Physics 232 — Homework up to Exam 1 – 2/7/13
General Physics 2 — Weekly HW Due Mon. 4pm

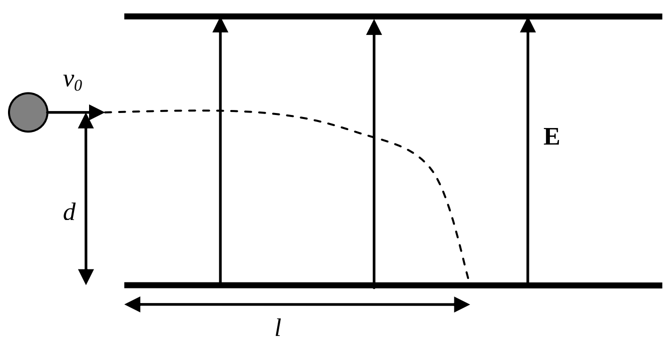
Daily	Daily	Daily	Weekly
Wed 1/9 – E1: B5, B7, S1	Fri 1/11 – E1: S7, S8 due 1pm	Mon 1/14 - E2: B3, B7	Mon 1/14 – #1-3; E2: S6
Wed 1/16 – C5S.10, C6S.6	Fri 1/18 – E2: B8, S2	Mon 1/21 – E3: B2, B4, B9	Mon 1/21 - #4-7, E1: S10
Wed 1/23 - E3: S2, S3	Fri 1/25 -TBA	Mon 1/28 – #8-9	Mon 1/28 - E3: S4(let r be d), S6, S8; #10-11
Wed 1/30 – E4: B2, B6, B8	Fri 2/1 – E4: B11, B12, #12	Mon 2/4 - #13, E4: S4	Mon 2/4 - #14-15; E4: S1, S9, S11, S12

1. The charges and coordinates of two charges particles held fixed in the xy plane are q_1 = +3.0 μC, x_1 = 3.5 cm, y_1 = 0.50 cm, and q_2 = -4.0 μC, x_2 = -2.0 cm, y_2 = 1.5 cm. (a) Find the magnitude and direction of the electrostatic force on q_2. (b) Where could you locate a third charge q_3 = +4.0 μC such that the net electrostatic force on q_2 is zero?

2. Two tiny, spherical water drops, with identical charges of -1.00×10^{-16} C, have a center-to-center separation of 1.00 cm. (a) What is the magnitude of the electrostatic force acting between them? (b) How many excess electrons are on each drop, giving its charge imbalance?

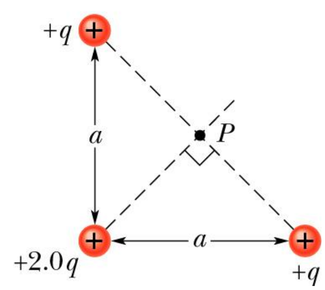
3. An electric field $\vec{E}$ with an average magnitude of about 150 N/C points downward in the atmosphere near Earth's surface. We wish to "float" a sulfur sphere weighing 4.4 N in this field by charging the sphere. (a) What charge (both sign and magnitude) must be used? (b) Why is the experiment impractical?

4. At some instant the velocity components of an electron are $v_x = 1.5 \times 10^5$ m/s and $v_y = 3.0 \times 10^3$ m/s. Suppose there is a constant electric field in this region given by $\vec{E} = \langle 0, 120 \text{ N/C}, 0 \rangle$.
(a) What is the acceleration of the electron?
(b) What will be the velocity of the electron after its *x* coordinate has changed by 2.0 cm?



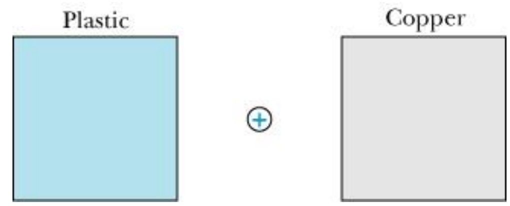
5. A beam of electrons is directed horizontally between two parallel horizontal charge plates, with velocity v_0, as shown. The electrons strike the lower plate a distance, *l*, to the right. Find **E** in terms of the vertical distance *d*, the initial velocity v_0, the horizontal distance *l*, and the electron mass m_e, and charge *e*.

6. In the figure at right, calculate the magnitude and direction of the electric field at (a) point P and (b) point Q (not shown) located to make a square with the 3 point charges.



7. Two identical charges *q* are located along the x-axis a distance *a* apart. (a) Using symmetry arguments, find the direction of the electric field at point *P* along the y axis. (b) Find the expression for the electric field along the y-axis. (c) In the limit of $|y| \gg a$, find the approximate expression for the field along the y-axis. Does this limit make sense? Why? (d) Find the approximate expression for the electric field along the y-axis very close to

the origin, $y<<a$. Describe this relationship qualitatively. Find the value of E at the origin. Does it make sense? Why? (e) Calculate the location and magnitude of the maximum value of E_y and sketch a graph of E_y as a function of y.

