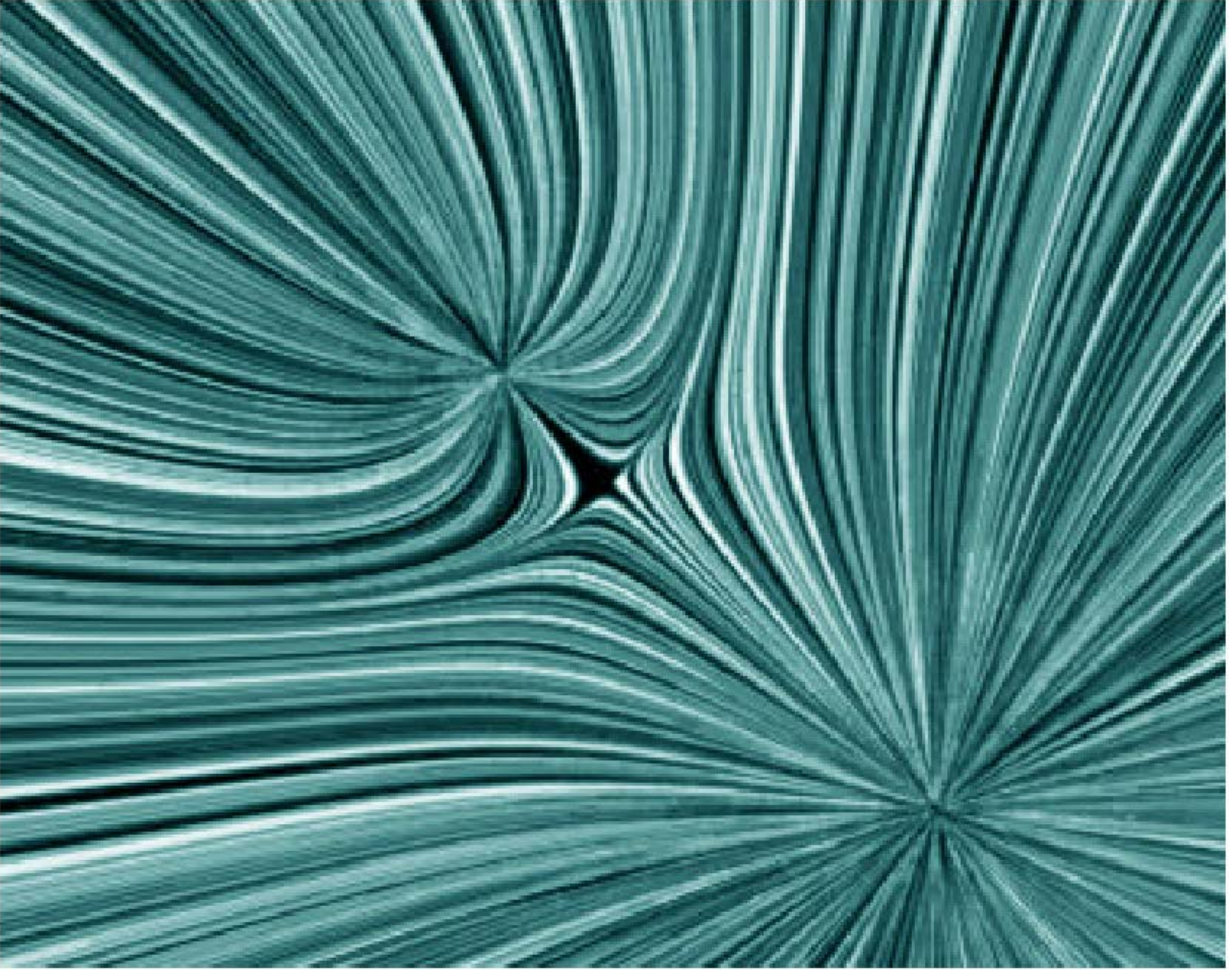


Electric field lines in the space surrounding a charge distribution show:

1. Directions of the forces that exist in space at all times.
2. Only directions in which static charges would accelerate when at points on those lines
3. Only directions in which moving charges would accelerate when at points on those lines.
4. Directions in which either static or moving charges would accelerate when passing through points on those lines.
5. Paths static or moving charges would take.

