

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

A

B

C

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

D

E

$\sigma = \sigma_0 \cos(\theta)$

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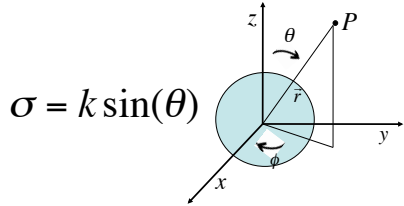
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$\vec{E}(\vec{r}) = \frac{P}{4\pi\epsilon_0 r^3} (2\cos\theta \hat{r} + \sin\theta \hat{\theta})$

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?



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

$$V(\mathbf{r}) = \frac{1}{4\pi\epsilon_0} \iiint_{\mathfrak{R}} \frac{\rho(\vec{r}') d\tau'}{\mathfrak{R}}$$

$$V(z) = \frac{1}{4\pi\epsilon_0} \int \frac{\lambda dz'}{\mathfrak{R}}$$

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$$= \frac{1}{4\pi\epsilon_0} \int_{z'=-d}^{z'=0} \frac{\lambda dz'}{(z - z')}$$

if $z > 0$

$$= \frac{\lambda}{4\pi\epsilon_0} (-) \ln(z - z') \Big|_{-d}^0$$

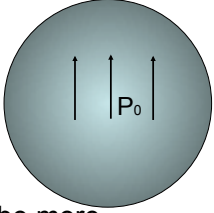
$$= \frac{\lambda}{4\pi\epsilon_0} \ln\left(\frac{z+d}{z}\right)$$

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

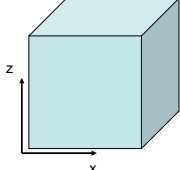
The sphere below (radius a) has uniform polarization \mathbf{P}_0 (which points in the z direction.)
 What is the total dipole moment of this sphere?



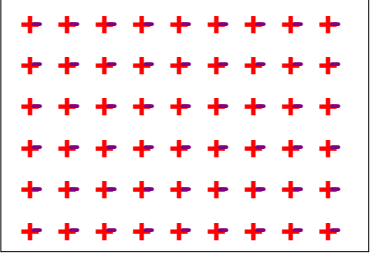
A) zero
 B) $\mathbf{P}_0 a^3$
 C) $4\pi a^3 \mathbf{P}_0/3$
 D) \mathbf{P}_0
 E) None of these/must be more complicated

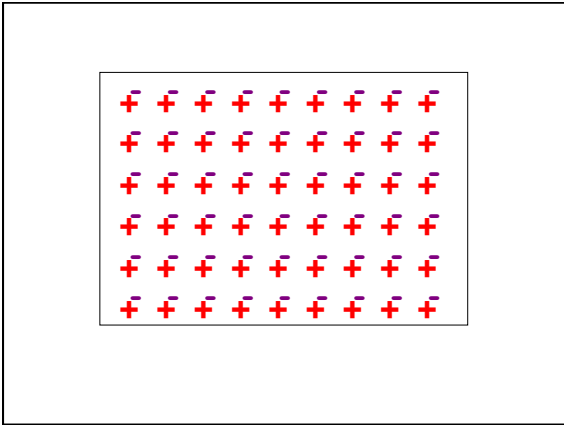
4.1

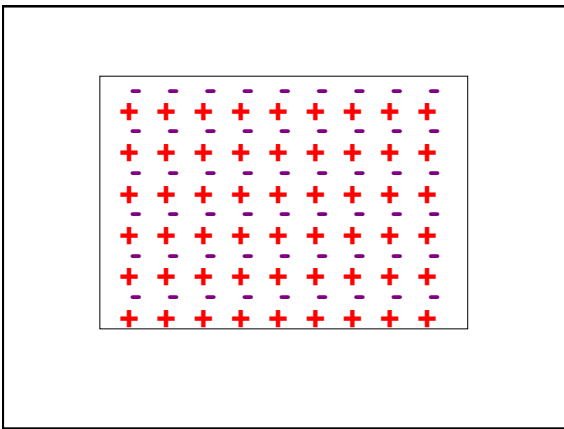
The cube below (side a) has uniform polarization \mathbf{P}_0 (which points in the z direction.)
 What is the total dipole moment of this cube?

