Electric Fields

The **electric field** is a region of space around a charge where another charge will experience a force. The symbol we use for electric field is *E*.

The **electric field intensity** (or strength) at a point in space is defined as the amount of **electric force** per coulomb of charge experienced by a charge placed at that point.

$$E = \frac{F_E}{q}$$

The units of electric field intensity are newtons per coulomb (N / C).

To measure the electric field, we place a charge at a given point in space and measure the electric force acting on this charge. We can then calculate the electric field using the above formula.

Electric Field Diagrams

It is customary to draw electric fields using **lines of force**. A line of force is a continuous line showing the direction of the electric field at any point in space. By convention, the direction of the electric field is in the direction of the force it would exert on a positive charge. This has two consequences:

1. A positive charge placed in an electric field will experience a force in the same direction as the field lines.

2. A negative charge placed in an electric field will experience a force in the opposite direction from the field lines.

Example
A positive charge is placed in an electric field that is directed to the right. What will be the direction of the force experienced by this charge? In what direction would a negative charge experience a force if placed in the same field?

Facts About Electric Field Lines

1. Field lines always start on and point away from positive charges.

2. Field lines always end on and point towards negative charges.

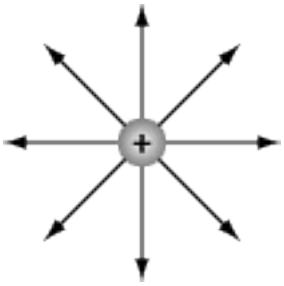
3. The number of lines leaving or entering a charge is proportional to the magnitude of the charge.

4. The density of the lines (how close together they are) is proportional to the strength of the electric field.

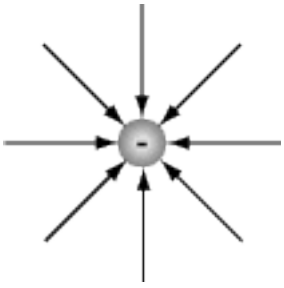
5. Field lines never cross one another.

Some Common Electric Fields

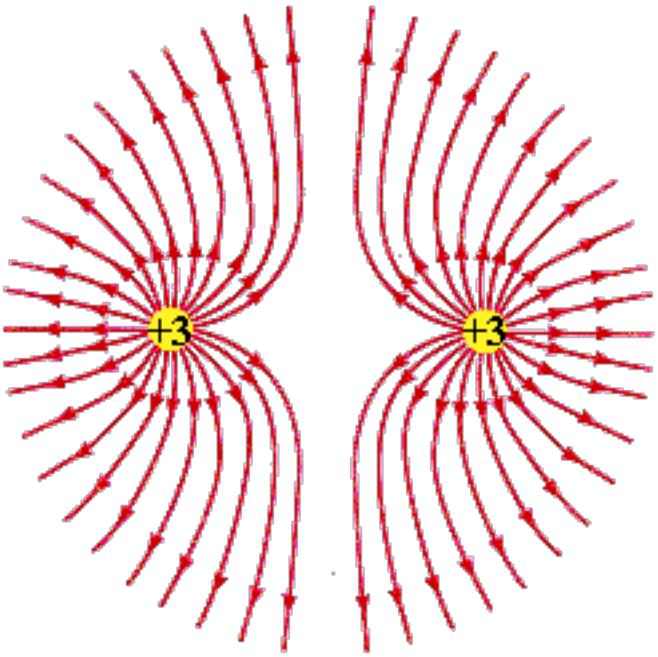
Electric Field Around a Positive Point Charge