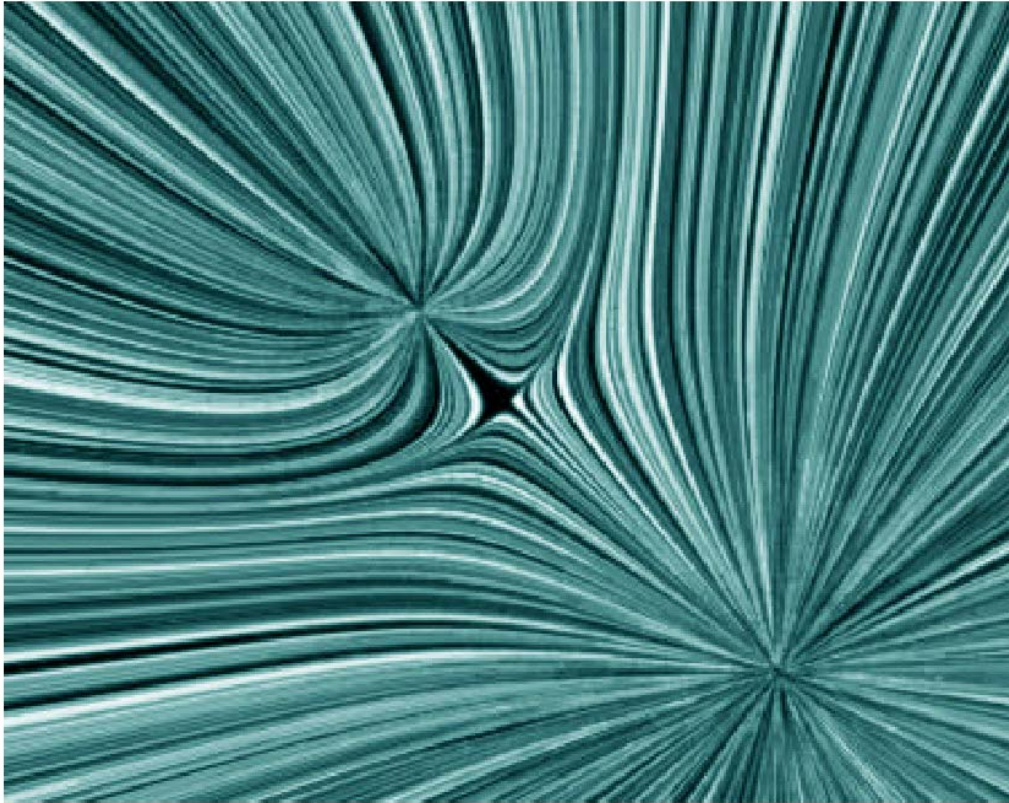
**(4) Direction of acceleration of charges
either “in” or “moving through”**

**NOTE: This is different than flow
lines (5). Particles do NOT move along
field lines.**



The force between the two charges is:

- 1) Attractive
- 2) Repulsive
- 3) Can't tell without more information



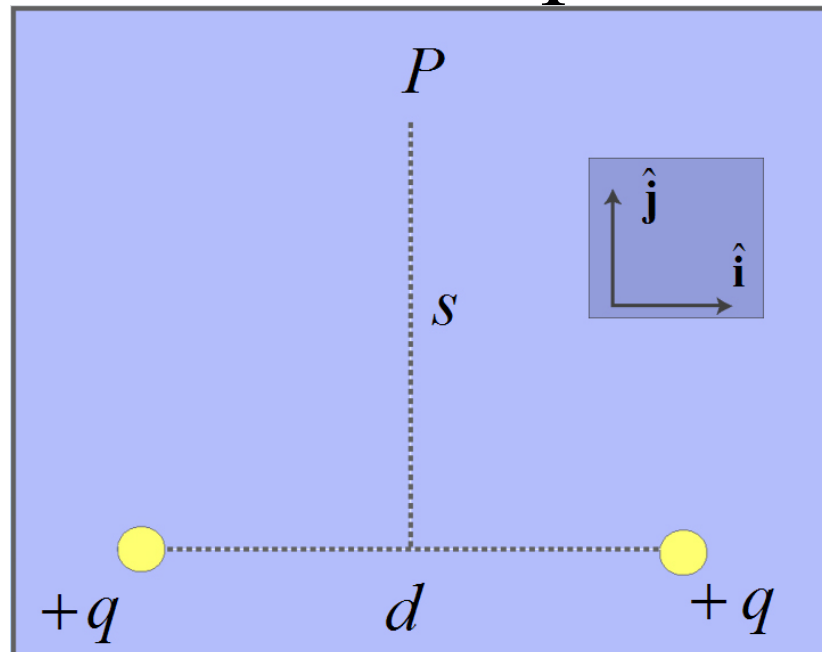
(2) Repulsive

One way to tell is to notice that they both must be sources (or sinks).

