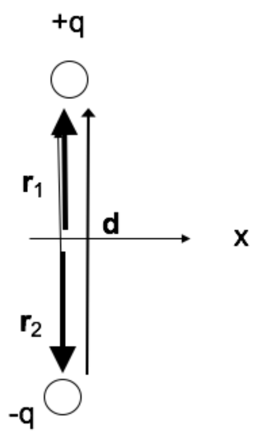
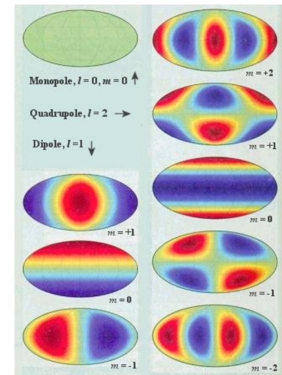


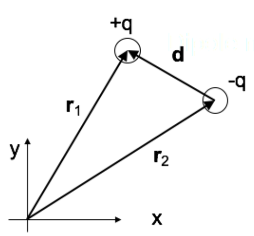
Two charges are positioned as shown to the left. The relative position vector between them is $\mathbf{d}$. What is the value of of the dipole moment? $\sum_i q_i \mathbf{r}_i$

A. $+q\mathbf{d}$
B. $-q\mathbf{d}$
C. Zero
D. None of these

MULTIPOLE EXPANSION



Multipole Expansion of the Power Spectrum of CMBR



Two charges are positioned as shown to the left. The relative position vector between them is $\mathbf{d}$. What is the dipole moment of this configuration?

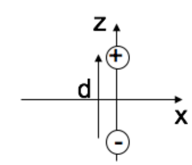
$$\sum_i q_i \mathbf{r}_i$$

A. $+q\mathbf{d}$
B. $-q\mathbf{d}$
C. Zero
D. None of these; it's more complicated than before!

For a dipole at the origin pointing in the z-direction, we have derived:

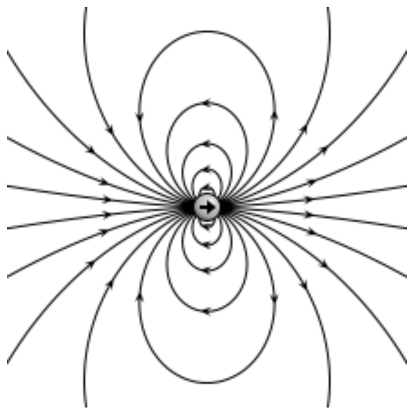
$$\mathbf{E}_{dip}(\mathbf{r}) = \frac{p}{4\pi\varepsilon_0 r^3}\left(2\cos\theta\,\hat{\mathbf{r}} + \sin\theta\,\hat{\theta}\right)$$

For the dipole $\mathbf{p} = q\mathbf{d}$ shown, what does the formula predict for the direction of $\mathbf{E}(\mathbf{r}=0)$?



A. Down
B. Up
C. Some other direction
D. The formula doesn't apply

IDEAL VS. REAL DIPOLE



Griffiths argues that the force on a dipole in an E field is:

$$\mathbf{F} = (\mathbf{p} \cdot \nabla)\,\mathbf{E}$$

If the dipole $\mathbf{p}$ points in the z direction, what direction is the force?

A. Also in the z direction
B. perpendicular to z
C. it could point in any direction

Griffiths argues that the force on a dipole in an E field is:

$$\mathbf{F} = (\mathbf{p} \cdot \nabla)\,\mathbf{E}$$

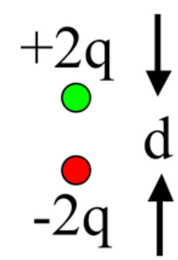
If the dipole p points in the z direction, what can you say about E if I tell you the force is in the x direction?

A. $\mathbf{E}$ simply points in the x direction
B. E_z must depend on x
C. E_z must depend on z
D. E_x must depend on x
E. E_x must depend on z

$$\mathbf{p} = \sum_i q_i \mathbf{r}_i$$

What is the magnitude of the dipole moment of this charge distribution?

