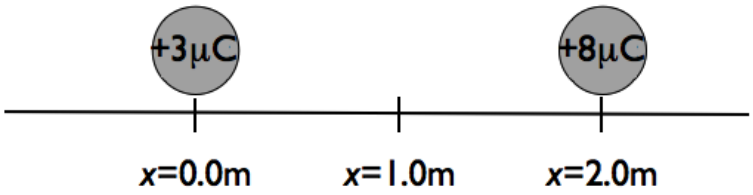
Closed book. No work needs to be shown for multiple-choice questions.

1. A charge of +3.0 μC is placed at the origin and a charge of +8.0 μC is placed at x = 2.0 m, as shown in the figure to the right. Which of the following statements is true?



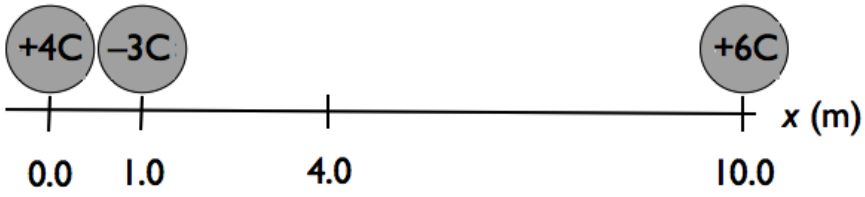
a) There is a location to the left of the origin where a negative charge feels no force.
b) There is a location to the right of x = 2.0 m where a negative charge feels no force.
c) A negative charge placed at x = 1.0 m feels no force.
d) There is a location between the origin and x = 1.0 m where a negative charge feels no force.
e) There is a location between x = 1.0m and x = 2.0 m where a negative charge feels no force.

2. A charge of **–**3.0 mC is in an electric field of strength 5.0 N/C directed west. The charge:

a) feels a force of 15 N pointing west.
b) feels a force of 15 mN pointing west.
c) feels a force of 15 N pointing east.
d) feels a force of 15 mN pointing east.
e) feels a force of 1.7 N pointing west.

3. A charge of +4.0 C is placed at the origin. A charge of **–**3.0 C is then placed at x = 1.0 m. A third charge of **+**6.0 C is then placed at x = 10.0 m. What is the magnitude of the force on a proton placed at x = 4.0 m?

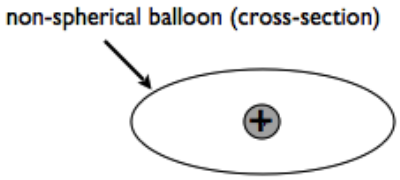
a) 3.6×10^{-10} N.
b) 1.7×10^{-8} N.
c) 8.4×10^{-8} N.
d) 1.2×10^{-10} N.
e) 7.5×10^{8} N.



4. A single point charge is placed at the origin. Which of the following statements is true? Assume the locations in the answers all lie on the x-axis (*i.e.* $y = 0.0$ m).