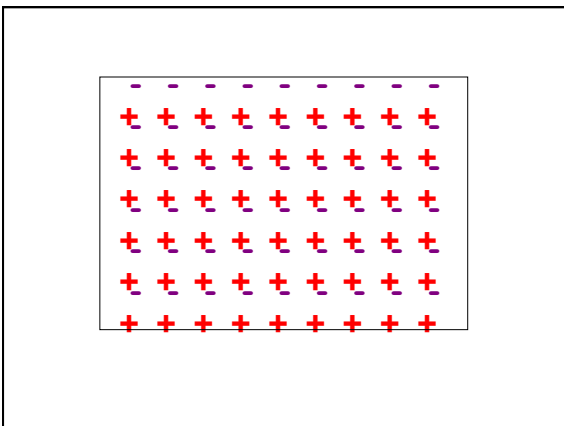


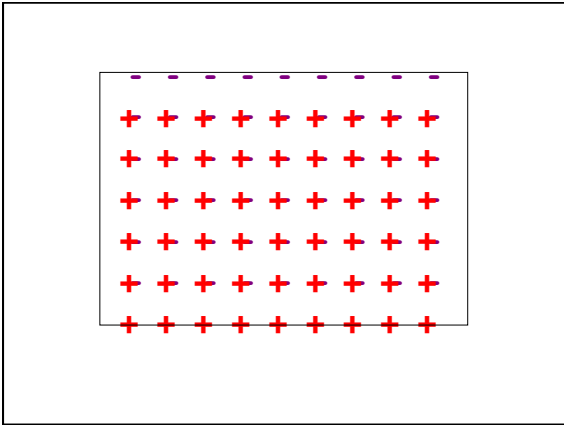
A) zero
 B) $a^3 \mathbf{P}_0$
 C) \mathbf{P}_0
 D) \mathbf{P}_0/a^3
 E) $2 \mathbf{P}_0 a^2$



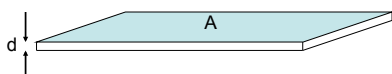






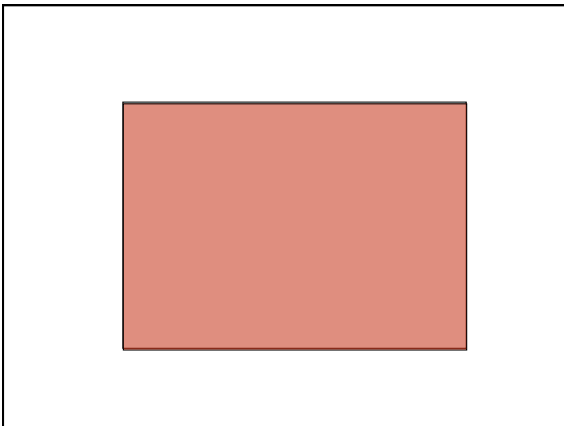


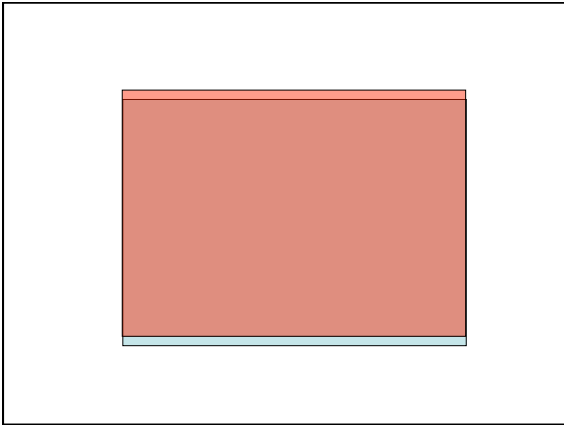
MD8-2
A VERY thin slab of thickness d and area A has
volume charge density $\rho = Q / V$.
Because it's so thin, we may think of it as a
surface charge density $\sigma = Q / A$.

