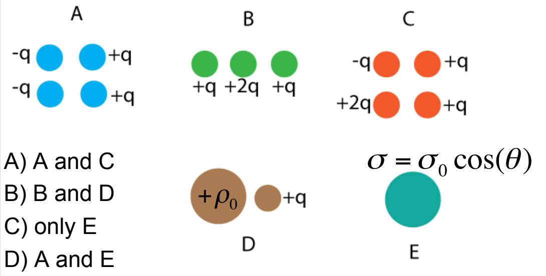
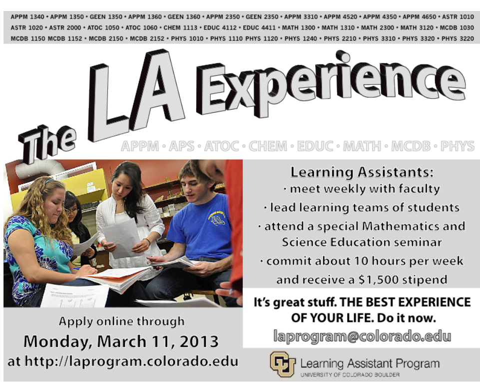
3.28 In which situation is the dipole term the leading non-zero contribution to the potential?

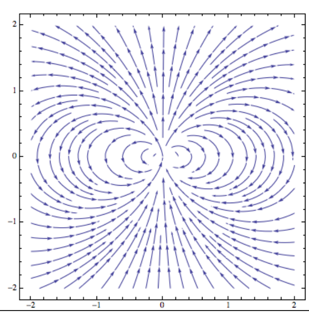


A) A and C
B) B and D
C) only E
D) A and E
E) Some other combo



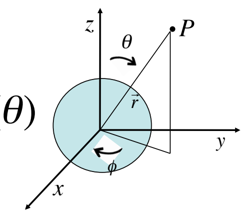
$$\vec{\mathbf{E}}(\vec{r}) = \frac{p}{4\pi\varepsilon_0 r^3}\left(2\cos\theta\,\hat{\mathbf{r}} + \sin\theta\,\hat{\theta}\right)$$

```
StreamPlot[
{(3*x*y)/(Sqrt[x^2 + y^2])^5,  (2*y*y – x*x)/(Sqrt[x^2 + y^2])^5},
 {x, -2, 2}, {y, -2, 2}]
```



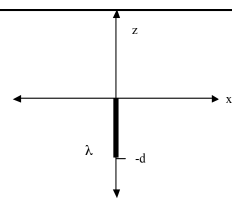
What is the direction of the dipole moment of the blue sphere?

$$\sigma = k\sin(\theta)$$

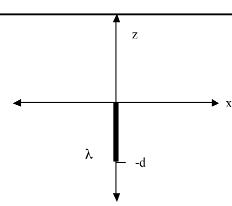


a) $\hat{\theta}$
b) $\hat{r}$
c) $\hat{z}$
d) $\hat{\phi}$
e) the dipole moment is zero (or is ill defined)

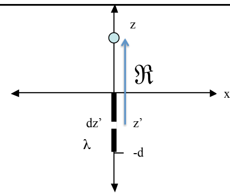
$$V(\mathbf{r}) = \frac{1}{4\pi\varepsilon_o}\iiint \frac{\rho(\vec{r}\,')d\tau'}{\Re}$$



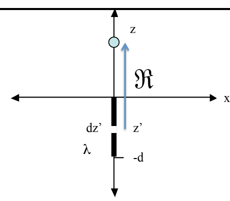
$$V(z) = \frac{1}{4\pi\varepsilon_o}\int \frac{\lambda\, dz'}{\Re}$$



$$V(z) = \frac{1}{4\pi\varepsilon_o} \int \frac{\lambda \, dz'}{\Re}$$



$$V(z) = \frac{1}{4\pi\varepsilon_o} \int \frac{\lambda \, dz'}{\Re}$$



$$\underset{\text{if } z>0}{=} \frac{1}{4\pi\varepsilon_0} \int_{z'=-d}^{z'=0} \frac{\lambda dz'}{(z-z')}$$

$$= \frac{\lambda}{4\pi\varepsilon_0} (-) \ln(z - z') |_{-d}^{0}$$

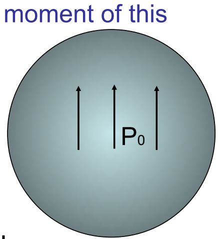
$$= \frac{\lambda}{4\pi\varepsilon_0} \ln(\frac{z+d}{z})$$

Let me know how far along you are:

A) DONE with page 1
B) DONE with page 2
C) DONE with page 3!

