Announcements

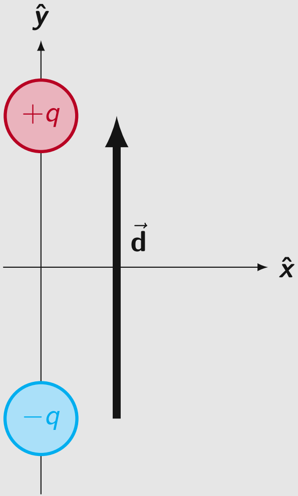
- Homework 6 due on Monday!
  - Hopefully you are making progress on it! Do not save it all till Monday, or you are going to have a really sad day!
- Exam 1 a week from today! *in class*
  - I'm working on cleaning up my solutions in case you want to check other homework problems against them next week
  - I'm also going to try to make a nice list of learning objectives of what I expect you to be able to do
- Read Ch 4.1 for Monday. Heading into understanding electric fields in matter!

Q1

Two charges are positioned as shown to the right. The relative vector between them is $\vec{\mathbf{d}}$. What is the value of the dipole moment?

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

A. $+q\vec{\mathbf{d}}$
B. $-q\vec{\mathbf{d}}$
C. 0
D. None of these



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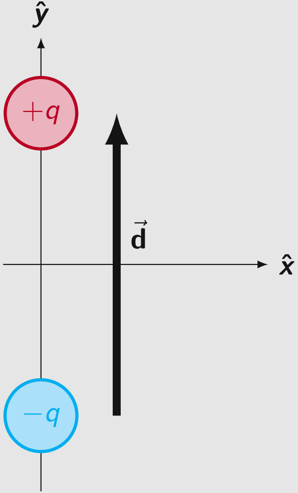
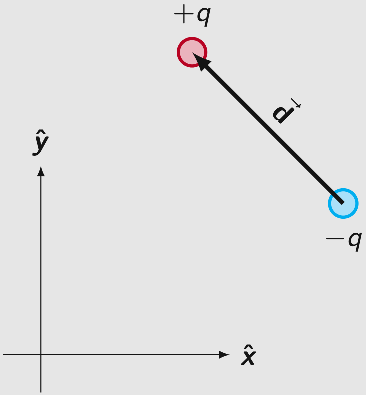


Q2



Now we have positioned the two charges as shown to the left. The relative position vector between them is still $\vec{\mathbf{d}}$. What is the dipole moment of this configuration?

A. $+q\vec{\mathbf{d}}$
B. $-q\vec{\mathbf{d}}$
C. 0
D. None of these. It is more complicated.

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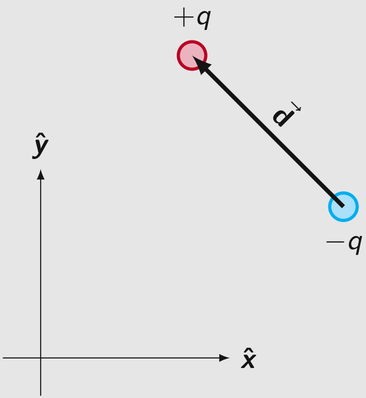

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Q3

In Eq 3.103, your book derives that:

$$\vec{\mathbf{E}}_{dip}(\vec{r}) = \frac{p}{4\pi\epsilon_0 r^3}(2\cos\theta\,\hat{\boldsymbol{r}} + \sin\theta\,\hat{\boldsymbol{\theta}})$$

What does the formula predict for the direction of the electric field at $\vec{r} = 0$?

A. Down

B. Up

C. Some other direction

D. Something is wrong!

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Q4

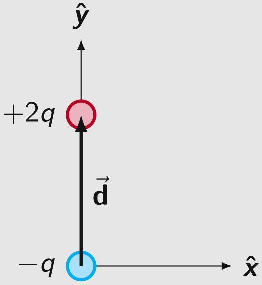
What are the first two terms of the multipole expansion for the configuration shown to the right?

A. $\dfrac{kq}{r} + \dfrac{2qd}{r^2}\,\hat{\boldsymbol{y}} \cdot \hat{\boldsymbol{r}}$

B. $0 + \dfrac{2qd}{r^2}\,\hat{\boldsymbol{y}} \cdot \hat{\boldsymbol{r}}$

C. $\dfrac{kq}{r} + \dfrac{5qd}{2r^2}\,\hat{\boldsymbol{y}} \cdot \hat{\boldsymbol{r}}$

D. $\dfrac{3kq}{r} + \dfrac{2qd}{r^2}\,\hat{\boldsymbol{y}} \cdot \hat{\boldsymbol{r}}$



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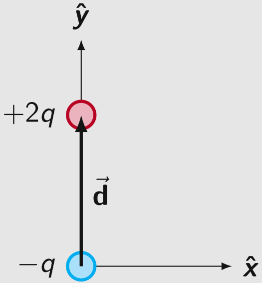
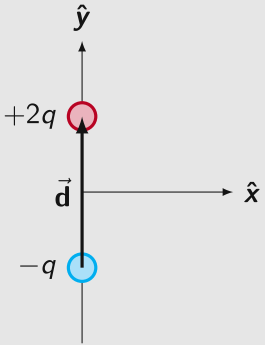


Q5

What about the first two terms of the multipole expansion for the configuration shown to the left (same basic configuration, but shifted)?



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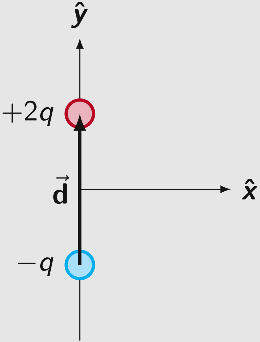

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Q6

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

$$V(\vec{\boldsymbol{r}}) = \frac{1}{4\pi\epsilon_0}\frac{\vec{\mathbf{p}}\cdot\hat{\boldsymbol{r}}}{r^2}$$

A. This expression is exact everywhere

B. It is valid for large r

C. It is valide for small r

D. This expression is not true anywhere

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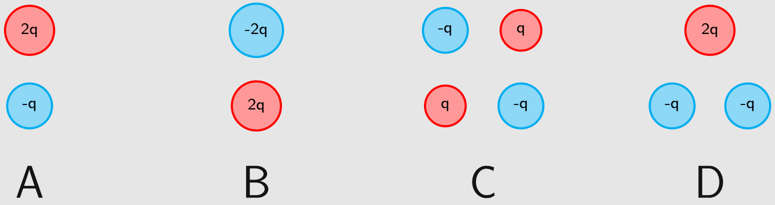
Exercise

In groups, for each of the charge distributions below decide what the dominating behavior will be when r is large. (Will it go as $\frac{1}{r}$? $\frac{1}{r^2}$? $\frac{1}{r^4}$? etc)

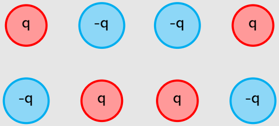


Q7

In terms of the multipole expansion

$$V(r) = V_{mono}(r) + V_{dip}(r) + V_{quad}(r) + \cdots$$

The below charge distribution would have what 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

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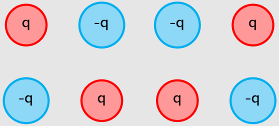

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