Chapter 12
Electrostatics

Homework # 95

Useful Information

Coulomb's constant for air, $k = 9.0 \times 10^{9}\ N \cdot m^2 / C^2$
permittivity of empty space, $\varepsilon_o = 8.85 \times 10^{-12}\ C^2 / N \cdot m^2$
charge of an electron, $q_e = -1.60 \times 10^{-19}\ C$
mass of an electron, $m_e = 9.11 \times 10^{-31}\ kg$
charge of a proton, $q_p = +1.60 \times 10^{-19}\ C$
mass of a proton, $m_p = 1.67 \times 10^{-27}\ kg$
charge of a neutron, $q_n = 0\ C$
mass of a neutron, $m_n = 1.67 \times 10^{-27}\ kg$
charge of an alpha particle (helium nucleus), $q_\alpha = +3.20 \times 10^{-19}\ C$
mass of an alpha particle (helium nucleus), $m_\alpha = 6.68 \times 10^{-27}\ kg$
one atomic mass unit, $1\ u = 1.67 \times 10^{-27}\ kg$

Dielectric Constants (at 20°C)

Material	Dielectric Constant, *K*
Vacuum	1.0000
Air (1 atm)	1.0006
Paraffin	2.2
Rubber, Hard	2.8
Vinyl (Plastic)	2.8 - 4.5
Paper	3 - 7
Quartz	4.3
Glass	4 - 7
Porcelain	6 - 8
Mica	7
Ethyl Alcohol	24
Water	80

Chapter 12
Electrostatics

12.1 Coulomb's Law — Homework #96

See Homework #95 in this chapter for the table of "Useful Information" such as mass and charge of a proton and an electron.

I

01. A pith ball has a surplus of 3.45 x10^{14} electrons. What is the net charge on this ball?

02. How many electrons are needed to produce a charge of -0.850 μC?

03. An electroscope has 5.87 x 10^{16} more protons than electrons. What is the net charge on this electroscope?

04. Two charged bodies exert a force of 0.72 N on each other.
    a.) What will be the force that each exerts on the other if they are moved so that they are six times as far apart?
    b.) What will be the force that each exerts on the other if they are moved so that they are one-sixth as far apart?

05. A pith ball that has a residual charge of -48.0 μC is placed in contact with a second identical pith ball that initially has a charge of 26 μC. Charges will flow until an electrostatic equilibrium is reached.
    a.) What will be the charge on each pith ball when this equilibrium is reached?
    b.) How many extra electrons are on each pith ball when this equilibrium is reached?

06. A conducting sphere (Sphere A) has a residual charge of +86 μC is placed in contact with a second conducting sphere (Sphere B) with twice the surface area and initially containing a residual charge of -17 μC. What is the charge on each sphere upon equilibrium?

07. What is the magnitude of the electrostatic force of attraction between an iron nucleus (q = +26e) and one of its innermost electrons at a distance of 1.50 x 10^{-12} m.

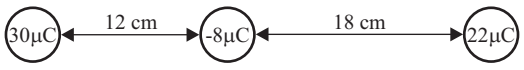
08. What will be the magnitude of the electrostatic force between two pith balls 18 cm apart if one has a charge of -37 μC and the other has a charge of 19 μC?

09. What is the magnitude of the electrostatic force between two protons in the nucleus of an atom that are separated by a distance of 5.6 x 10^{-15} m (5.6 Fermi)?

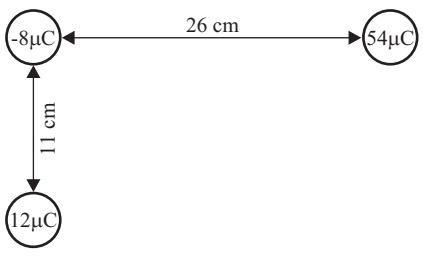
II

10. Calculate the net electrostatic force (magnitude and direction) acting on the -8.00 μC in each of the following arrangement of charges.

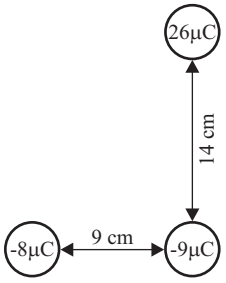
a.)



b.)



c.)



