Physics 513, Autumn Quarter 2017
Electrodynamics: Homework Assignment 9
Due Nov. 30, 5:00pm either 11:00am in class or 10:45am in the instructor's mailbox.

This is a short problem set due to the Thanksgiving holiday.

1. Space charge. Consider two closely-spaced (so you can ignore fringe fields) parallel conducting plates in vacuum. The plates are maintained at a voltage difference Φ_0. Suppose the work function of the electrons in the plates is zero (a condition obtained, say, by heating the plates). What is the current density between the plates?

2. There is a saying "Irrotational currents J cannot produce magnetic fields." However, the infinite straight current-carrying wire is an irrotational current sourcing magnetic fields. Find under what circumstances this saying is correct.

3. Recall we introduced a magnetic scalar potential $B = -\mu_0 \nabla \Phi_m$ where the scalar potential had a geometric interpretation $\Phi_m = \frac{I}{4\pi} d\Omega$ representing the change in the solid angle subtended by a current loop as seen at a field point due to a small translation of the loop. Suppose the loop is a circle of radius *R* carrying current *I*. Use this formalism to find the magnetic field along the loop axis.

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