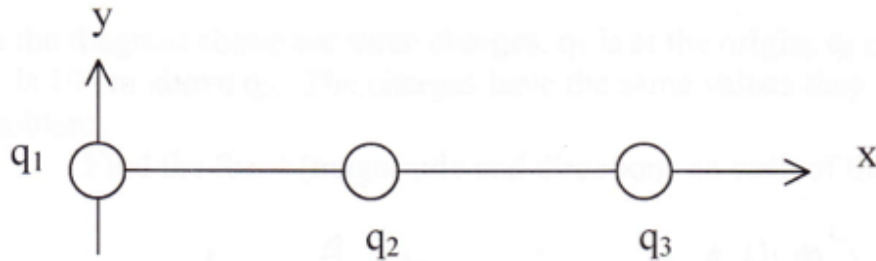1. A typical lightening bolt deposits -50C of charge on the ground. How many electrons is this?

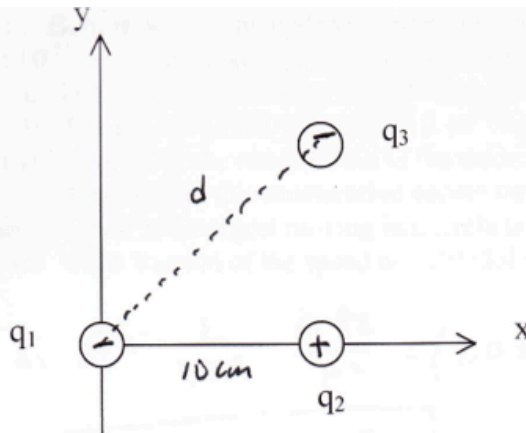2. Three charges are evenly spaced on the x-axis as shown.

The separations are 10.0 cm. $q_1 = -3.0 \, \mu C$; $q_2 = 6.0 \, \mu C$; and $q_3 = -9.0 \, \mu C$. (μ means 10^{-6}).

   Find the force (magnitude and direction) on each of the three charges.

3.

$d = 10 \, cm \sqrt{2} = 14.1 \, cm$

In the diagram above are three charges. q_1 is at the origin; q_2 is on the x-axis 10 cm away; q_3 is 10 cm above q_2. The charges have the same values they have in the previous problem.

   Find the force (magnitude and direction) on each of the three charges.

4. In the Bohr model of the hydrogen atom, an electron and a proton have a separation of 5.29×10^{-11} m. They have equal and opposite charges of 1.6×10^{-19} C.

   a. Determine the force on the electron. Determine the force on the proton.

   b. The proton has a mass of 1.67×10^{-27} kg; the electron has a mass of 9.11×10^{-31} kg. Find the acceleration of the electron.

   c. Assume that this acceleration causes the electron to move in a circular orbit. The acceleration of an object moving in a circle is v^2/r. What is the speed of the electron? What fraction of the speed of light (3.0×10^8 m/s) is this?

5.
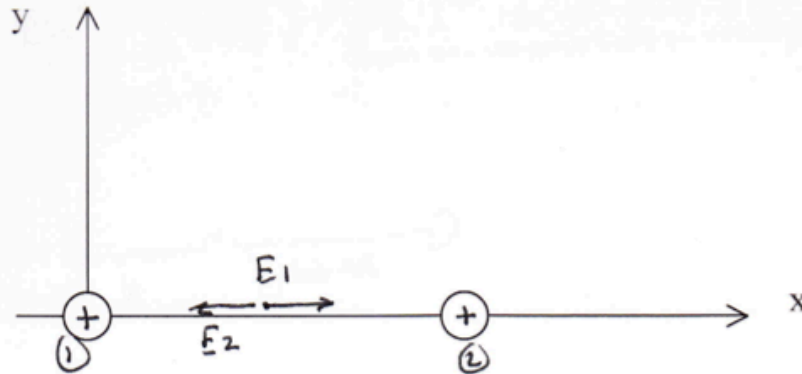
Two charges are on the x-axis. The charge at the origin is 10 µC; the second charge, 10.0 cm away, is 20 µC.
   a. What is the electric field half way between?
    b. At what point on the x-axis is the electric field zero?
    c. What is the electric field (magnitude and direction) at a position on the y-axis where y = 5.0 cm?

6.

The plates of a parallel plate capacitor are 2.0 cm apart. In between is a downward electric field $E = 1.5 \times 10^4$ N/C. An electron is released from rest halfway between the two plates.
    a. What is the acceleration of the electron? In what direction?
    b. How much time elapses before it strikes a plate?
   c. How fast is the electron going just before it strikes a plate?
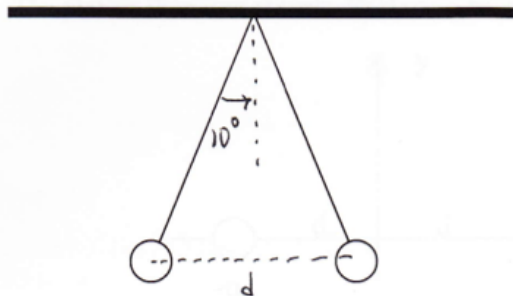
7. In the picture above, two balls of equal mass m = 0.15 gm are shown suspended from massless strings. There are equal charges on the two spheres. The angle between the two strings is 20°. The lensth is 10 cm
    How much charge is on one of the spheres?   Σ F = 0

8. The picture shows an electric dipole, opposite charges separated by a distance 2d.
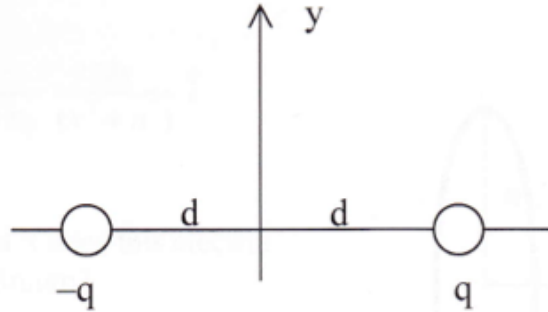
a. What is the electric field at the origin?
b. For what value of y is the electric field on the y-axis half its value at the origin?

9. Example 21.10 shows that the electric field on the axis of a ring of radius a carrying a total charge Q is

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{Qx}{(x^2+a^2)} \hat{i}$$

For what value of x does this electric field have a maximum?
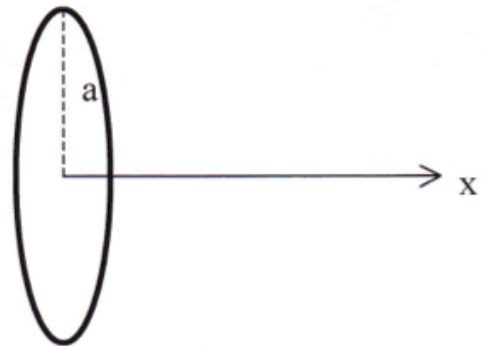
10. Four identical charges q = 10 μC are on the corners of a square whose sides are 10.0 cm long.
     a. Find the force (magnitude and direction) on any of the charges.
     b. Find the electric field (magnitude and direction) midway between two adjacent corners.