ANSWERS: **01.** -5.52 x 10^{-5} C (-55.2 μC) **02.** 5.31 x10^{12} **03.** 9.39 x10^{-3} C (9.39 mC) **04.** a.) 0.02 N **04.** b.) 25.92 N **05.** a.) -11 μC b.) 6.88 x10^{13} **06.** +23 μC, +46 μC **07.** 2.66 x 10^{-3} N **08.** 195 N **09.** 7.35 N **10.** a.) 101 N to the left b.) 91.7 N @ 51.1° below + x-axis c.) 71.6 N @ 52.6° above - x-axis

Chapter 12
Electrostatics
12.2 Electric Fields-Point Sources — Homework #97

See Homework #95 in this chapter for the table of "Useful Information" such as mass and charge of a proton and an electron.

I

01. Sketch the electric field lines for each of the following arrangements. Use 8 field lines per charge, *q*.

a.)

b.)

c.)

d.)

e.)

02. An electron is placed in a uniform electric field with a magnitude 2250 N/C.
    a.) What is the magnitude of the force on the electron from this field?
    b.) Describe the direction of this force relative to the direction of the electric field.
    c.) What is the magnitude of the acceleration of the electron?

03. A proton is placed in a uniform electric field with a magnitude 2250 N/C.
    a.) What is the magnitude of the force on the proton from this field?
    b.) Describe the direction of this force relative to the direction of the electric field.
    c.) What is the magnitude of the acceleration of the proton?

04. An electrostatic force of 2.94×10^{-3} N is exerted in an upward direction on a 0.735 μC charge. What is the magnitude and direction of the electric field at this point?

05. What is the charge on an object that experiences a force of 18.2 N when placed in an electric field of 1825 N/C?

ANSWERS: **02.** a.) 3.60×10^{-16} N b.) opposite c.) 3.95×10^{14} m/s^2
03. a.) 3.60×10^{-16} N b.) same c.) 2.16×10^{11} m/s^2 **04.** 4000 N/C up **05.** 9.97 mC

Chapter 12
Electrostatics
12.3 Vector Nature of Electric Fields-Point Sources Homework #98

See Homework #95 in this chapter for the table of "Useful Information" such as mass and charge of a proton and an electron.

I

01. Two charges of +75.0 μC each are 6.00 cm apart. What is the **NET** electric field at a point midway between them?

02. Two charges of -75.0 μC each are 6.00 cm apart. What is the **NET** electric field at a point midway between them?

03. Two equal but opposite charges of 75.0 μC are 6.00 cm apart. What is the **NET** electric field at a point midway between them?

04. A charge of +75.0 μC and +150.0 μC are 6.00 cm apart. What is the **NET** electric field at a point along the line joining them that is 2.00 cm from the +75.0 μC and 4.00 cm from the +150.0 μC charge?

05. A charge of +75.0 μC and -150.0 μC are 6.00 cm apart. What is the **NET** electric field at a point along the line joining the them that is 2.00 cm from the +75.0 μC and 4.00 cm from the -150.0 μC charge?

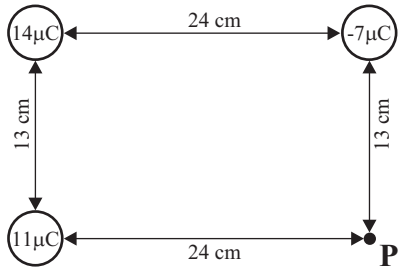
II

06. A charge of +75.0 μC and +150.0 μC are 6.00 cm apart. At what point in space is the **NET** electric field zero?

07. A charge of +75.0 μC and -150.0 μC are 6.00 cm apart. At what point in space is the **NET** electric field zero?

08. Three charges are placed at the corners of a rectangle as shown to the right.
    a.) What is the **NET** electric field at point P?
    b.) What would the net force be on an alpha particle (helium nucleus) placed at point P?
    c.) What would be the acceleration of an alpha particle placed at point P?

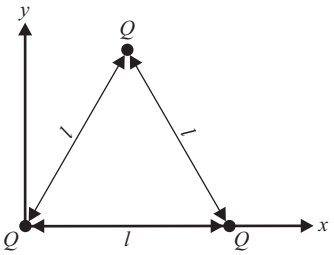
Problem 08



09. What is the acceleration of an electron in a 4200-N/C electric field?

10. What is the electric field at a point in space where a proton experiences an acceleration of 7.85 x 10^5 m/s^2?

Problems 11 and 12



Problems 11 and 12 refer to the diagram to the right which shows three identical charges of *Q* are placed at the corners of an equilateral triangle with sides of *l*.

