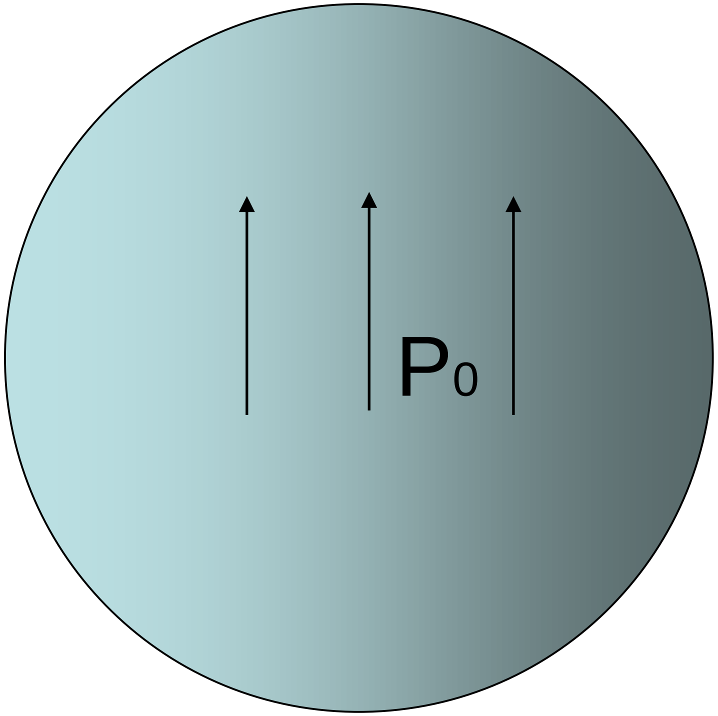
POLARIZATION

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

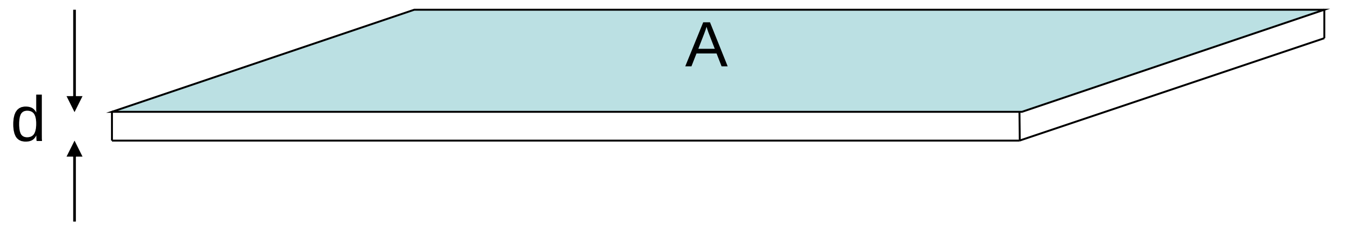
B) $P_0\, a^3$

C) $4\pi a^3\, P_0/3$

D) P_0

E) None of these/must be more complicated

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) $\sigma = \rho$

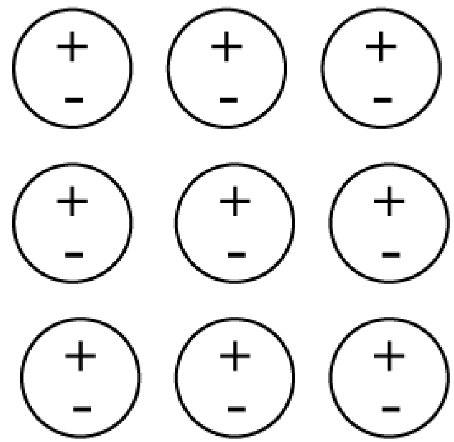
B) $\sigma = d\,\rho$

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

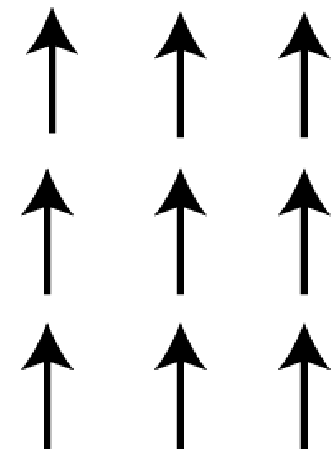
D) $\sigma = V\,\rho$

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

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



Physical dipoles



idealized dipoles

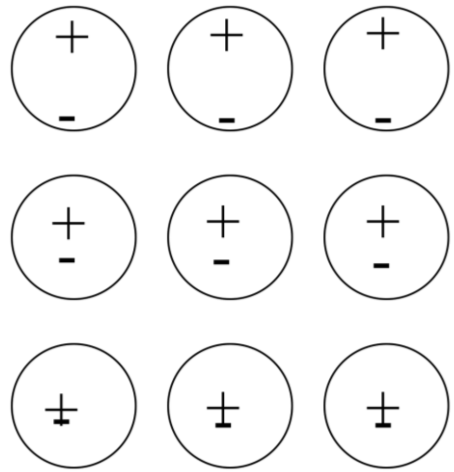
A. $\sigma_b = 0,\ \rho_b \neq 0$

B. $\sigma_b \neq 0,\ \rho_b \neq 0$