4.1
alt

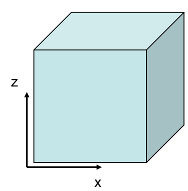
The sphere below (radius a) has uniform polarization $\mathbf{P}_0$ (which points in the z direction.)
What is the total dipole moment of this sphere?



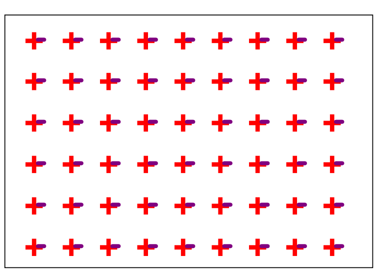
A) zero
B) $P_0 a^3$
C) $4\pi a^3 P_0/3$
D) P_0
E) None of these/must be more complicated

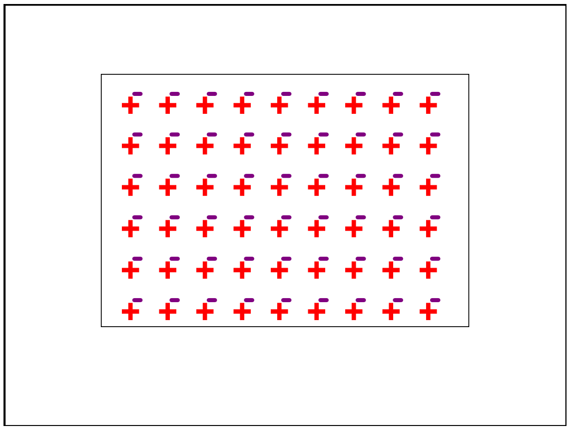
4.1

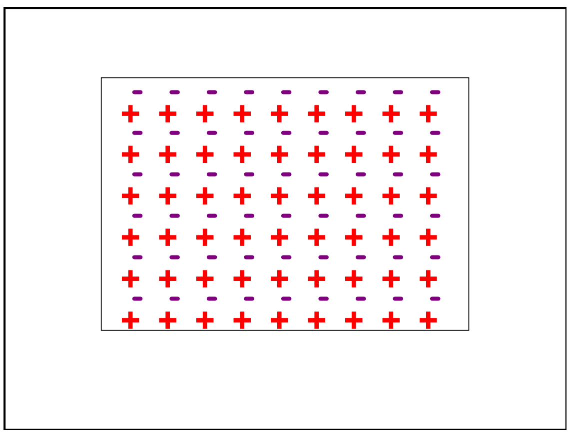
The cube below (side a) has uniform polarization $\mathbf{P}_0$
(which points in the z direction.)
What is the total dipole moment of this cube?

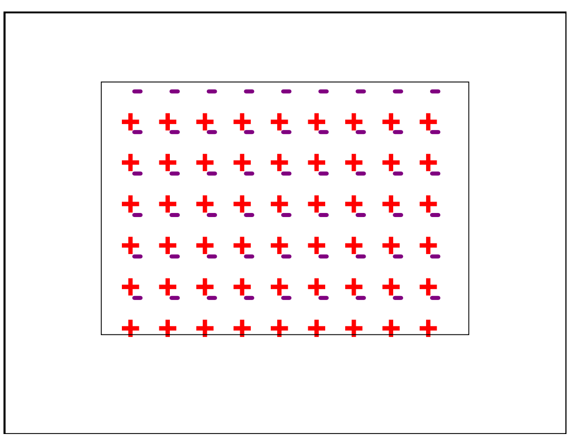


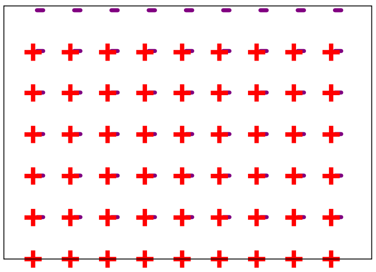
A) zero
B) $a^3 \mathbf{P}_0$
C) $\mathbf{P}_0$
D) $\mathbf{P}_0 /a^3$
E) $2 \mathbf{P}_0 a^2$





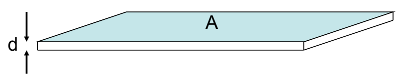






MD8-2

A VERY thin slab of thickness d and area A has *volume charge density* $\rho = Q / V$.
Because it's so thin, we may think of it as a *surface charge density* $\sigma = Q / A$.