11. Where is the **NET** electric field zero?

12. If Q = 9 μC and l = 20.0 cm, what is the **NET** electric field at the origin?

13. If a spaceship were to travel from the earth in a straight line to the moon (380,000 km away from earth), at what point along the trip would the **NET** gravitational field be zero? The mass of the moon is about $\frac{1}{81}$ that of the earth.

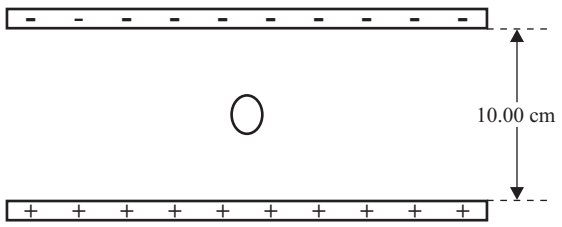
ANSWERS: **01.** 0 N/C **02.** 0 N/C **03.** 1.50 x 10^9 N/C twrd - chrg **04.** 8.44 x 10^8 N/C twrd +150 μC chrg
05. 2.53 x 10^9 N/C twrd - chrg **06.** 0.0249 m fr +75 μC chrg (0.0351 m fr 150 chrg) **07.** 0.145 m fr +75 μC chrg
08. a.) 4.34 x10^6 N/C @ 42.4° above + x-axis b.) 1.38 x 10^{-12} N (same dir) c.) 2.09 x 10^{14} m/s^2 (same dir)
09. 7.38 x 10^{14} m/s^2 **10.** 8.19 x 10^{-3} N/C **11.** (0.5*l*, 0.289*l*) **12.** 3.51 x 10^6 N/C @ 30° below - x-axis
13. 3.42 x 10^8 m from the earth (0.38 x 10^8 m from the moon)

Chapter 12
Electrostatics
12.4 Uniform Electric Fields-Two Plates — Homework # 99

II

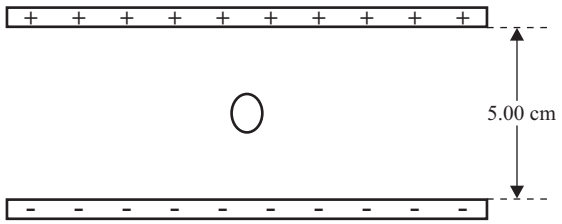
01. An oil drop with a mass of 2.45 g is suspended between two oppositely-charged plates that are 10.00 cm apart and have a potential difference of 6000 V as shown in the diagram to the right.
    a.) Show the direction of the electric field on the diagram.
    b.) What is the magnitude of the electric field?
    c.) What is the force due to gravity acting on the oil drop?
    d.) What is the charge on the oil drop?
    e.) Show the equipotential lines for 1500 V, 3000 V, and 4500 V on the diagram.

Problem 01



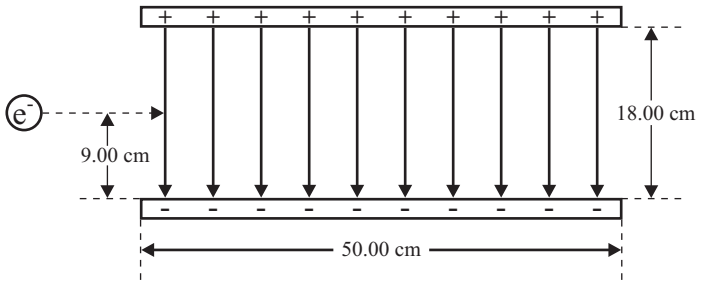
02. Another oil drop with a mass of 2.83 g is suspended between two oppositely-charged plates that are 5.00 cm apart and produce an electric field of 90,000 V/m as shown in the diagram to the right.
    a.) Show the direction of the electric field on the diagram.
    b.) What is the potential difference between the plates?
    c.) What is the force due to gravity acting on the oil drop?
    d.) What is the charge on the oil drop?

Problem 02

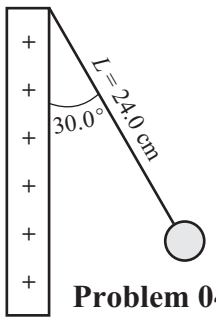


03. An electron traveling at 2.65 x 10^7 m/s enters an electric field created by two oppositely-charged plates that are 18.00 cm apart as shown in the diagram to the right. The potential difference between the two plates is 4500 V.
    a.) What is the magnitude of the electric field between the plates?
    b.) What is the electrostatic force (magnitude and direction) on the electron when it enters the field?
    c.) What is the force of gravity acting on the electron?
    d.) What is the acceleration (magnitude and direction) that the electron experiences when it enters the field?
    e.) How long will it take the electron to hit the positive plate?
    f.) How far from the left edge of the positive plate will the electron hit this plate?
    g.) If a proton entered this field what would be the acceleration (magnitude and direction) of the proton?