A. qd
B. 2qd
C. 3qd
D. 4qd
E. It's not determined

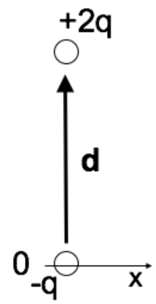


$$\mathbf{p} = \sum_i q_i \mathbf{r}_i$$

What is the dipole moment of this system?

(BTW, it is NOT overall neutral!)

A. $q\mathbf{d}$
B. $2q\mathbf{d}$
C. $\frac{3}{2}q\mathbf{d}$
D. $3q\mathbf{d}$
E. Someting else (or not defined)

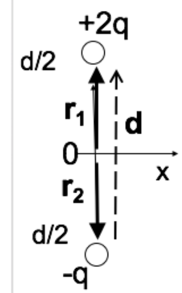


$$\mathbf{p} = \sum_i q_i \mathbf{r}_i$$

What is the dipole moment of this system?

(Same as last question, just shifted in z.)

A. $q\mathbf{d}$
B. $2q\mathbf{d}$
C. $\frac{3}{2}q\mathbf{d}$
D. $3q\mathbf{d}$
E. Someting else (or not defined)



You have a physical dipole, $+q$ and $-q$ a finite distance d apart. When can you use the expression:

$$V(\mathbf{r}) = \frac{1}{4\pi\varepsilon_0}\frac{\mathbf{p}\cdot\hat{\mathbf{r}}}{r^2}$$

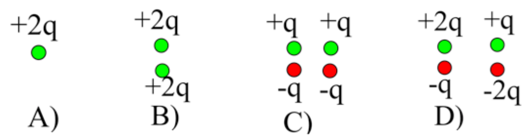
A. This is an exact expression everywhere.
B. It's valid for large r
C. It's valid for small r
D. No idea...

You have a physical dipole, $+q$ and $-q$ a finite distance d apart. When can you use the expression:

$$V(\mathbf{r}) = \frac{1}{4\pi\varepsilon_0}\sum_i \frac{q_i}{\mathfrak{R}_i}$$

A. This is an exact expression everywhere.
B. It's valid for large r
C. It's valid for small r
D. No idea...

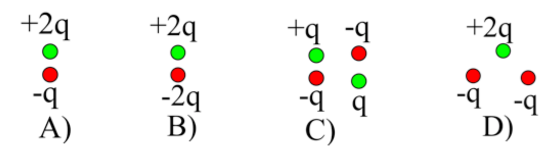
Which charge distributions below produce a potential that looks like $\frac{C}{r^2}$ when you are far away?



E) None of these, or more than one of these!

(For any which you did not select, how DO they behave at large r?)

Which charge distributions below produce a potential that looks like $\frac{C}{r^2}$ when you are far away?



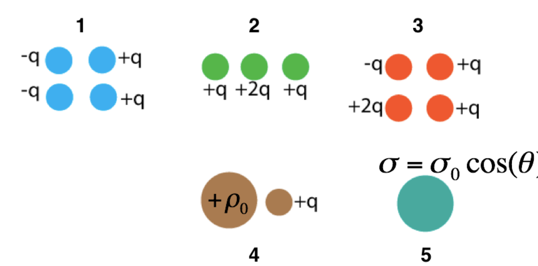
E) None of these, or more than one of these!

(For any which you did not select, how DO they behave at large r?)

In terms of the multipole expansion $V(r) = V(mono) + V(dip) + V(quad) + \ldots$, the following charge distribution has the form:

A. $V(r) = V(mono) + V(dip) +$ higher order terms
B. $V(r) = V(dip) +$ higher order terms
C. $V(r) = V(dip)$
D. $V(r) =$ only higher order terms than dipole
E. No higher terms, $V(r) = 0$ for this one.

In which situation is the dipole term the leading non-zero contribution to the potential?



A. 1 and 3
B. 2 and 4
C. only 5
D. 1 and 5
E. Some other combo