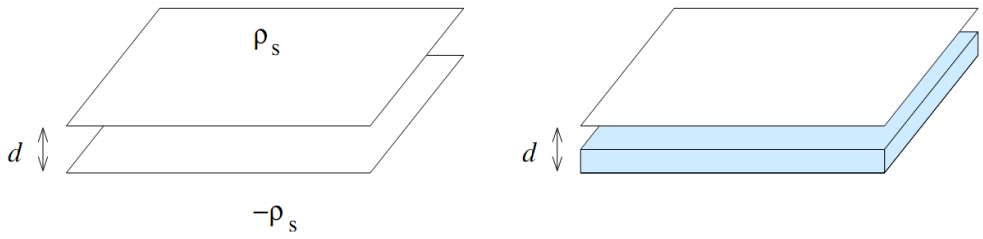
Homework 1

Static Electric and Magnetic Fields

Ex 1.1: Capacitor

Two large parallel conducting plates a distance d apart are charged with a surface charge density $\pm\rho_s$, see the figure (left panel).



a) What is the magnitude of the electric field between the plates? Ignore edge effects.

b) What is the pressure (force per unit area) the two plates exert on each other?

c) A sheet of dielectric material of thickness $d/2$ is placed between the plates, see the figure (right panel). The dielectric constant of the material is ϵ. What is the electric field between the plates, inside the dielectric and outside the dielectric?

d) What is the potential difference between the two plates in this case?

Ex 1.2: Sphere and spherical cavity in medium of uniform polarization

Heald & Marion, ex. 1-13.

Ex 1.3: Coaxial solenoids

Consider two long coaxial solenoids that each carry a current I, but in opposite directions. The two solenoids have different turns of wire per unit length: The inner solenoid, which has radius a_1, has n_1 turns of wire per unit length, while the outer solenoid, which has radius a_2, has n_2 turns of wire per unit length. Find the magnetic field $\mathbf{B}$

a) inside the inner solenoid,

b) between the two solenoids,

c) outside the outer solenoid.

Neglect end corrections.

Ex 1.4: Lorentz force and Newton's 3rd law

Heald & Marion, ex. 1-29.

Ex 1.5: dipoles

Heald & Marion, ex. 1-10.

Ex 1.6: Electret

Heald & Marion, ex. 1-15.

Suggested Problems for Further Study:

Heald & Marion, ex. 1-8: Charged soap bubble (Feel free to ignore the hint)

Heald & Marion, ex. 1-20: Magnetic Field of an infinite solenoid