Problem 03



04. One end of a 24.0 cm long string is attached to a wall of positive charge producing a uniform electric field with a strength of 67,500 V/m. The other end is attached to a charged pith ball with a mass of 0.185 g as shown in the diagram to the right. The electric field from the wall acts on the pith ball causing the string to make a 30.0° angle.
    a.) What is the force of gravity acting on the pith ball?
    b.) What is the force of tension in the string?
    c.) What is the electrostatic force acting on the pith ball?
    d.) What is the charge on the pith ball?



Problem 04

ANSWERS: **01.** b.) 60,000 V/m c.) 0.0240 N d.) 0.400 μC **02.** b.) 4500 V c.) 0.0277 N d.) -0.308 μC
03. a.) 25,000 V/m b.) 4.00 x 10^{-15} N Up c.) 8.93 x 10^{-30} N d.) 4.39 x 10^{15} m/s^2 Up e.) 6.40 x 10^{-9} s
03. f.) 17.0 cm g.) 2.40 x 10^{12} m/s^2 **04.** a.) 1.81 x 10^{-3} N b.) 2.09 x 10^{-3} N c.) 1.05 x 10^{-3} N
04. d.) 1.55 x 10^{-8} C

Chapter 12
Electrostatics
12.5 Uniform Electric Fields-Potential Difference, Work, and Energy Homework # 100

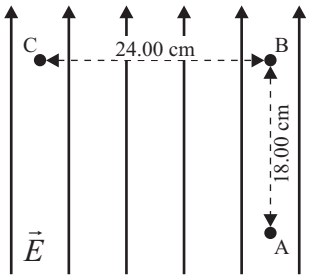
I

01. A small spherical 1.35-g conductor with a charge of 37.5 μC is placed in a uniform electric field with a strength of 65,000 V/m. The charge is mechanically moved 85.0 cm in a direction exactly opposite that of the electric field.
    a.) What is the magnitude of the electrostatic force acting on this charge?
    b.) How much work was done in moving the charge?
    c.) What is the potential difference between the points where the charge started and ended?
    d.) If the charge were released and allowed to travel back to its original point, what would be its velocity there?

II

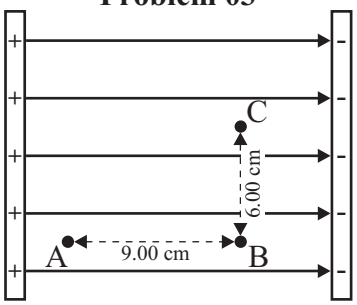
02. A 2.85-g charged particle (q = -3500 μC) is placed, initially at point A, between two oppositely-charged parallel plates that produce an electric field with a strength of $\vec{E}$ = 3750 V/m between them which is directed toward the top of the page as shown in the diagram to the right.
    a.) What is the electrostatic force (magnitude and direction) acting on this charge at point A?
    b.) What is the minimum work done in moving the charge from point A to B?
    c.) What is the potential difference between points A and B?
    d.) If the charge is released from point B, what will be its velocity as it passes point A?
    e.) What is the potential difference between points B and C?
    f.) What is the minimum work done in moving the charge from point B to C?
    g.) What is the potential difference between points A and C?
    h.) What is the minimum work done in moving the charge from point A to C?

Problem 02



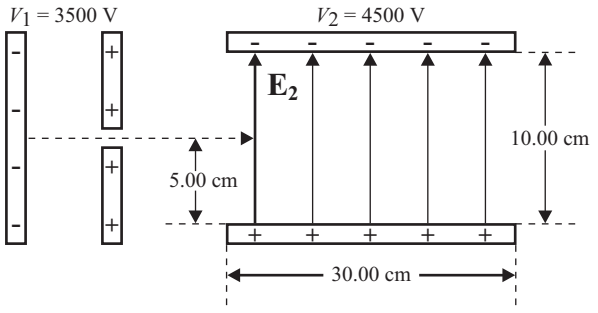
03. A proton is placed at point A between the two oppositely-charged parallel plates shown in the diagram to the right. The potential difference between the plates is 3000 V and the plates are 16.0 cm apart.
    a.) What is the electrostatic force (magnitude) acting on this charge at point A?
    b.) What is the potential difference between points A and B?
    c.) If the charge is released from A and allowed to accelerate to point B, what will be its velocity when it reaches point B?
    d.) What is the minimum work done in moving the charge from point A to C?

