Electrodynamics I: Assignment 6. Due November 7 at 11:00am in class or 10:45am in the instructor's mailbox.

1. Separation of variables. Consider a variant of the first exam problem: A plane at potential Φ_0, with a hemisphere of radius *R* and potential Φ_0 with its flat face on the plane. Use separation of variables to find the potential everywhere on the hemisphere-side of the plane.

2. Child's Law, an application of Poisson's equation. An "ideal" parallel-plate capacitor in vacuum has plate-spacing *d*. One plate is at ground, the other at potential Φ_0. Suppose the work function of the electrons is zero (that is, it requires no work to pull an electron out of a plate). Find the current density between the plates. You might perhaps be surprised the current is not infinite since there is no resistance to extracting an electron from the plate, but the electrons in transit between the plates (the "space charge") depresses the electric field. The only knowledge of currents you need is at a Griffiths level.

3. Challenge problem, another application of Poisson's equation. An infinitely-long grounded, hollow, square conductor of side *d* contains a point charge *q* at a point on the central axis. Find the potential everywhere inside the pipe and a simplified expression for the potential at distances much greater than *d*.

4. Spherical harmonics. Consider a conductor consisting of a spherical shell. But the shell has holes; some parts of the shell are removed and brought to infinity. The remaining conducting parts of the shell are kept at potential Φ_0. For every point on the remaining conducting parts, find the difference in surface charge between the inside and outside surfaces. You might be surprised by the answer.

[ver 01Nov19 09:30]