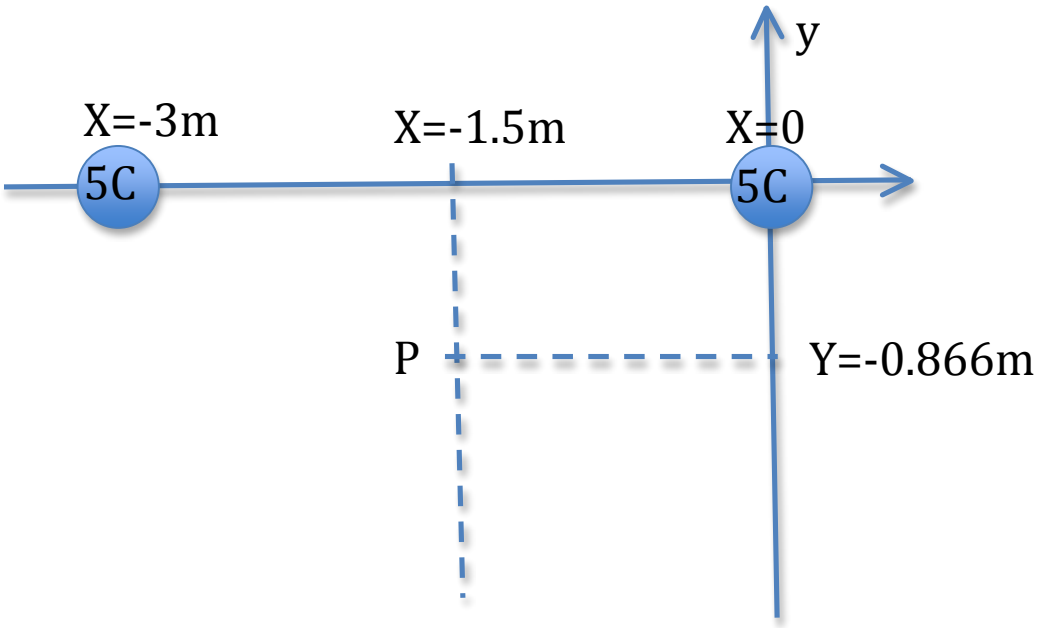
a) The magnitude of the electric field at $x = 2.0$ m is the same as the magnitude of the electric field at $x = -2.0$ m.
b) The magnitude of the electric field at $x = 2.0$ m is twice the magnitude of the electric field at $x = 4.0$ m.
c) The magnitude of the electric field at $x = 2.0$ m is four times the magnitude of the electric field at $x = 4.0$ m.
d) Both a) and b) are true.
e) Both a) and c) are true.

5. A positive point charge is placed inside a non-spherical rubber balloon. The balloon is originally neutral and the point charge never touches the balloon. The point charge is located at the center of the balloon. Which of the following statements is true?



a) The electric flux through the balloon would increase if the balloon was blown up more.
b) The electric field has the same strength everywhere on the surface of the balloon.
c) The electric flux through the balloon changes if the point charge moves to a new position inside the balloon.
d) All of the statements a) – c) are false.
e) All of the statements a) – c) are true.

Questions 6, and 7 refer to the following situation:



a charge of +5.0 C is placed at $x = -3.0$ m. A second charge of +5.0 C is placed at the origin, as shown to the right. The location labeled *P* has coordinates $x = -1.5$ m, $y = -0.866$ m.

6. The direction of the net electric field at *P*:

a) in the direction of the positive y-axis.
b) in the direction of the negative y-axis.
c) in the direction 45° below the positive x-axis.
d) in the direction 45° below the negative x-axis.
e) there will be no direction because the net electric field is zero at point *P*.

7. What charge needs to be placed where to make the field at P approximately zero?
a) nothing needs to be done as E is already zero
b) a charge of +5C needs to be placed at x=-1.5m, y=-3.6m
c) a charge of -5C needs to be placed at x=-1.5m, y=-3.6m
d) a charge of +5C needs to be placed at x=-1.5m, y=-2.6m
e) none of the above will reduce the field at P by more than a factor 2.

8. An electron is shot into a homogenous E-field pointing in the Y-direction. At some point in time, the electron velocity points in the positive X-direction. Given the electric force due to the E-field, which of the following best describes the flight direction of the electron immediately thereafter?

a) Between the positive X-axis and the positive Y-axis
b) Between the positive X-axis and the negative Y-axis
c) Between the negative X-axis and the positive Y-axis
d) Between the negative X-axis and the negative Y-axis
e) The situation is not possible as an electron can not fly orthogonal to the E field lines.

9. A charge of 1.0 Coulomb is at the center of a cube of edge length 1.0m. Which of the following best describes the situation.

a) The flux through each face of the cube is the same.
b) If one were to move the charge to some other location within the cube, the flux through each face would remain the same.
c) If one were to move the charge to some other location within the cube, the total flux through all faces combined would remain the same.
d) All of the above a)-c) are correct.
e) Only a) and c) are correct

10. The electric field anywhere on the surface of a spherical shell of radius 1m is measured to be 1000 N/C and pointing radially inwards, i.e. towards the center of the sphere. Which of the following best describes the situation.

a) The charge inside the sphere is negative.
b) The charge inside the sphere is positive.
c) The charge distribution of the charge inside the sphere is spherically symmetric.
d) Both a) and c) are correct.
e) Both b) and c) are correct.