Problem 03



04. An AC power source heats the first negative plate in the diagram to the right allowing electrons to be "boiled off" (easily removed). The beam of electrons accelerates to the positive plate and continues at a constant speed (through a hole in this positive plate) into the second electric field between the two horizontal plates.
    a.) What is the velocity of the beam of electrons as it passes through the hole in the first positive plate?
    b.) What is the magnitude of the electric field, $\mathbf{E_2}$.
    c.) What is the force on each electron in the second field?
    d.) What is the acceleration of each electron in the second field?
    e.) Sketch the path of the beam in $\mathbf{E_2}$ and calculate how long will it takes this beam to hit the positive plate.
    f.) How far from the left edge of the positive plate will the beam of electrons exit the field (hit the positive plate)?
    g.) With what velocity will each electron strike the plate?

Problem 04



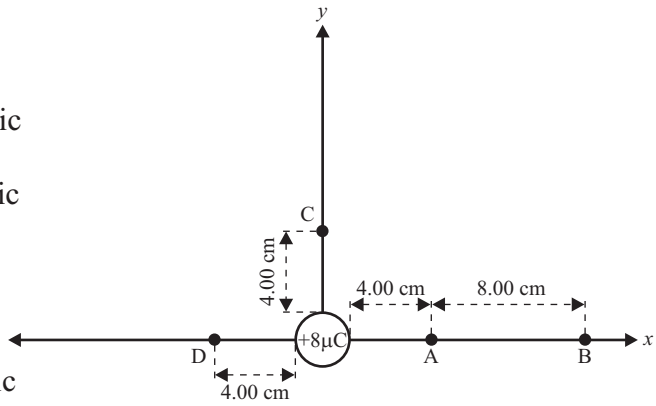
ANSWERS: **01.** A.) 2.44 N b.) 2.07 J c.) 55,250 V d.) 55.4 m/s **02.** a.) 13.1 N down b.) 2.36 J c.) 675 V d.) 40.7 m/s e.) 0 V f.) 0 J g.) 675 V h.) 2.36 J **03.** a.) 3.00×10^{-15} N b.) 1688 V c.) 5.69×10^{5} m/s **03.** d.) 2.70×10^{-16} J **04.** a.) 3.51×10^{7} m/s b.) 45,000 V/m c.) 7.20×10^{-15} N d.) 7.90×10^{15} m/s^2 **04.** e.) 3.56×10^{-9} s f.) 12.5 cm g.) 4.49×10^{7} m/s @ 38.7° below the horizontal

Chapter 12
Electrostatics
12.6 Electrostatic Potential-Point Sources — Homework # 101

I

01. A small spherical +8.00-μC charge is oriented as shown in the diagram to the right.

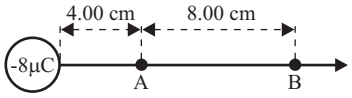
Problem 01



a.) What is the magnitude and direction of the electric field at point A?
b.) What would be the magnitude and direction of the electrostatic force acting on a proton if it were placed at A?
c.) What would be the magnitude and direction of the electrostatic force acting on an electron if it were placed at A?
d.) What is the electrostatic potential at point A?
e.) What is the magnitude and direction of the electric field at point B?
f.) What would be the magnitude and direction of the electrostatic force acting on a proton if it were placed at B?
g.) What would be the magnitude and direction of the electrostatic force acting on a electron if it were placed at B?
h.) What is the electrostatic potential at point B?
i.) Which point is at a higher potential, point A or point B? Explain!
j.) How much work is done by the field in moving a proton from point A to point B?
k.) What minimum work would be required to move a proton from point A to point B?
l.) What minimum work would be required to move an electron from point B to point A?
m.) What is the electrostatic potential at a point that is an infinite distance away?
n.) What is the potential difference between infinity and point B?
o.) What minimum work would be required to move a proton from infinity to point B?
p.) How much work is done by the field in moving a proton from point B to infinity?
q.) What minimum work would be required to move an electron from infinity to point B?
r.) What minimum work would be required to move a proton from point A to point C?
s.) What minimum work would be required to move a proton from point A to point D?

