

PROBLEM SET 7

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NE 290 H BARNARD & LUND

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POINTS

CONSIDER A DIODE OF VOLTAGE V_0 AND GAP LENGTH d .
Let a current density J be composed of two species such

that $J_1 = \alpha J$ and $J_2 = (1 - \alpha) J$ (so that $J = J_1 + J_2$).

Let the mass of ions in species 1 be m_1 and those of species 2 be m_2 . What is the effective mass

m_{eff} that should be used in the resulting Child Langmuir

Law:
$$J = \frac{4}{9} \epsilon_0 \left(\frac{zq}{m_{\text{eff}}} \right)^{1/2} \frac{V_0^{3/2}}{d^2}$$

(Both ion species have charge q).

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POINTS

PROBLEM 7 CONSIDER THE FOLLOWING DIODE OF VOLTAGE V_0 AND LENGTH d .

SUPPOSE AT SOME TIME $t_p > \tau \equiv \frac{3d}{(\frac{2qV_0}{m})^{1/2}}$ THE

CURRENT IS ABRUPTLY TURNED OFF. WHAT VOLTAGE WAVEFORM IS REQUIRED TO ENSURE THAT THE ELECTRIC FIELD AT THE TAIL OF THE PULSE IS IDENTICAL TO THE CHILD-LANGMUIR ELECTRIC FIELD?

