PHYSICS 231 – SAMPLE TEST # 1

Problem 1

(a) Draw the field lines for a system of two charges if

1. both charges are positive
2. one charge is positive and the other one is negative
3. both charges are negative

In each case show the direction of field lines with arrows.

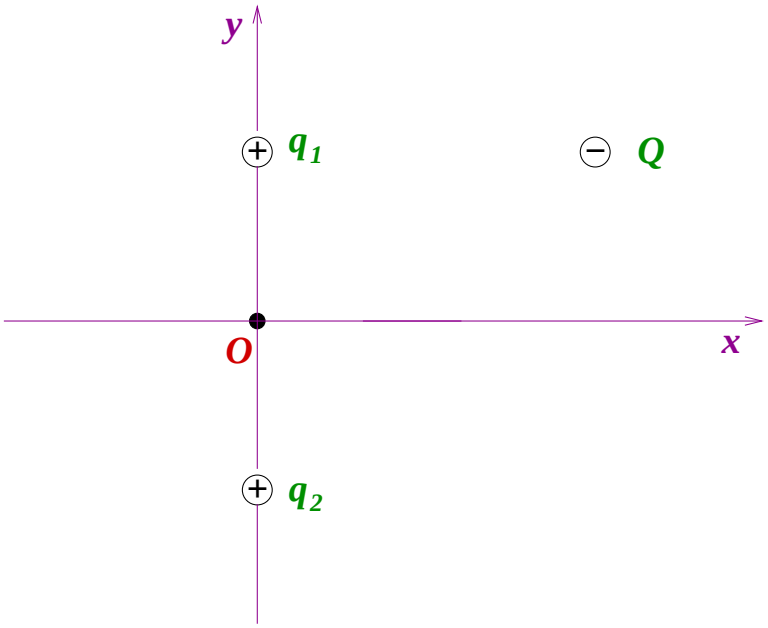
(b) Which of the following statements are true?

1. Gauss's law holds only for symmetric charge distributions.
2. If there is no charge in a region of space, the electric field on a surface surrounding the region must be zero everywhere.
3. If the net charge on a conductor is zero, the charge density must be zero at every point on the surface of the conductor.
4. All charges Q can be written as Q = Ne, where N is an integer (positive or negative) and e is the charge of a proton.

(c) An electron that is free to move but is momentarily at rest in an electric field E will

1. accelerate in the direction perpendicular to E.
2. remain at rest.
3. accelerate in the direction opposite to E.
4. accelerate in the same direction as E.
5. do none of the above.

Problem 2

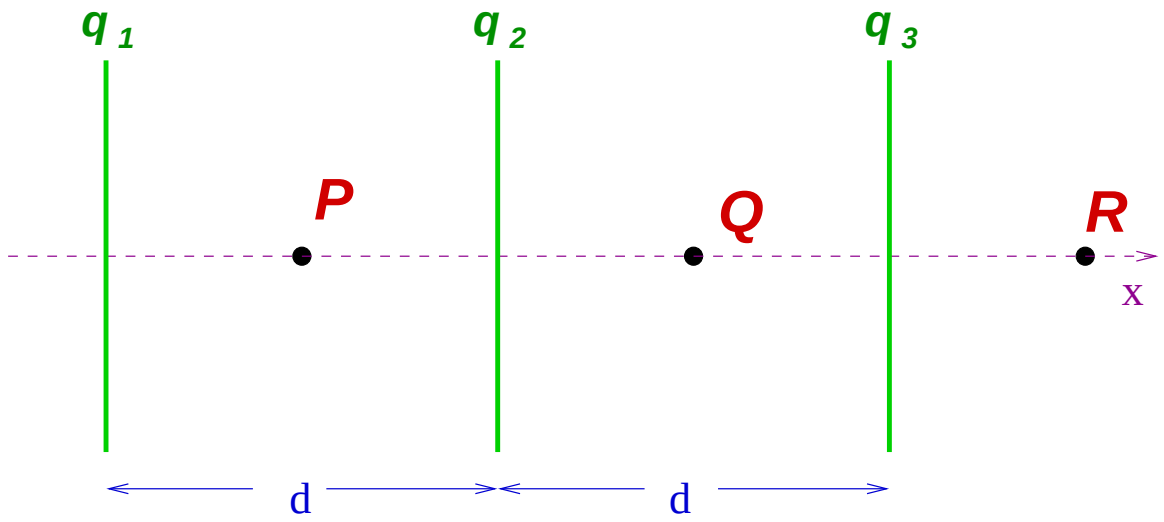


Positive charges $q_1 = 3\ \mu C$ and $q_2 = 5\ \mu C$ are placed along the y-axis at $y = 2.0$ m and $y = -2.0$ m, respectively. A negative charge $Q = -4\ \mu C$ is placed at $x = 4.0$ m, $y = 2.0$ m.

(a) Find the magnitude and direction of the electric field at the origin ($x = y = 0$).

(b) What is the magnitude and direction of the force on the negative charge Q?

Problem 3



Three large parallel sheets have charges $q_1 = +2\ \mu C$, $q_2 = +5\ \mu C$, and $q_3 = -7\ \mu C$. Each sheet has area $A = 1.5\ m^2$. Adjacent sheets are a distance $d = 4$ cm from each other.

(a) What are the charge densities on the three sheets?

(b) Find the magnitude and direction of the electric field at the points:

1. P, at 2 cm to the right of the first sheet;
2. Q, at 2 cm to the right of the second sheet;
3. R, at 2 cm to the right of the third sheet.

(c) What is the force exerted on the third sheet by the other two sheets?