Prelim: Electromagnetism
Fall 2013

Saturday September 14^{th} 2013
Choose 2 out of the 3 problems.

Problem 1: (*20 points*)
The potential difference between two parallel flat electrodes is V and the distance between them is d. The field induced emission of of electrons from one of the electrodes continues till a space charge forms between the electrodes, which opposes the external field. At steady state, compute the constant current density as a function of V and d. Take the electron charge e, mass, m and permittivity of free space ϵ_0.

Problem 2: (*20 points*)
Consider a strip of infinite length and width a made of a conducting material. A current with surface density i flows uniformly through the strip. Calculate the magnetic field everywhere. What happens when you take the limiting cases of the width of strip tending to infinity and to zero. Are they what you expect?

Problem 3: (*20 points*)
Two plain monochromatic waves are linearly polarized in perpendicular directions. Determine the polarization of the resulting wave if both waves propagate in the same direction, their frequencies are the same and their amplitudes are E_1 and E_2 respectively with a phase difference of ϕ.