02. A small spherical -8.00-μC charge is oriented as shown in the diagram to the right.

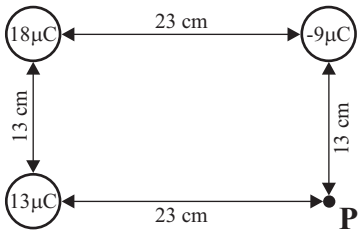
Problem 02



a.) What is the magnitude and direction of the electric field at point A?
b.) What is the potential difference between point A and point B?
c.) What minimum work would be done in moving a proton from point A to point B?
d.) What work is done by the field in moving a proton from infinity to point B?

03. Three charges are arranged as shown in the diagram to the right.

Problem 03



a.) What is the **NET** potential at point P?
b.) How much work would be required to move an alpha particle (helium nucleus) from infinity to point P?

04. Find the electrostatic potential at 52.9 pm (1 pm = 10^{-12} m) from the hydrogen nucleus. [This is the Bohr radius for an electron in the ground state]

ANSWERS: **01.** a.) 4.50×10^{7} N/C right b.) 7.20×10^{-12} N right c.) 7.20×10^{-12} N left d.) 1.80×10^{6} V
01. e.) 5.00×10^{6} N/C right f.) 8.00×10^{-13} N right g.) 8.00×10^{-13} N left h.) 6.00×10^{5} V i.) point A
01. j.) 1.92×10^{-13} J k.) -1.92×10^{-13} J l.) -1.92×10^{-13} J m.) 0 V n.) 6.00×10^{5} V o.) 9.60×10^{-14} J
01. p.) 9.60×10^{-14} J q.) -9.60×10^{-14} J r.) 0 J s.) 0 J **02.** a.) 4.50×10^{7} N/C left b.) 1.20×10^{6} V
02. c.) 1.92×10^{-13} J d.) 9.60×10^{-14} J **03.** a.) 4.99×10^{5} V b.) 1.60×10^{-13} J **04.** 27.2 V

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12.7 Capacitors — Homework # 102

See Homework #95 in this chapter for the table of "Dielectric Constants"

I

01. The two plates of a capacitor hold equal but opposite charges of 2500 μC when the potential difference is 900 V. What is the capacitance of the capacitor?

02. How much charge flows to a 6.25-μF capacitor when it is connected to a 20.0-V battery?

03. A 16,500 pF capacitor holds a charge of 0.280 μC. What is the potential difference between the two plates of the capacitor?

04. A capacitor consists of two square parallel plates 14.0 cm on a side separated by 3.45 mm of hard rubber. What is the capacitance of this capacitor?

05. What is the area of each plate of a 9.62×10^{-10} F capacitor if the plates have 2.85 mm of air between them?

06. Each of the two plates of a 90.0-pF capacitor (air gap) has an area of 0.0475 m^2. How far apart are the two plates?

07. How much energy is stored on 2750-pF capacitor when 250 V are applied to it?

II

08. The charge on a capacitor increases by 22.0 μC when the voltage across it increases from 18 V to 32 V. What is the capacitance of this capacitor?

09. Two 645-cm^2 parallel plates separated by 2.25 cm are to have an electric field of 34.0×10^6 V/m.
    a.) If the plates are separated by air, what is the charge on each plate?
    b.) If the plates are separated by mica, what is the charge on each plate?
    c.) If the plates are separated by paraffin, what is the charge on each plate?

10. What is the strength of the electric field between the plates of a 25.0-μF capacitor with an air gap of 2.70 mm if each plate has a charge of 675 μC?

11. Two square plates, 25.0 cm on a side, are separated 4.42 mm apart. Each plate holds an equal but opposite charge of 725 μC. How much energy is stored if the gap between the plates is filled with _____?
    a.) air b.) mica

III

12. A 7.25-μF capacitor is charged fully by an 18.00-V battery and then disconnected from the battery. The charged capacitor is subsequently connected to a second capacitor, C_2, that is initially uncharged. When equilibrium is reached (charges no longer flow), the voltage on the first capacitor drops to 8.00 V. What is the capacitance of C_2?

13. A 12.4-μF capacitor is charged to 1600 V while a 19.8-μF capacitor is charged to 950 V. The positive plates of the two capacitors are connected as are their negative plates. Eventually equilibrium is established.
    a.) What is the potential difference across each? b.) What is the charge on each?

