

Problem Set 4

Physics 110A, UC Berkeley, Spring 2021

Due Monday, 2/22, at 11:59PM

Problem 1

Consider a spherical thin *shell* of radius R with charges uniformly distributed on its surface. The uniform surface charge density is denoted as σ .

- (a) Setting the potential V to be zero at infinity, find the electric potential created by the charged shell.
- (b) Using V , find the electric field \mathbf{E} created by the shell.

Problem 2

Continue from Problem 1, find the energy W stored in this system.

Problem 3

Continue from Problem 1 and 2, consider the situation where the radius of the shell expands by δR , and the energy stored in the system changes by δW accordingly.

- (a) Find the expression for δW .
- (b) The change in energy must be equal to the work done by the pressure f (force per unit area) exerted by the electric force when the shell expands:

$$\delta W = -f (4\pi R^2) \delta R.$$

There is a negative sign as the energy stored in the system is being used by the electric force to do work. Use this relation to find f . Does the electric force try to squeeze the shell or stretch the shell?

Below are selected optional problems from Griffiths. We do not collect your work, but you are encouraged to do as many practice problems as you can.

- Problem 2.35
- Problem 2.37
- Problem 2.39
- Problem 2.41
- Problem 2.42
- Problem 2.53