

Physics 222

Quiz 1 – Electric Field, Form: A

Name: _____

Date: _____

For each situation below, sketch the electric field at the point P due to the charged particles shown. Assume there are no hidden charges anywhere.

1. Positively charged particle.

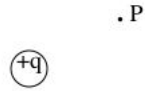


Figure 1:

2. Negatively charged particle.

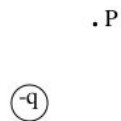


Figure 2:

3. Dipole.

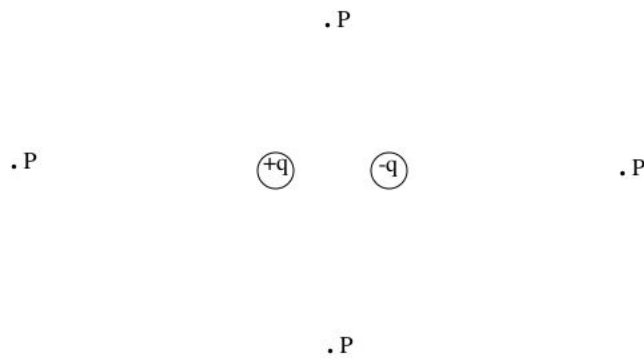


Figure 3:

4. Two dipoles.



Figure 4:

5. The electric field at point P is shown in the picture below. If a neutral atom is placed at point P, in what direction would it be polarized? Sketch a picture of the polarized atom and draw the dipole moment \vec{p} vector of the neutral atom.



Figure 5:

6. Two charged particles are near a hydrogen atom. Sketch the following vectors: (1) the force of $+q$ on the H atom; (2) the force of $-q$ on the H atom; and (3) the net force on the H atom.

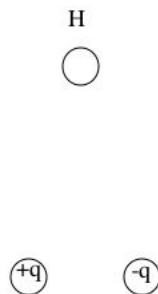


Figure 6:

7. What is the electric field at point P due to the two dipoles shown in Figure 4 if $q = 1.6 \times 10^{-19}$, $s = 2 \times 10^{-10}$ m and $d = 5 \times 10^{-8}$ m? (Note that electric field is a vector, so you should express it in vector form.)
8. Consider the dipole shown in Figure 3. Suppose the distance of P along the +x axis is much greater than the length of the dipole, s , so you can use the large distance approximation for the magnitude of the electric field at that point. If the magnitude of the electric field at P when P is at a distance r is E , what would be the magnitude of the field at a distance $r/2$ along the same axis?
- (a) $8E$
 - (b) $2E$
 - (c) $4E$
 - (d) $\frac{1}{2}E$
 - (e) $\frac{1}{4}E$
 - (f) $\frac{1}{8}E$
9. Suppose that a proton in space is at rest, and the electric field at a point P in space due to that proton is \vec{E} . Then, instantly, the proton is moved to a new location. What happens to the electric field at point P during this process?
- (a) The electric field will instantly change.
 - (b) The electric field will remain the same indefinitely.
 - (c) The electric field will remain the same for a very short time, at least as long as it takes light to travel the same distance from the proton to this location in space.

10. A charged sphere of $+4 \text{ nC}$ is near another charged sphere of -1 nC . Which object creates a larger electric field at the location of the other object?
- (a) $+4 \text{ nC}$ charged sphere
 - (b) -1 nC charged sphere
 - (c) They create the same magnitude electric field at the location of the other object.
11. For the spheres in the previous question, which sphere exerts a larger force on the other one?
- (a) Neither, because they exert equal magnitude forces on each other, regardless of the fact that they have different charges.
 - (b) The sphere with the larger charge ($+4 \text{ nC}$) exerts a larger force.
 - (c) The sphere with the smaller charge (-1 nC) exerts a larger force.
12. Like charged objects repel and unlike charged objects attract. A charged object and a neutral object, if close enough but not too close, will
- (a) attract.
 - (b) repel.
 - (c) not interact at all since one of the objects is neutral.
13. Suppose that a negatively charged sphere is uniformly charged on its surface, meaning that the excess electrons are uniformly spread over its surface. The electric field anywhere inside the sphere
- (a) is zero.
 - (b) points inward toward the center.
 - (c) points outward toward the surface.
 - (d) is infinite.
14. Suppose I have two pieces of Scotch tape stuck together. They are neutrally charged. When I pull them apart, one will have a charge $+Q$ and the other one will have a charge $-Q$. I know that they have equal magnitude, opposite charge because of the fundamental principle of
- (a) conservation of charge
 - (b) conservation of energy
 - (c) conservation of momentum
 - (d) superposition principle

Answer Key for Exam A

1. The electric field vector should be drawn at point P, and it should point up and to the right, radially away from the particle (because it is a positively charged particle).
2. The electric field vector should be drawn at point P, and it should point up and to the right, radially toward the particle (because it is a negatively charged particle).
3. At the top and bottom points marked P, the electric field points to the right.
At the right and left points marked P, the electric field points to the left.
4. The electric field at point P due to each dipole points to the left. Thus, the net electric field is to the left.
5. The electric field will cause the neutral atom to polarize with the negative side away from the electric field and the positive side toward the electric field. The dipole moment \vec{p} points from the negatively charged side to the positively charged side.
6. A charged particle always attracts a neutral atom. The force of $+q$ on the neutral atom is down and to the left. The force of $-q$ on the neutral atom is down and to the right. The net force on the neutral atom is therefore in the $-y$ direction.
- 7.

$$\vec{E} = 23040 \langle -1, 0, 0 \rangle \text{ N/C}$$

- | | |
|---------|---------|
| 8. (f) | 12. (a) |
| 9. (c) | 13. (a) |
| 10. (a) | |
| 11. (a) | 14. (a) |