Hence, as like particles repel, the force is repulsive.

You can also see this as tension in the field lines

E-Field of Two Equal Charges



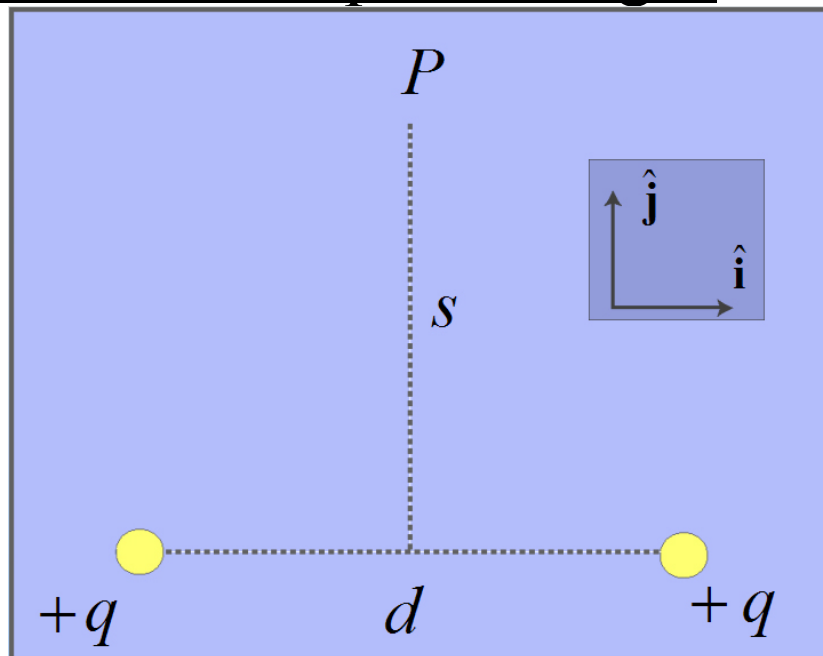
Electric field at point P is:

$$1. \vec{E} = \frac{2k_e q s}{\left[s^2 + \frac{d^2}{4} \right]^{3/2}} \hat{j} \qquad 2. \vec{E} = -\frac{2k_e q d}{\left[s^2 + \frac{d^2}{4} \right]^{3/2}} \hat{i}$$

$$3. \vec{E} = \frac{2k_e q d}{\left[s^2 + \frac{d^2}{4} \right]^{3/2}} \hat{j} \qquad 4. \vec{E} = -\frac{2k_e q s}{\left[s^2 + \frac{d^2}{4} \right]^{3/2}} \hat{i}$$

5. Don't Know

E-Field of Two Equal Charges



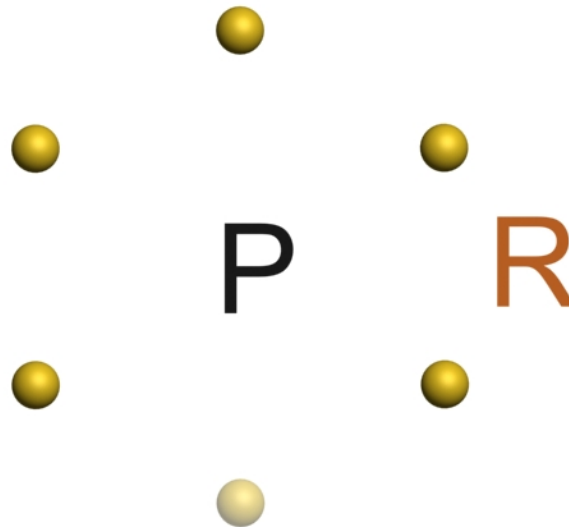
$$1. \vec{\mathbf{E}} = \frac{2k_e q s}{\left[s^2 + \frac{d^2}{4} \right]^{3/2}} \hat{\mathbf{j}}$$

There are a several ways to see this. For example, consider $d \rightarrow 0$. Then,

$$\vec{\mathbf{E}} \rightarrow k_e \frac{2q}{s^2} \hat{\mathbf{j}}$$

which is what we want (sitting above a point charge with charge $2q$)

