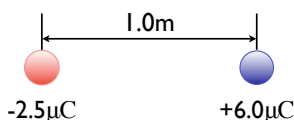


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## Quiz 2: SOLN

Note: all of these problems are taken directly from the end of Chapter 3 in the course notes. You can find detailed solutions there.



1. Determine the point (other than infinity) at which the total electric field is zero.

- 1.8 m to the right of the negative charge
- 0.61 m to the right of the positive charge
- 0.39 m to the right of the negative charge
- 1.8 m to the left of the negative charge

See the notes for this one.

2. A flat surface with an area of  $73 \text{ m}^2$  is rotated in a uniform electric field of magnitude  $E = 3.1 \times 10^4 \text{ N/C}$ . What is the electric flux when the electric field is parallel to the surface?

- $2.26 \times 10^7 \text{ N} \cdot \text{m}^2/\text{C}$
- 0
- $7.18 \text{ N} \cdot \text{m}^2/\text{C}$
- $425 \text{ N} \cdot \text{m}^2/\text{C}$

Flux is the number of field lines per unit area penetrating the surface ... if the field is parallel to the surface, there is no flux.

3. A point charge  $q$  is located at the center of a (non-conducting) spherical shell of radius  $a$  that has a charge  $-q$  uniformly distributed on its surface. What is the electric field for all points outside the spherical shell?

- $E = 0$
- $E = q/4\pi a^2$
- $E = k_e q/r^2$
- $E = k_e q/a^2$

If you draw a surface around the point charge and conducting shell, the total enclosed charge is zero - the  $+q$  and  $-q$  add to zero. If there is no net enclosed charge, Gauss' law tells us that the electric field is zero.

4. A "free" electron and a "free" proton are placed in an identical electric field. Which of the following statements are true? Check all that apply.

- Each particle is acted on by the same electric force and has the same acceleration.
- The electric force on the proton is greater in magnitude than the force on the electron, but in the opposite direction.
- The electric force on the proton is equal in magnitude to the force on the electron, but in the opposite direction.
- The magnitude of the acceleration of the electron is greater than that of the proton.
- Both particles have the same acceleration.

The electric force is the same in magnitude because both the proton and electron have the same magnitude of charge. Since they have different signs, though, the forces are in opposite directions. For the same force, the electron experiences a larger acceleration because it is much lighter than the proton.

5. Two isolated identical conducting spheres have a charge of  $q$  and  $-3q$ , respectively. They are connected by a conducting wire, and after equilibrium is reached, the wire is removed (such that both spheres are again isolated). What is the charge on each sphere?

- $q, -3q$
- $-q, -q$
- $0, -2q$
- $2q, -2q$

When we connect the spheres, since everything is conducting the charges spread out evenly over both spheres. The total charge is  $q + (-3q) = -2q$ , spread out evenly over both spheres, which gives  $-q$  on each.