Problem Set II: This problem set should be completed within two weeks.

1.) a.) Derive the Fokker-Planck equation for the motion of a Brownian particle in a spectrum of thermal fluctuation - induced forces, with white noise. Calculate all parameters explicitly.

b.) What pdf is the stationary state solution of this equation? What does this imply about the time-asymptotic particle distribution?

2.) a.) Compute the average power dissipated by a test particle moving at velocity $\underline{v}$ thru a plasma. Do this by computing $\left(\underline{E}\cdot\underline{J}\right)$, for $\underline{J} = q\delta\left(\underline{x} - \underline{v}t\right)$.

b.) Now, integrate your result from a.) over a distribution $\langle f \rangle$ of test particles and compare that to the power dissipated by the dynamical friction term in the Lenard-Balescu equation.

c.) What can we conclude from this? Discuss your result.

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4.) Consider an ensemble of Brownian particles distributed in a jar of water at temperature *T*. Assume the particles fall under gravity, and experience a Stokes drag.

a.) Assuming the particles quickly reach terminal velocity, derive the Fokker-Planck equation for the density of particles.

b.) Calculate the steady state density profile and show that your result agrees with that from equilibrium statistical mechanics.

5.) Consider a linearly stable current driven ion acoustic system (i.e. 1D, electrons with shifted Maxwellian at mean velocity v_0 and temperature T_e; ions with unshifted Maxwellian and temperature T_i).

a.) What condition is sufficient to *guarantee* stability?

b.) Derive the effective resistivity (i.e. electron-ion momentum transfer) using the Lenard-Balescu equation. Justify your result.

c.) Discuss how the dimensionless parameters m_e/m_i, T_e/T_i, v_0/c_s influence this resistivity.

d.) Explain in detail how your result differs from its counterpart from simpler collision theory. When would you expect this difference to be most dramatic? Express your answer to this last question in terms of the dimensionless parameters above.