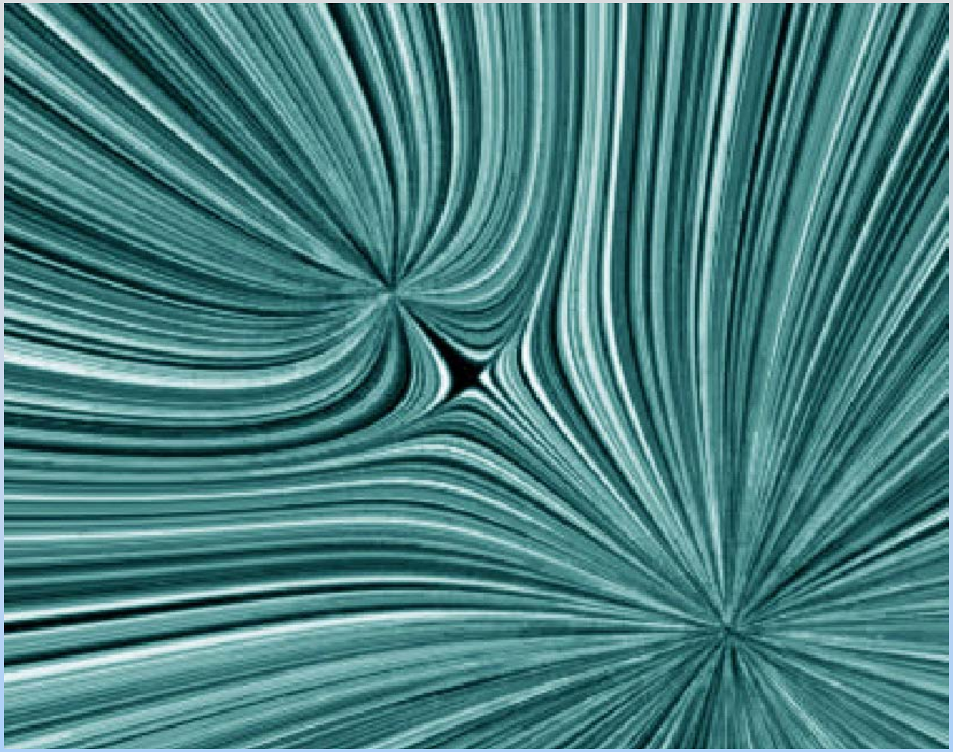
Concept Question: Force

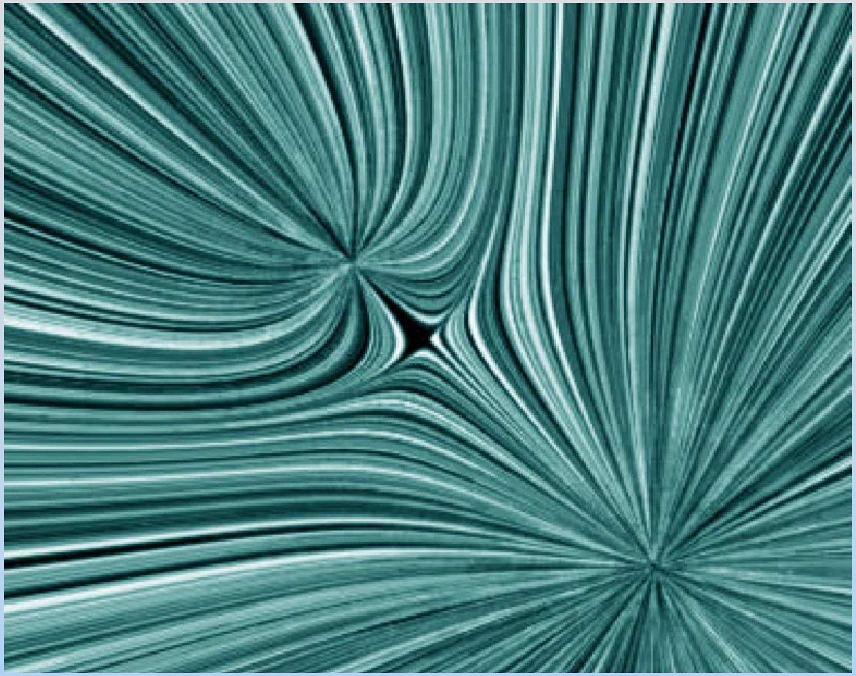


The picture shows the field lines around two charges.

