PHYS 2020: Homework 7 (due Wednesday Nov. 11)

Reading: Purcell & Morin, Chapters 1.15, 3.5, 3.7.

Problem 1 (20 points): Consider parallel conducting plates with area A and charges $+Q$ and $-Q$, respectively.

(a) If the plates are separated by a distance x, what is the potential energy U? **(5 points)**

(b) What is the change in potential energy ΔU if the distance between the plates is increased from x to $x + \Delta x$? **(5 points)**

(c) Using your result from (b), determine the force between the two conducting plates. **(5 points)**

(d) Now, compute the force in a different way. Divide the upper plate into tiny patches dq. The force on each patch dq is $\vec{E}dq$, where $\vec{E}$ is the electric field from the lower plate. Compute the total force by integrating over dq and check that your result agrees with (c). **(5 points)**

Problem 2 (15 points): Purcell & Morin, 3.59.

Problem 3 (15 points): Consider two solid conducting spheres, which are separated far from one another, with sphere 1 having a radius twice as large as sphere 2 ($R_1 = 2R_2$). Initially, sphere 1 has charge Q, while sphere 2 is neutral. Now, suppose that the spheres are connected by a long conducting wire. What is the resulting charge on each of the spheres?

Problem 4 (15 points): Consider a solid nonconducting sphere of radius R and uniform charge density ρ.

(a) What is the potential energy of this charge configuration? **(5 points)**

(b) Now, suppose that the sphere becomes conducting and the charge on the sphere can move. After the charges reach their equilibrium positions on the sphere, what is the new potential energy of the charge configuration? **(5 points)**

(c) Is the change in potential energy between (a) and (b) positive or negative? Justify whether your result makes sense. **(5 points)**