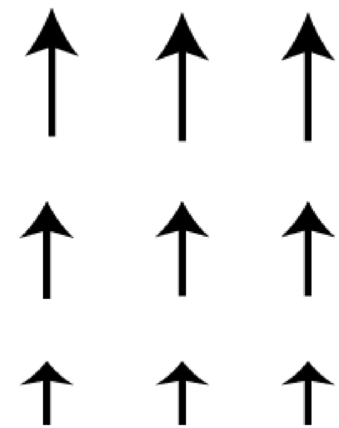
X. $\sigma_b = 0,\ \rho_b = 0$

Δ. $\sigma_b \neq 0,\ \rho_b = 0$

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



Physical dipoles



idealized dipoles

A. $\sigma_b = 0,\ \rho_b \neq 0$

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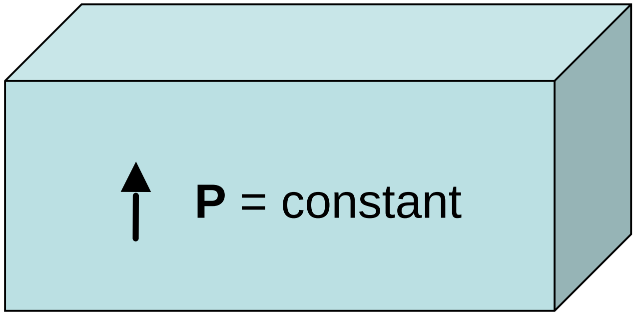
Δ. $\sigma_b \neq 0,\ \rho_b = 0$

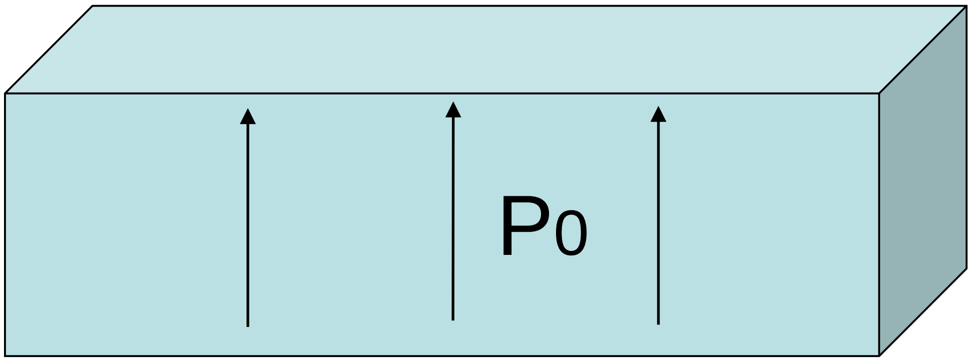
A linear dielectric in the shape of a rectangular block has a uniform polarization **P** (due to an external E-field) parallel to an edge, as shown. How many of the sides of the block have a non-zero surface charge density?

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



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.’)

