1. (20%)

Two infinite parallel plates separated by a distance s are at potentials 0 and V_0.

(a) Use Poisson's equation to find the potential V in the region between the plates where the space charge density is $\rho = \rho_0(x/s)$. The distance x is measured from the plate at zero potential.

(b) What are the charge densities on the plates?

2. (20%)

Find the capacitance per unit length of a capacitor consisting of a pair of infinite coaxial cylinders having inner and outer radii a and b, respectively.

3 (20%)

A conducting bar slides at a constant velocity u along conducting rails in a region of uniform magnetic induction, as in Figure 3. The resistance in the circuit is R and the inductance is negligible.

(a) Calculate the current I flowing in the circuit..

(b) How much power is required to move the bar?

(c) How does this power compare with the power loss in the resistance R?

4 (20%)

Two plane parallel electrodes are separated by a plate of thickness s whose conductivity σ varies linearly from σ_0 near the positive plate to $\sigma_0 + a$ near the negative plate.

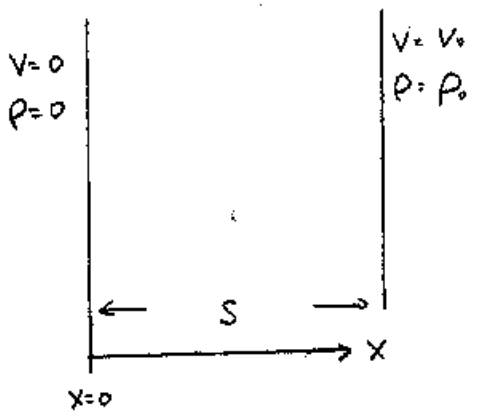
(a) Calculate the space charge density ρ_f when the current density is J_f.

(b) Calculate ρ_f near both plates for $\sigma_0 = 1.00 \times 10^7$ mhos/meter, $\sigma_0 + a = 2.00 \times 10^7$ mhos/meter, $J_f = 1.00$ ampere/meter^2, $\varepsilon_r = 1$, $s = 1.00$ centimeter, $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m.

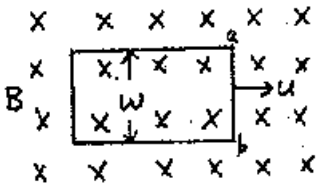
5 (20%)

Describe the Maxwell's equations and their physical meaning.

1. Figure 1



3. Figure 3



2. Figure 2