The force between the two charges is:

1. Attractive
2. Repulsive
3. Can’t tell without more information
4. I don’t know

Concept Question Answer: Force



The force between the two charges is:

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 "pressure" in the field lines pushing the two charges apart

Concept Question: Field Lines

Electric field lines show:

1. Directions of forces that exist in space at all times.
2. Directions in which positive charges on those lines will accelerate.
3. Paths that charges will follow.
4. More than one of the above.
5. I don't know.

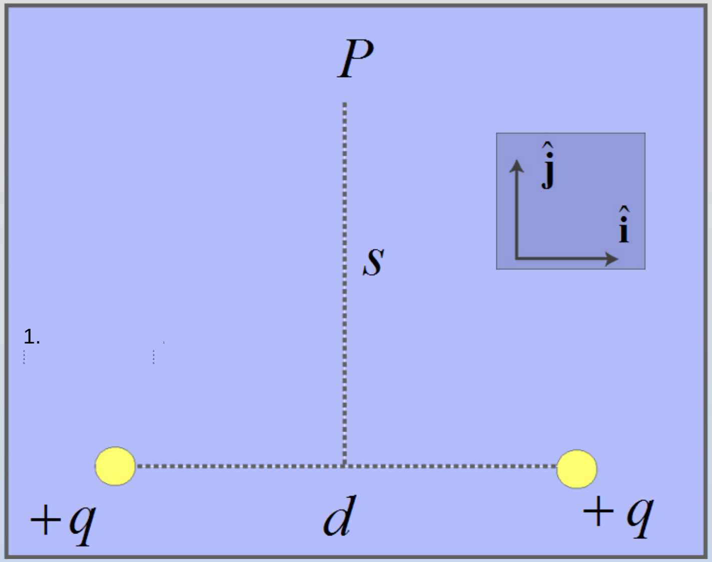
Concept Question Answer: Field Lines

Answer: 2. Directions positive charges accelerate.

NOTE:

(1) is incorrect because the direction of the force depends on the sign of the charge.

(3) is incorrect because field lines are different from flow lines. Particles do NOT move along field lines.



Concept Question: Equal Charges

Electric field at P is:

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

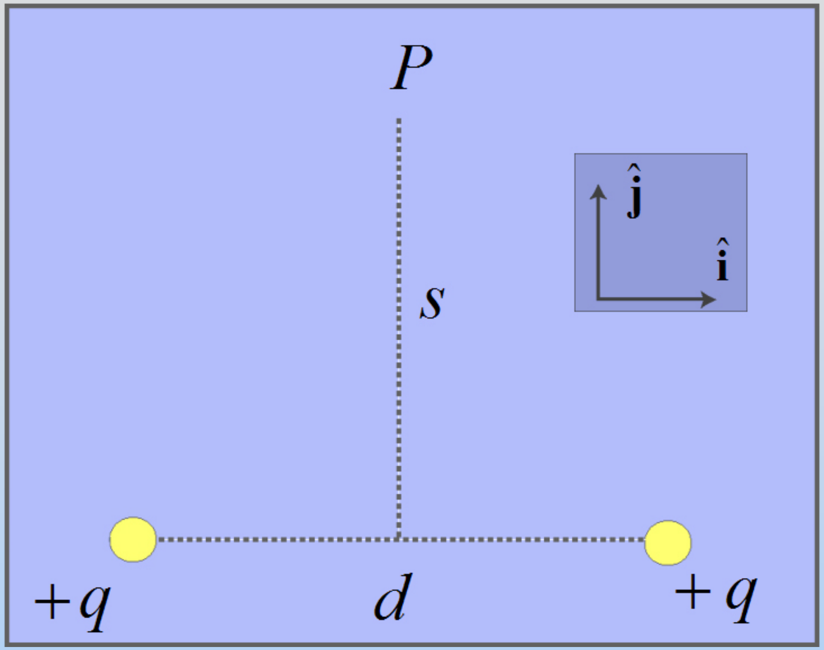
2. $\vec{\mathbf{E}} = -\dfrac{2k_e q d}{\left[s^2 + \dfrac{d^2}{4} \right]^{3/2}} \hat{\mathbf{i}}$

