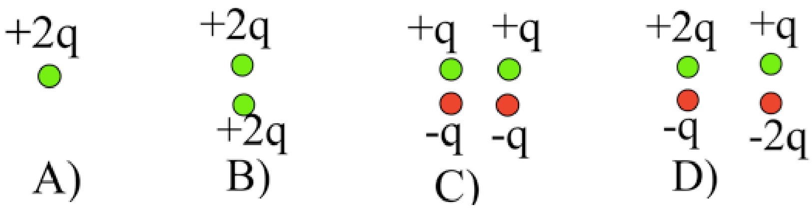
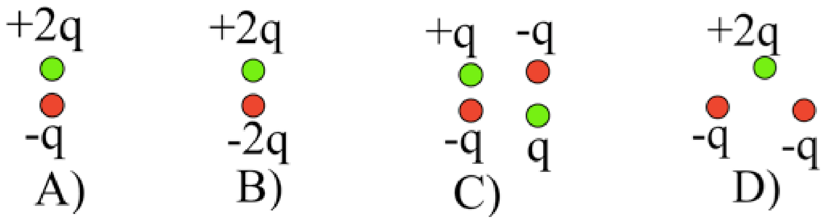
Which charge distributions below produce a potential that looks like $\frac{C}{r^2}$ when you are far away?



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

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

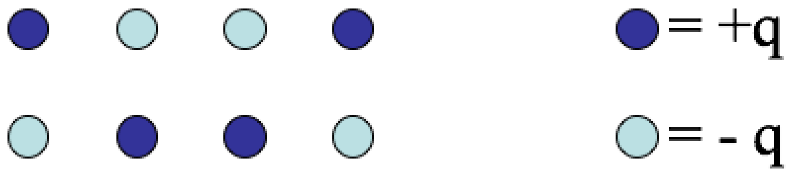
Which charge distributions below produce a potential that looks like $\frac{C}{r^2}$ when you are far away?



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

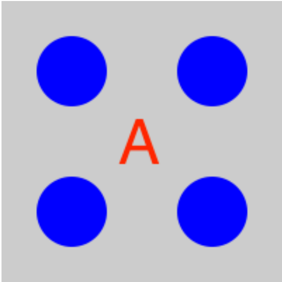
(For any which you did not select, how DO they behave at large r?)

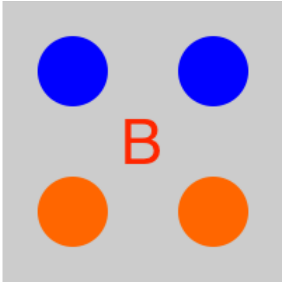
In terms of the multipole expansion $V(r) = V(mono) + V(dip) + V(quad) + \ldots$, the following charge distribution has the form:

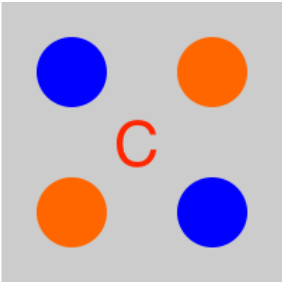


A. $V(r) = V(mono) + V(dip) +$ higher order terms
B. $V(r) = V(dip) +$ higher order terms
C. $V(r) = V(dip)$
D. $V(r) =$ only higher order terms than dipole
E. No higher terms, $V(r) = 0$ for this one.

Which of the following distributions could have a dipole contribution to the potential far from the charges?



