

ENEE 380: Homework #1

Due: Tuesday Sept. 15, 2009

Jackson: Problems 1.1, 1.5, 1.6, 1.12, 1.13, 1.15

Also,

Prob. 1.A) Derive the relationship between the current density J and the applied voltage V_0 for a space charge limited flow in a vacuum diode in the ultra relativistic regime, $eV_0 \gg mc^2$. (Hint: take the electron speed to be c)

Prob. 1B) Consider electrostatics in one dimension; i.e., $\rho = \rho(x)$, and $\Phi = \Phi(x)$. (i) What is the Dirichlet Green's function for the domain $0 \leq x \leq b$? (ii) What is the one-dimensional analog to Eq. (1.44)

Prob 1C) The potential surrounding a point charge, q , located at position \mathbf{x}_0 in a plasma is given by,

$$\Phi_0(\mathbf{x}) = \frac{q \exp(-|\mathbf{x} - \mathbf{x}_0| / \lambda_d)}{4\pi\epsilon_0 |\mathbf{x} - \mathbf{x}_0|},$$

where λ_d is known as the Debye length. a) Find the charge density induced in the plasma. b) Show that it is proportional to the local potential.