the two shells?

- b
- (a) zero
  - (b) 200 N/C
  - (c) 400 N/C
  - (d) 600 N/C
  - (e) 800 N/C
  - (f) none of these answers

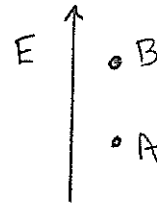


(5 pts) 2. A small object with negative charge is released from rest at point  $A$ . The only force on the object is the electric force. When the object reaches point  $B$  it has speed 30 m/s. How are the electric potentials at points  $A$  and  $B$  related?

- b
- (a) potential at  $B$  equals the potential at  $A$
  - (b) potential at  $B$  is greater than the potential at  $A$
  - (c) potential at  $B$  is less than the potential at  $A$

(5 pts) 3. There is a uniform electric field directed upward. Point  $B$  is 0.2 m above point  $A$ . How are the potentials at  $A$  and  $B$  related?

- (a) potential at  $B$  equals the potential at  $A$   
(b) potential at  $B$  is greater than the potential at  $A$   
C (c) potential at  $B$  is less than the potential at  $A$

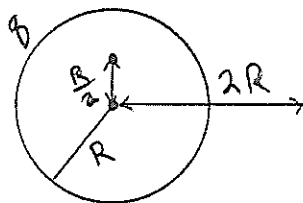


(5 pts) 4. A small object with negative charge is placed in an electric field that is directed upward. The electric force on the object is

- (a) zero  
C (b) upward  
(c) downward

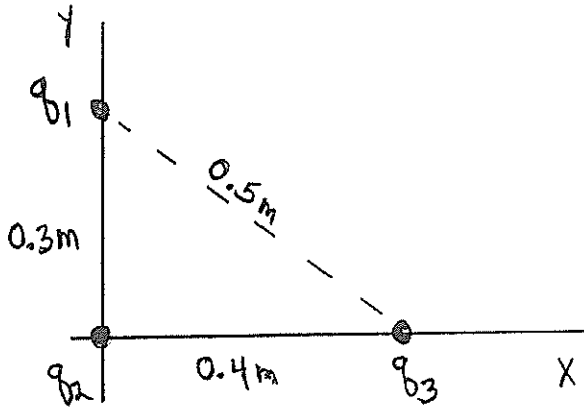
(5 pts) 5. A solid conducting sphere with radius  $R$  and net charge  $q$  produces an electric potential of 500 V at a point that is  $2R$  from its center. What is the electric potential at a point inside the sphere, a distance  $R/2$  from its center?

- (a) zero  
(b) 125 V  
(c) 250 V  
(d) 500 V  
e (e) 1000 V  
(f) 2000 V  
(g) none of these



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

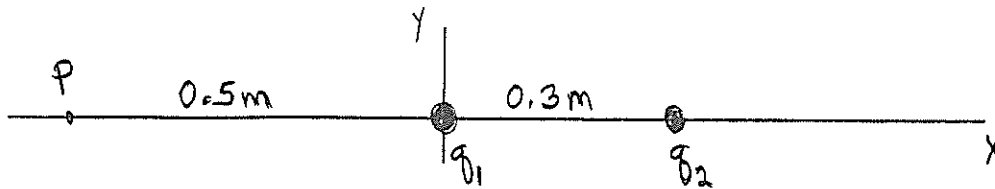
(20 pts) 6. Positive point charge  $q_1 = +6.0 \times 10^{-6}$  C is on the  $y$  axis at  $y = 0.30$  m, negative point charge  $q_2 = -4.0 \times 10^{-6}$  C is at the origin and positive point charge  $q_3 = +8.0 \times 10^{-6}$  C is on the  $x$  axis at  $x = 0.40$  m. What are the  $x$  and  $y$  components of the net force exerted on  $q_1$  by  $q_2$  and  $q_3$ ? Be sure to include the correct sign of each force component as part of your answer.



Ans.  $F_x = \underline{-1.38\text{ N}}$

$F_y = \underline{-1.36\text{ N}}$

(18 pts) 7. Negative point charge  $q_1 = -3.0 \times 10^{-6} \text{ C}$  is at the origin. Point charge  $q_2$  is on the  $x$  axis at  $x = 0.30 \text{ m}$ . Point  $P$  is on the negative  $x$  axis at  $x = -0.50 \text{ m}$ .



a) What is  $q_2$  (magnitude and sign) if the resultant electric field  $E$  at point  $P$  is zero?

Ans.  $+7.68 \times 10^{-6} \text{ C}$

b) What is  $q_2$  (magnitude and sign) if the resultant electric potential  $V$  at point  $P$  is zero?

Ans.  $+4.8 \times 10^{-6} \text{ C}$

(18 pts) 8. Positive point charge  $q_1 = +5.0 \times 10^{-4} \text{ C}$  is held at a fixed position. A small object with mass  $4.0 \times 10^{-3} \text{ kg}$  and charge  $q_2 = -3.0 \times 10^{-4} \text{ C}$  is projected toward  $q_1$ . Gravity can be neglected. When  $q_2$  is 0.40 m from  $q_1$  its speed is 800 m/s. What is its speed when it is 0.20 m from  $q_1$ ?

Ans. 1526 m/s

(19 pts) 9. The plates of a parallel-plate capacitor each have area  $2.0 \times 10^{-4} \text{ m}^2$  and are separated by a distance of  $3.0 \times 10^{-3} \text{ m}$ . There is air between the plates. One plate has charge  $q = +6.0 \times 10^{-12} \text{ C}$  and the other plate has charge  $-6.0 \times 10^{-12} \text{ C}$ .

a) What is the potential difference between the two plates of the capacitor?

Ans. 10.2 V

b) What is the magnitude of the electric field at a point midway between the two plates?

Ans.  $3.39 \times 10^3 \text{ N/C}$

c) A dielectric with dielectric constant 5.0 is inserted between the plates of the capacitor while the charge on the plates stays constant. The dielectric completely fills the region between the plates. What is the potential difference between the two plates after the dielectric has been inserted?

Ans. 2.04 V