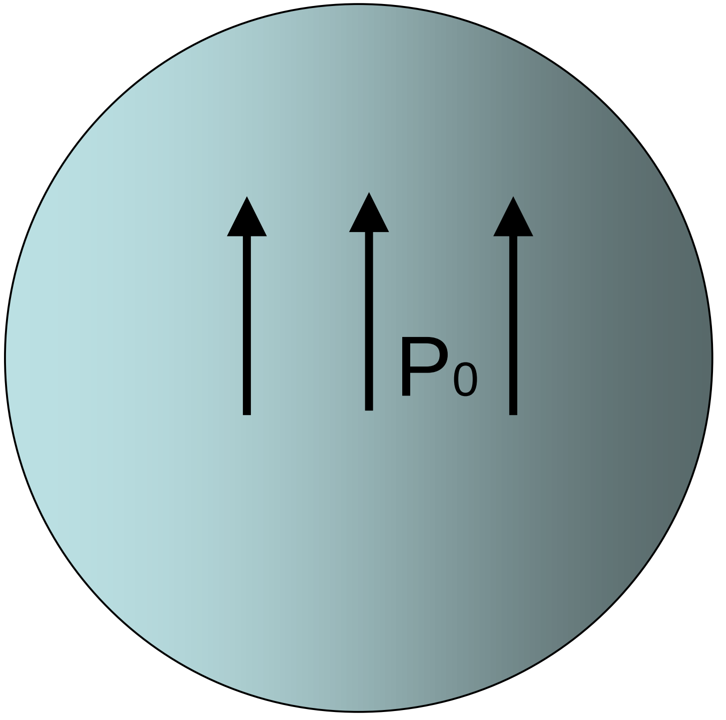
B) Of course they are! They are as real as it gets! (Like σ and ρ in Chapter 2.)

C) I have no idea ☹

A dielectric sphere is uniformly polarized,

$$\mathbf{P} = +P_0\,\hat{z}$$

What is the surface charge density?



A) 0

B) Non-zero Constant

C) constant*sin(θ)

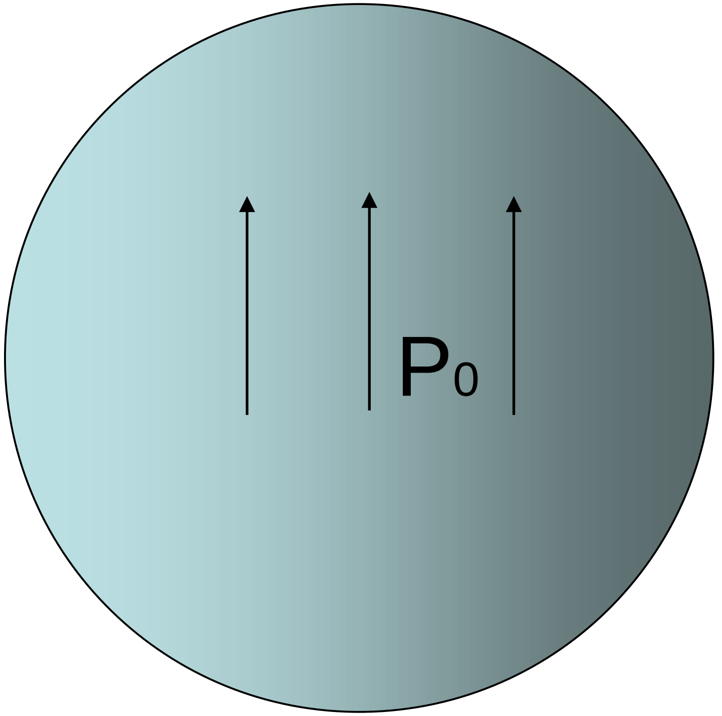
D) constant*cos(θ)

E) ??

A dielectric sphere is uniformly polarized,

$$\mathbf{P} = +P_0\,\hat{z}$$

What is the volume charge density?



A) 0

B) Non-zero Constant

C) Depends on r, but not θ

D) Depends on θ, but not r

E) ?

A dielectric sphere is uniformly polarized,

$$\mathbf{P} = +P_0\,\hat{z}$$

$$s_{bound} = \mathbf{P}\cdot\hat{n}$$

$$r_{bound} = \nabla\cdot\mathbf{P}$$