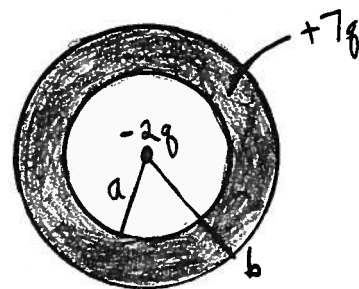


Exam I Chaps. 17-18 in Young&Geller 8e

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

(5 pts) 1. A hollow conducting sphere has inner radius $r = a$ and outer radius $r = b$. The sphere carries a net charge of $+7q$, where q is a positive constant. A point charge $-2q$ is placed at the center of the hollow space, at $r = 0$. In the hollow space, where $r < a$, the expression for the resultant electric field due to all the charges is

- (a) zero
 b (b) $k(2q)/r^2$, toward the point charge
 (c) $k(2q)/r^2$, away from the point charge
 (d) $k(7q)/r^2$, toward the point charge
 (e) $k(7q)/r^2$, away from the point charge
 (f) $k(5q)/r^2$, toward the point charge
 (g) $k(5q)/r^2$, away from the point charge



(5 pts) 2. For the same objects and charges as in problem 1, the electric field within the conductor, where $a < r < b$, is

- a (a) zero
 (b) $k(2q)/r^2$, toward the point charge
 (c) $k(2q)/r^2$, away from the point charge
 (d) $k(7q)/r^2$, toward the point charge
 (e) $k(7q)/r^2$, away from the point charge
 (f) $k(5q)/r^2$, toward the point charge
 (g) $k(5q)/r^2$, away from the point charge

(5 pts) 3. Two protons are placed close to each other and released from rest. The protons repel each other and move apart. As they move apart,

- (a) their speed and acceleration are both constant
 (b) their speed and acceleration decrease
 (c) their speed and acceleration increase
 d (d) their speed increases and their acceleration decreases
 (e) their speed decreases and their acceleration increases

(5 pts) 4. A parallel-plate capacitor is charged and then disconnected from the battery, so that the charge Q on its plates can't change. Originally the separation between the plates of the capacitor is d and the electrical energy stored in the capacitor is 8 J. If the plates are moved farther apart, so that their separation is doubled and becomes $2d$, what then is the energy stored in the capacitor?

- (a) 2 J
(b) 4 J
(c) 8 J
 (d) 16 J
(e) 32 J

(5 pts) 5. A parallel-plate capacitor is charged and then disconnected from the battery, so that the charge Q on its plates can't change. Originally the separation between the plates of the capacitor is d and the electrical field between the plates of the capacitor is $E = 6.0 \times 10^4$ N/C. If the plates are moved closer together, so that their separation is halved and becomes $d/2$, what then is the electrical field between the plates of the capacitor?

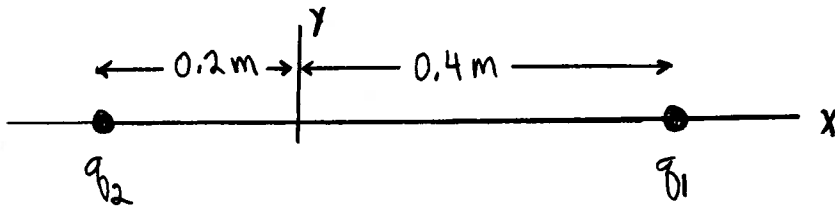
- (a) 1.5×10^4 N/C
(b) 3.0×10^4 N/C
 (c) 6.0×10^4 N/C
(d) 12.0×10^4 N/C
(e) 24.0×10^4 N/C

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

(17 pts) 6. A positive point charge $q_1 = +6.0 \times 10^{-9}$ C is held fixed at the same point and can't move. A second point charge, with charge $q_2 = -3.0 \times 10^{-9}$ C is released from rest at a point 0.80 m from q_1 . What is the kinetic energy of q_2 when it is 0.40 m from q_1 ?

Ans. $+ 2.02 \times 10^{-7}$ J

(20 pts) 7. Two point charges are placed along the x -axis, as shown in the sketch. Charge $q_1 = -6.0 \times 10^{-9}$ C is at $x = +0.40$ m and charge $q_2 = +3.0 \times 10^{-9}$ C is at $x = -0.20$ m.



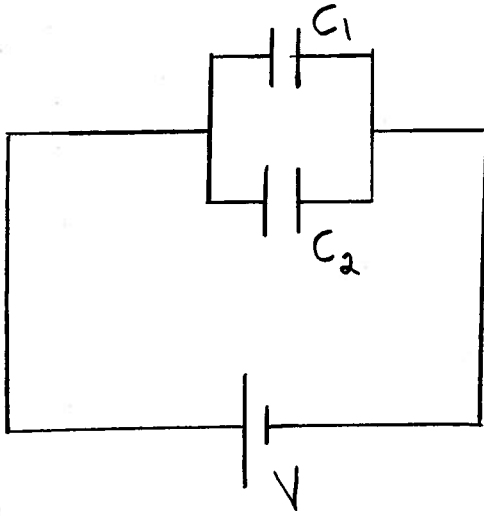
a) What is the x -component E_x of the resultant electric field at the origin that is produced by these two charges? Be sure to include the correct $+$ or $-$ sign with your answer.

Ans. + 1013 N/C

b) What is the electric potential V at the origin that is produced by these two charges? Be sure to include the correct $+$ or $-$ sign with your answer.

Ans. zero

(18 pts) 8. Two capacitors $C_1 = 2 \times 10^{-6} \text{ F}$ and $C_2 = 4 \times 10^{-6} \text{ F}$ are connected to a battery, as shown in the sketch. If the charge on C_1 is $Q_1 = 5.0 \times 10^{-6} \text{ C}$, what is the voltage V_1 for C_1 and what are the voltage V_2 and charge Q_2 for the C_2 capacitor?



Ans. $V_1 = \underline{2.5 \text{ V}}$
 $V_2 = \underline{2.5 \text{ V}}$
 $Q_2 = \underline{10 \times 10^{-6} \text{ C}}$

(20 pts) 9. An object with charge $q = -6.0 \times 10^{-9} \text{ C}$ is placed in a region of uniform electric field. The charge is released from rest at point A . After the charge has moved 0.50 m to the right, to point B , it has kinetic energy $3.0 \times 10^{-7} \text{ J}$.

a) If the electric potential at point A is +30 V, what is the electric potential at point B ?

Ans. +80 V

b) What are the magnitude and direction of the electric field in this region?

Ans. magnitude 100 N/C
direction (to the left or to the right) to the left