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

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

5. I Don't Know

Concept Question Answer: Equal Charges



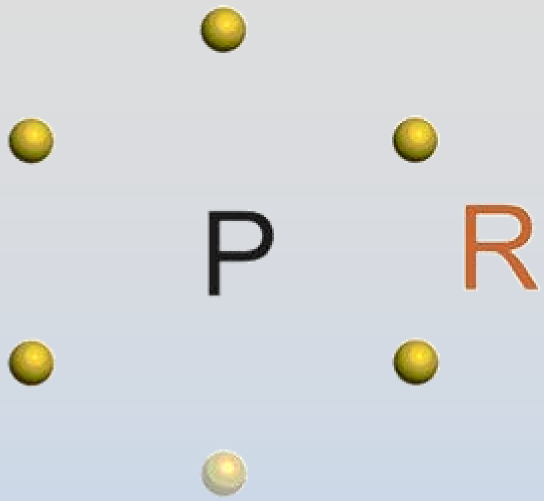
Electric field at P is:

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

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*)

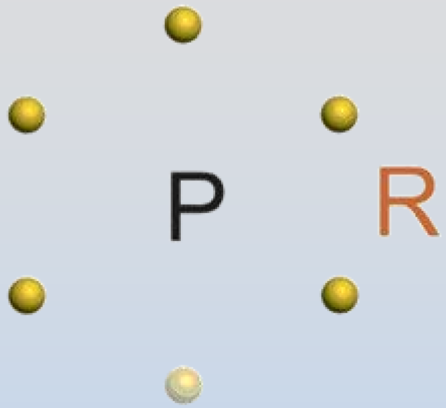


Concept Question: 5 Equal Charges

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 (at 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. $\vec{\mathbf{E}} = 0$
6. I Don't Know

Concept Question Answer: 5 Equal Charges



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

- E fields of the side pairs cancel (symmetry)
- E at center due only to top charge
- Field points downward

Alternatively:

- To get this configuration we can add a negative charge at bottom of a "symmetric" 6 +
- Therefore field is that of the negative charge below P, so field is downward

Concept Question: Dipole Field

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

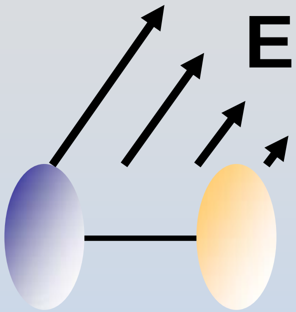
1. $1/r^2$, just like a point charge
2. More rapidly than $1/r^2$
3. More slowly than $1/r^2$
4. I Don't Know

Concept Question Answer: Dipole Field

Answer: 2) More rapidly than $1/r^2$

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 than if there were a point charge there.

Concept Question: Dipole in Non-Uniform Field

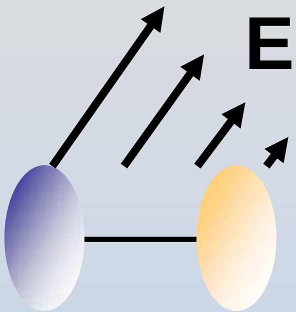


A dipole sits in a non-uniform electric field E, as shown

Due to the electric field this dipole will feel:

1. force but no torque
2. no force but a torque
3. both a force and a torque
4. neither a force nor a torque

Concept Question Answer: Non-Uniform Field



Answer: 3. both force and torque

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

As always, the dipole wants to rotate to align with the field – there is a torque on the dipole as well

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