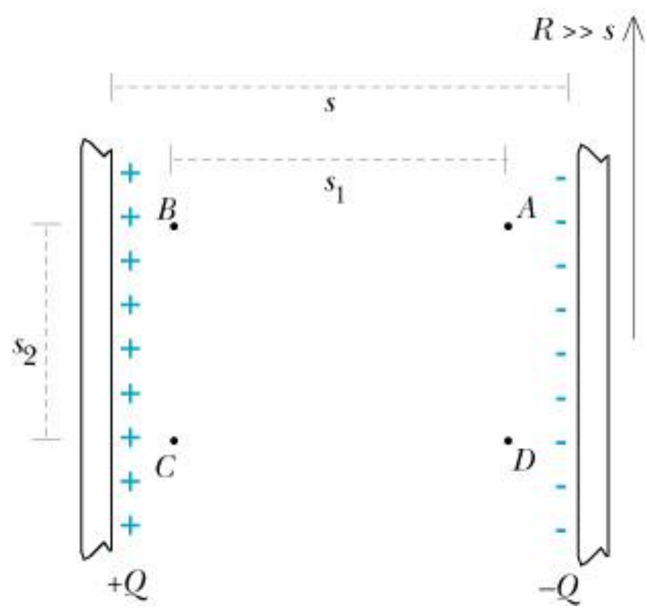


8. A positive charge is located between a neutral block of plastic and a neutral block of copper. Draw the approximate charge distribution for this situation.

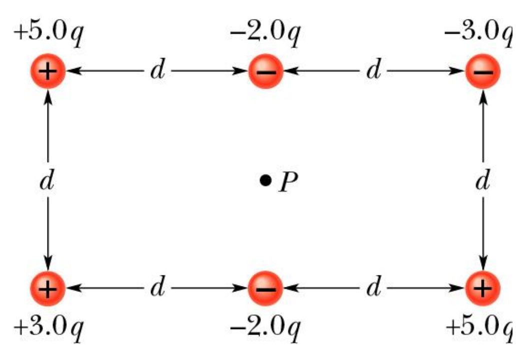
9. An object can be both charged and polarized. On a negatively charged metal ball, the charge is spread uniformly all over the surface. If a positive charge is brought near, the charged ball with polarize. (a) Draw the approximate final charge distribution. Draw an arrow at the center of the ball representing (b) the electric field due to the external positive charge, (c) the electric field due to the charge on the surface of the ball, and (d) the net electric field.

10. Two identical metal spheres are suspended from insulating threads. One is charged with excess electrons, and the other is neutral. When the two spheres are brought near each other, they swing toward each other and touch, then swing away from each other. Explain in detail why both these swings happen. In your explanation, include clear diagrams showing charge distributions, including the final charge distribution.

11. A very small thin spherical plastic shell of radius 15 cm carries a uniformly-distributed negative charge of -8 nC on its outer surface. An uncharged solid metal block 10 cm thick is placed 10 cm away from the surface of the charged sphere. (a) Sketch the approximate charge distribution of the neutral solid metal block. (b) Draw the electric field vector at the center of the metal block that is due solely to the charge distribution you sketched. (c) Calculate the magnitude of the electric field vector you drew.



12. A parallel-plate capacitor with plates R in radius are places a distance s apart and are given charges of $\pm Q$ such that $s << R$. Consider points A, B, C, D inside the capacitor as shown in the diagram. (a) Show that $\Delta V = V_C - V_A$ is the same for these paths by evaluating ΔV along each path: Path 1: $A \rightarrow B \rightarrow C$; Path 2: $A \rightarrow C$; Path 3: $A \rightarrow D \rightarrow B \rightarrow C$. (b) If $Q = 43\ \mu C$, $R = 4.0$ m, $s_1 = 1.5$ mm, and $s_2 = 0.7$ mm, what is the value of ΔV? (c) Choose two different paths from point A back to point A again, and show that $\Delta V = 0$ for a round trip along both of these paths.



13. In the figure at right, point P is at the center of the rectangle. With $V = 0$ at infinity, what is the net electric potential at P due to the six charged particles?

14. A plastic rod of length L lies along the x-axis (starting at

the origin) and has nonuniform charge density given by $\lambda=cx$, where c is a positive constant. (a) With V=0 at infinity, find the electric potential at a point a distance y along the y-axis. (b) Why cannot the field component E_x be found using the result of (a)?

15. This problem deals with several aspects of an oscilloscope. You have an 18,000-volt supply for accelerating electrons to a speed adequate to make the front phosphor-coated screen glow when the electrons hit it. Once the electron has emerged from the accelerating region, it coasts through a vacuum at nearly constant speed. You can apply a potential difference of plus or minus 40 volts across the deflection plates to steer the electron beam up or down on the screed to paint a display (other deflection plates not shown are used to steer the beam horizontally). Each of the two deflection plates is a thin metal plate of length 8 cm and width (into the diagram) 4 cm. The distance between the deflection plates is 3 mm. The distance from the deflection plates to the screen is 30 cm. When there is a 40 volt potential difference between the deflection plates, what is the deflection y of the electron beam where it hits the screen? Note the exaggerated vertical scale: the deflection is actually small compared to the distance to the screen.