ANSWERS: **01.** 2.780 μF **02.** 125 μC **03.** 17.0 V **04.** 141 pF **05.** 0.310 m^2 **06.** 4.67 mm
07. 8.59×10^{-5} J **08.** 1.57 μF **09.** a.) 19.4 μC b.) 136 μC c.) 42.7 μC **10.** 10,000V/m
11. a.) 2100 J b.) 300 J **12.** 9.00 μF **13.** a.) 1200 V b.) $Q_1' = 14.9$ mC, $Q_2' = 23.8$ mC

Chapter 12
Electrostatics

Electrostatic Review — Homework # 103

01. Consider the set of charged particles distributed as shown to the right where:

$q_A = 14.0\ \mu C$ $q_B = -5.00\ \mu C$ $q_C = 7.00\ \mu C$

$d_1 = 20.0$ cm $d_2 = 15.0$ cm

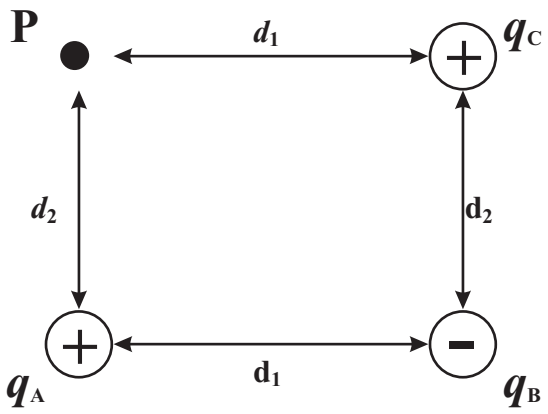
a.) What will be the magnitude of the electrostatic force between the B and C?

b.) What will the direction and magnitude of the electric field at point P?

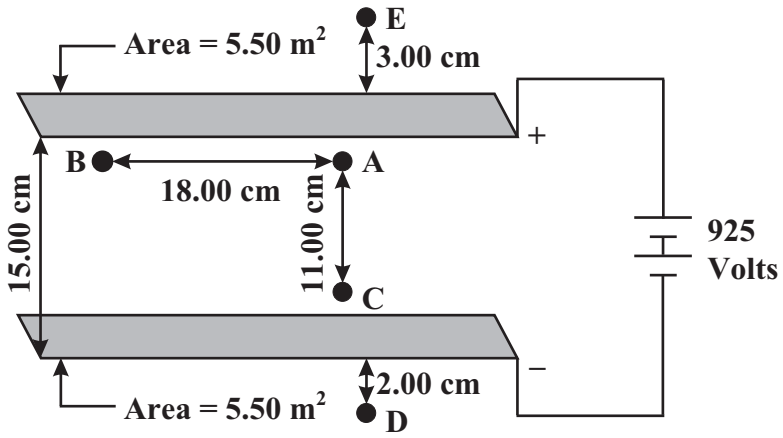
c.) What will be the electrostatic potential at point P?

d.) What will the magnitude of the electrostatic force acting on a 3.00 μC charge placed at point P?

Problem 01



Problem 02



02. A capacitor consists of two horizontal parallel plates separated by air. Each of the plates has an area of 5.50 m^2 and the plates are separated by a distance of 15.0 centimeters.

a.) What is the capacitance of this parallel plate capacitor?

b.) What would be the capacitance of this capacitor if the air between the plates is replaced by polyethylene which has a dielectric constant of 2.3?

For Parts c.) through i.), assume polyethylene is between the plates.

c.) How much charge will be stored on each plate of this capacitor under these conditions?

d.) What will be the direction and the magnitude of the electric field at point C?

e.) What will be the magnitude of the electric field at point D?

f.) How much work will be done in moving a 1.20 μC charge between point A and point B?

g.) What will be the potential difference between points B and C?

h.) What will be the potential difference between points A and C?

i.) What will be the potential difference between points D and E?