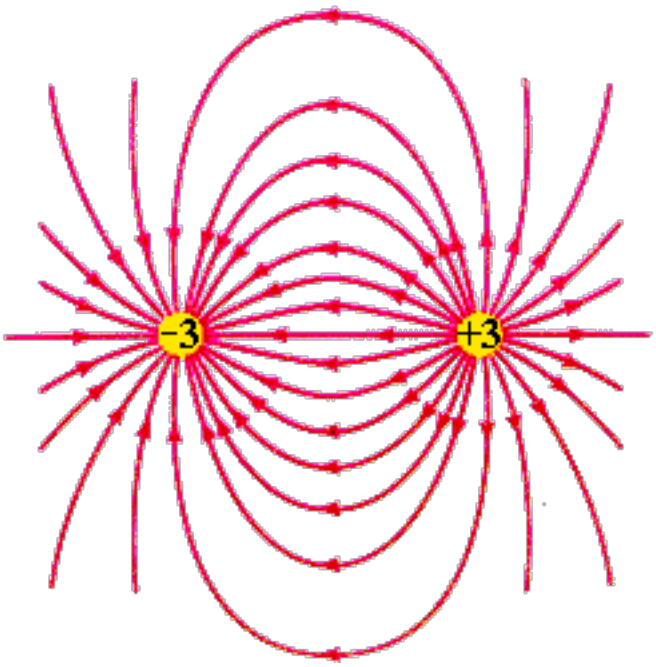
Electric Field Around a Negative Point Charge



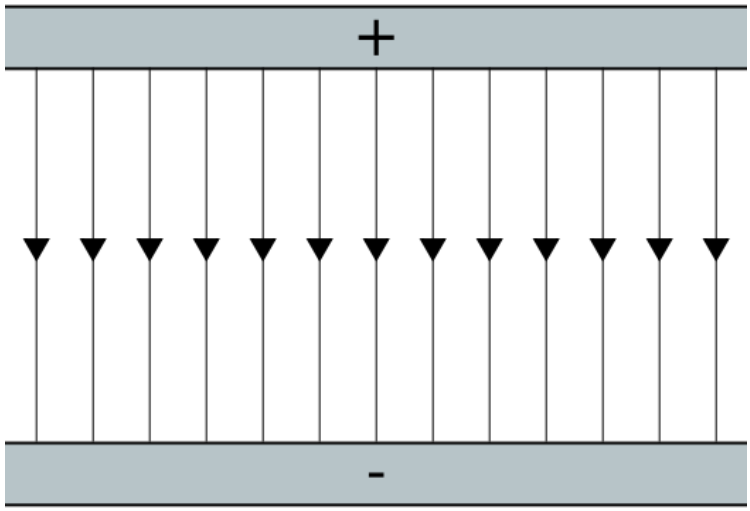
Electric Field Around Two Like Charges



Electric Field Around Two Opposite Charges



Electric Field Between Parallel Plates



Electric Fields Worksheet #1

1. How are a gravitational field and an electric field similar?

2. How are a gravitational field and an electric field different?

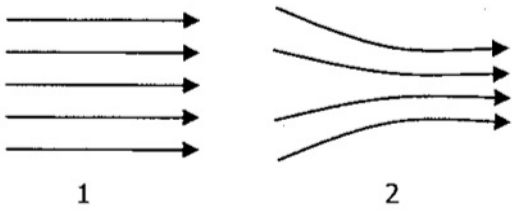
3. Why is electric field strength considered a vector quantity?

4. How does the direction of an electric field line compare with the direction of the force that acts on a positive test charge placed in the electric field?

5. How is the strength of an electric field indicated with field lines?

6. How do the field lines appear when an electric field has the same strength at all points in a region?

7. Diagrams 1 and 2 show two examples of electric field lines.



Decide which of the following statements are true and which are false.

a) In both 1 and 2, the electric field is the same everywhere.

b) As you move from the left to the right in each case, the electric field becomes stronger.

c) The electric field in 1 is the same everywhere, but the electric field in 2 becomes stronger as you move from left to right.

d) The electric fields in both 1 and 2 are created by negative charges located somewhere on the left and positive charges located somewhere on the right.

e) Both 1 and 2 arise from a single positive point charge located somewhere to the left.