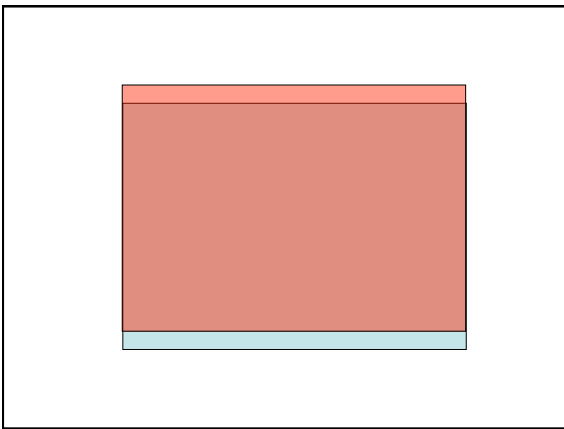


The relation between ρ and σ is

A) $\sigma = \rho$
B) $\sigma = d \rho$ C) $d \sigma = \rho$
D) $\sigma = V \rho$ E) $V \sigma = \rho$





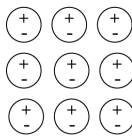


Imagine two fluids, red (+) and blue (-), each uniform, identical, in a rectangular shape (area A , height H). This fluid has N "atoms"/ m^3 , and each "atom" (or unit) has available a charge q (which can separate/move). Imagine the red fluid moves UP the page, uniformly, a distance " d ".

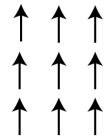
- 1) How much charge Q appears on the top surface? (on the bottom? the sides?)
- 2) What is σ on the top, in terms N , q , d , A , and/or H
- 3) What is the polarization P in terms of those variables?
- 4) What is σ on the top in terms of P ?=
- 5) What if we displace the fluid that same distance " d ", 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?



Physical dipoles

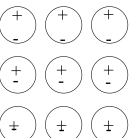


idealized dipoles

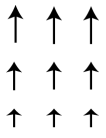
A. $\sigma_b = 0, \rho_b \neq 0$
 B. $\sigma_b \neq 0, \rho_b \neq 0$
 C. $\sigma_b = 0, \rho_b = 0$
 D. $\sigma_b \neq 0, \rho_b = 0$

4.3
b

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

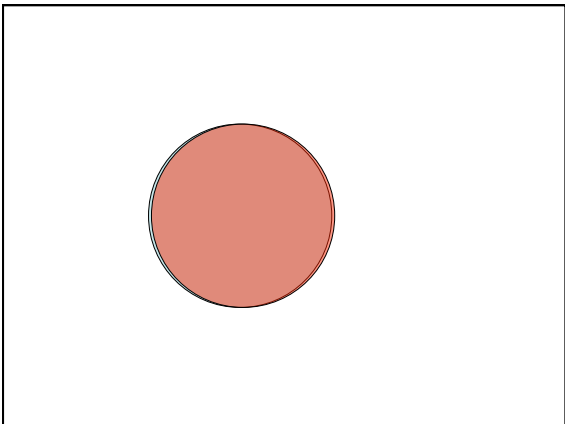


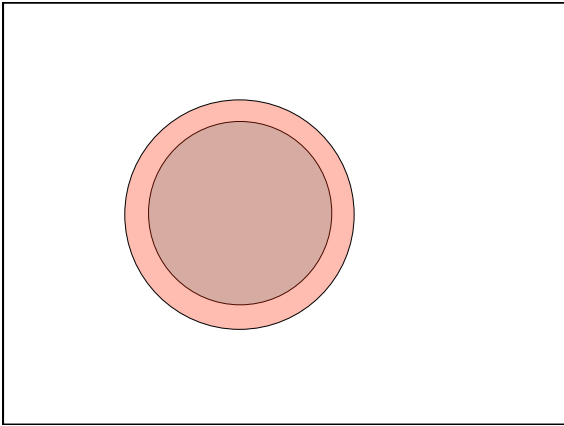
Physical dipoles



idealized dipoles

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 \mathbf{P} (due to an external \mathbf{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 $\mathbf{P} = P_0$ (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 ☹