ANSWERS: **01.** a.) 14.0 N b.) 5.26×10^6 N/C @ 79.0° above the negative x-axis c.) 9.75×10^5 V
01. d.) 15.8 N @ 79.0° above the negative x-axis **02.** a.) 3.25×10^{-10} F b.) 7.46×10^{-10} F
02. c.) 6.91×10^{-7} C d.) 6167 N/C e.) 0 N/C f.) 0 J g.) 678 V h.) 678 V i.) 0 V

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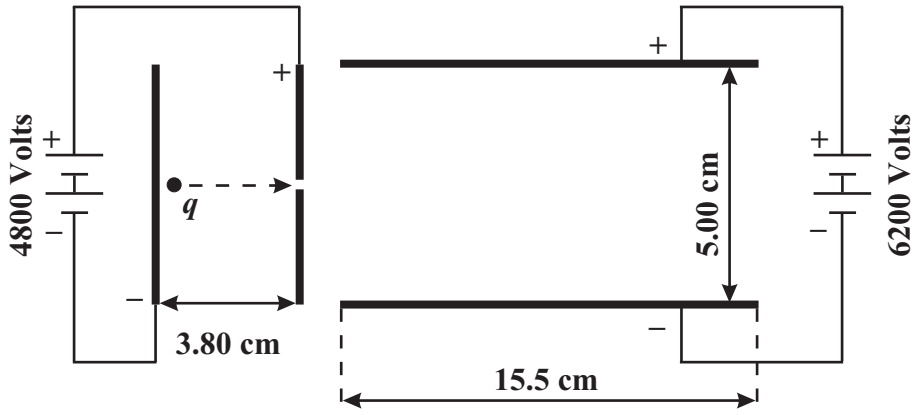
03. Two vertical plates are arranged so as to accelerate a negatively charged particle, q, which has a charge of 0.0050 μC and a mass of 1.10 x 10^{-9} grams, as shown to the right. The potential difference between the plates is 4800 V and the plates are spaced 3.80 cm apart. A second pair of plates are arranged horizontally as shown. The two horizontal plates are spaced 5.00 cm apart and are 15.5 cm long and are likewise charged to a potential of 6200 V. The charge q begins at the negative plate and then accelerates to the right until it passes through a hole in the center of the positive plate. This charge then passes into the area between the two horizontal plates exactly midway between the two plates.

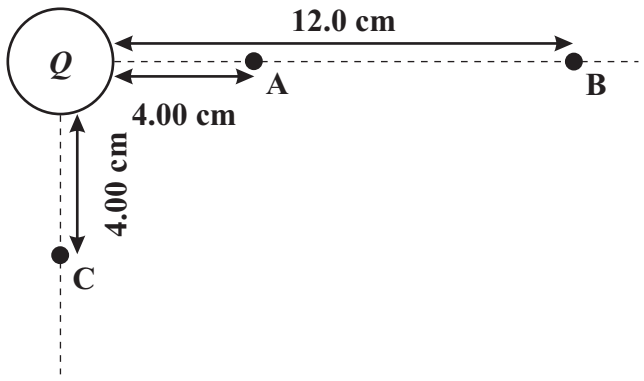
Problem 03



a.) What will be the kinetic energy of the charge q just as it passes through the hole in the positive plate?
b.) What will be the velocity of the charge as it passes through the hole in the positive plate?
c.) What will be the direction and magnitude of the force exerted on this charged particle as it passes into the space between the two horizontal plates?
d.) What will be the velocity of this particle as it exits the area between the two horizontal plates?
e.) Exactly where will the charged particle exit the electric field between the two horizontal plates?

04. Consider a point charge of Q = 8.80 μC as shown in the diagram to the right. Points A, B and C represent three points near Q. An alpha particle [q_α = +3.20 x 10^{-19} C and m_α = 6.69 x 10^{-27} kg] is located infinitely far away to the right off the edge of the paper.

Problem 04



a.) What will be the electrostatic potential at point A?
b.) How much work would be required to bring this α particle from infinity to point A?
c.) What will be the potential difference between points A and B?
d.) How much additional work would be required to move this α particle from point A to point B?
e.) What is the potential difference between point A and point C?
f.) How much work would be required to move this α particle from point A to point C?
g.) How much work would be required to move this α particle from point B to point C?
h.) Suppose that this α particle, while at point A, is released and is allowed to accelerate to point B. What will be the velocity of this α particle just as it reaches point B?

ANSWERS: **03.** a.) 2.40 x 10^{-5} J b.) 6.61 x 10^{3} m/s c.) Up; 6.20 x 10^{-4} N
d.) 8.48 x 10^{3} m/s @ 38.8° above the horizontal e.) 6.23 cm **04.** a.) 1.98 x 10^{6} V b.) 6.34 x 10^{-13} J
c.) 1.32 x 10^{6} V d.) -4.22 x 10^{-13} J e.) 0 V f.) 0 J g.) 4.22 x 10^{-13} J h.) 1.12 x 10^{7} m/s