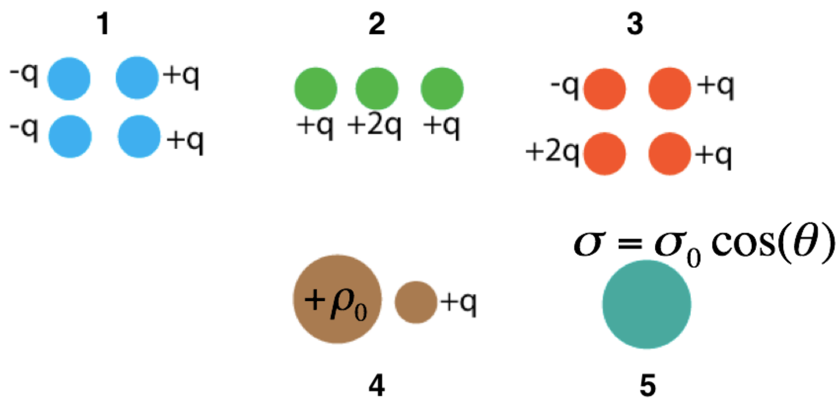




D. None

E. More than 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

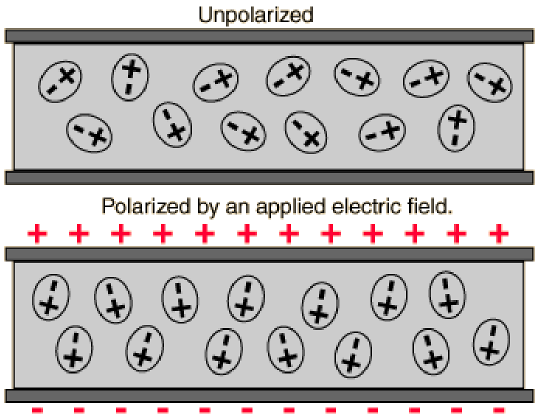
Consider a single point charge at the origin. It will have ONLY a monopole contribution to the potential at a location $\mathbf{r} = \langle x, y, z \rangle$.

As we have seen, if we move the charge to another location (e.g., $\mathbf{r}' = \langle 0, 0, d \rangle$), the distribution now has a dipole contribution to the potential at $\mathbf{r}$!

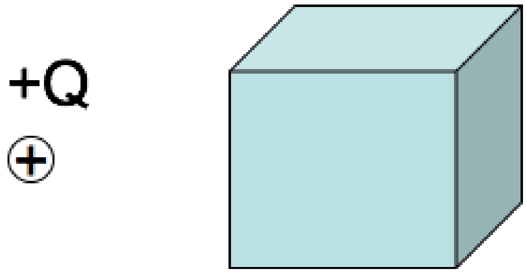
What the hell is going on here?

A. It's just how the math works out. Nothing has changed physically at $\mathbf{r}$.
B. There is something different about the field at $\mathbf{r}$ and the potential is showing us that.
C. I'm not sure how to resolve this problem.

POLARIZATION

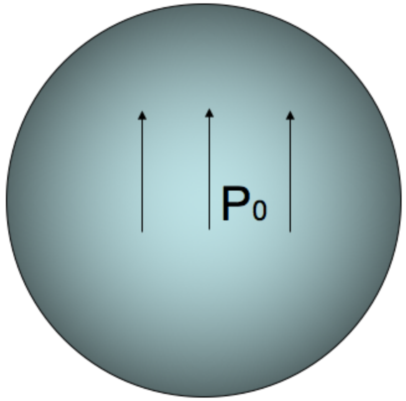


A stationary point charge $+Q$ is near a block of polarization material (a linear dielectric). The net electrostatic force on the block due to the point charge is:



A. attractive (to the left)
B. repulsive (to the right)
C. zero

The sphere below (radius a) has uniform polarization $\mathbf{P}_0$, which points in the $+z$ direction. What is the total dipole moment of this sphere?



A. zero
B. $\mathbf{P}_0 a^3$
C. $4\pi a^3 \mathbf{P}_0/3$
D. $\mathbf{P}_0$
E. None of these/must be more complicated

The cube below (side a) has uniform polarization $\mathbf{P}_0$, which points in the $+z$ direction. What is the total dipole moment of this cube?

A. zero

B. $a^3\mathbf{P}_0$

C. $\mathbf{P}_0$

D. $\mathbf{P}_0/a^3$

E. $2\mathbf{P}_0 a^2$