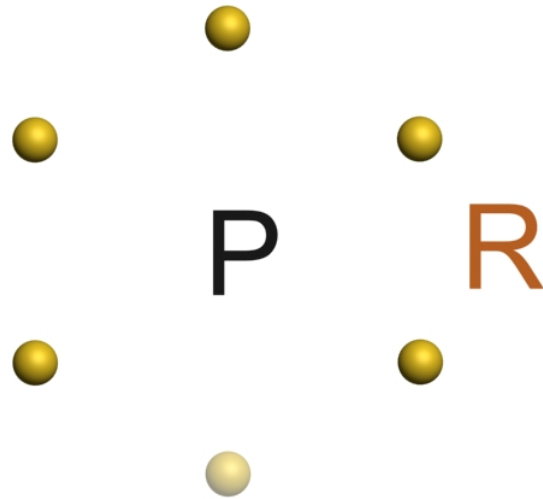
E-Field of Five Equal Charges



Six equal positive charges q sit at the vertices of a regular hexagon with sides of length R . We remove the bottom charge. The electric field at the center of the hexagon (point P) is:

1. $\vec{\mathbf{E}} = \frac{2kq}{R^2} \hat{\mathbf{j}}$
2. $\vec{\mathbf{E}} = -\frac{2kq}{R^2} \hat{\mathbf{j}}$
3. $\vec{\mathbf{E}} = \frac{kq}{R^2} \hat{\mathbf{j}}$
4. $\vec{\mathbf{E}} = -\frac{kq}{R^2} \hat{\mathbf{j}}$
5. $\vec{\mathbf{E}} = \vec{\mathbf{0}}$
6. Don't know

E-Field of Five Equal Charges



$$4. \quad \vec{\mathbf{E}} = -\frac{kq}{R^2} \hat{\mathbf{j}}$$

The electric field at the center is due to two pairs of charges across the diagonal and the unpaired top charge. The electric fields of the two pairs of charge will cancel at the center by symmetry.

Therefore the electric field at the center is due only to the top charge. The distance to the top charge is R , and the field points downward.

E-Field of a Dipole

As you move to large distances r away from a dipole, the electric field will fall-off as:

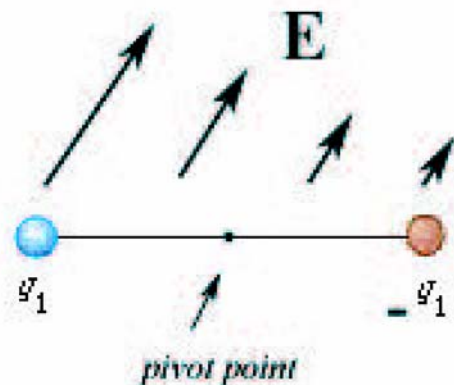
- 1) $1/r^2$, just like a point charge
- 2) More rapidly than $1/r^2$
- 3) More slowly than $1/r^2$
- 4) Who knows?

E-Field of a Dipole

(2) It falls off more rapidly

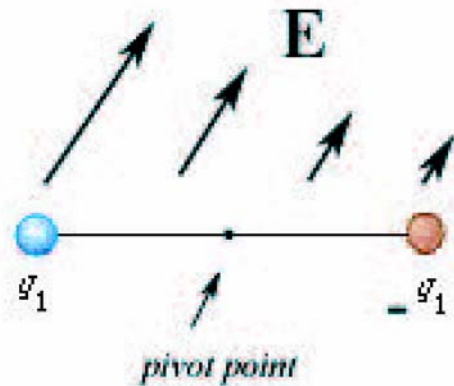
We know this must be a case by thinking about what a dipole looks like from a large distance. To first order, it isn't there (net charge is 0), so the E-Field must decrease faster.

An electric dipole, consisting of two equal and opposite point charges at the ends of an insulating rod, is free to rotate about a pivot point in the center. The rod is placed in a non-uniform electric field.



The dipole will experience

1. a noticeable electric force and no noticeable electric torque
2. no noticeable electric force and a noticeable electric torque
3. a noticeable electric force and a noticeable electric torque
4. no noticeable electric force and no noticeable electric torque



(3) A noticeable force and torque

Because the field is non-uniform, the force on the two equal but opposite point charges do not cancel.

As always, the dipole will rotate to align with the field, hence there must be a torque on the dipole as well