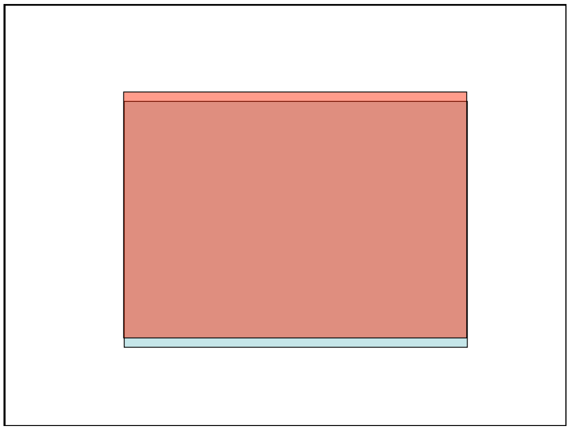


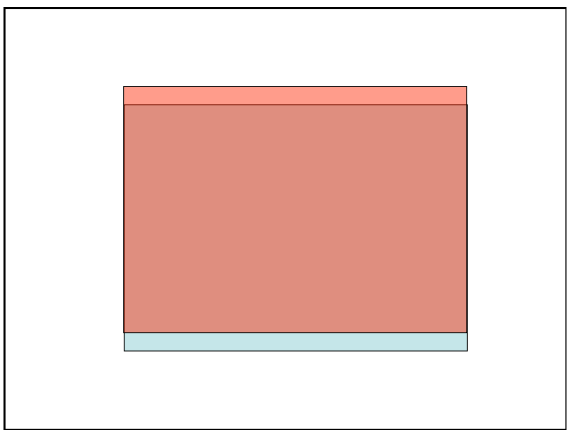
The relation between ρ and σ is

A) $\sigma = \rho$

B) $\sigma = d\,\rho$ C) $d\,\sigma = \rho$

D) $\sigma = V\,\rho$ E) $V\,\sigma = \rho$



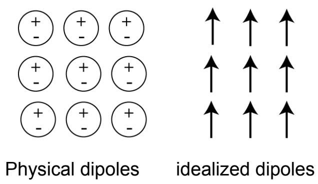


Imagine two fluids, red (+) and blue (-), each uniform, identical, in a rectangular shape (area A, height H).
This fluid has N "atoms"/m^3, and each "atom" (or unit) has available a charge q (which can separate/move). Imagine the red fluid moves UP the page, uniformly, a distance "d".

1) How much charge Q appears on the top surface? (on the bottom? the sides?)
2) What is σ on the top, in terms N, q, d, A, and/or H
3) What is the polarization P in terms of those variables?
4) What is σ on the top in terms of P?=
5) What if we displace the fluid that same distance "d", but at an angle θ with respect to the vertical. What are the answers above?

4.3

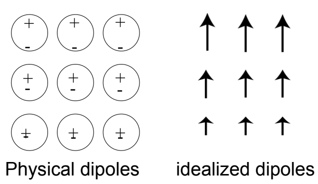
In the following case, is the bound surface and volume charge zero or nonzero?



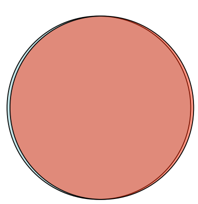
A. $\sigma_b = 0,\ \rho_b \neq 0$
B. $\sigma_b \neq 0,\ \rho_b \neq 0$
C. $\sigma_b = 0,\ \rho_b = 0$
D. $\sigma_b \neq 0,\ \rho_b = 0$

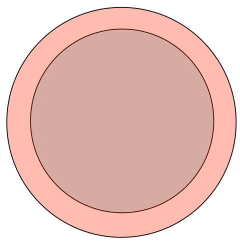
4.3 b

In the following case, is the bound surface and volume charge zero or nonzero?



A. $\sigma_b = 0,\ \rho_b \neq 0$
B. $\sigma_b \neq 0,\ \rho_b \neq 0$
C. $\sigma_b = 0,\ \rho_b = 0$
D. $\sigma_b \neq 0,\ \rho_b = 0$

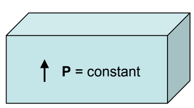




MD8-3

A linear dielectric in the shape of a rectangular block has a uniform polarization **P** (due to an external E-field) parallel to an edge, as shown. How many of the sides of the block have a non-zero surface charge density?

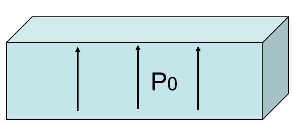
A) 1 B) 2 C) 4 D) 6 E) 0



4.4

A dielectric slab (top area A, height h) has been polarized, with **P**=P_0 (in the +z direction)

What is the surface charge density, σ_b, on the bottom surface?



A) 0
B) $-P_0$
C) P_0
D) $P_0 A h$
E) $P_0 A$

Are σ_b and ρ_b due to real charges?

A) Of course not! They are as fictitious as it gets! (Like in the 'method of images.')

B) Of course they are! They are as real as it gets! (Like σ and ρ in Chapter 2.)

C) I have no idea ☹