PHYSICS 140B : STATISTICAL PHYSICS
HW ASSIGNMENT #6

(1) Consider the collisionless Boltzmann equation for the Hamiltonian $\hat{H}(p) = \frac{1}{4}Ap^4$ in one space dimension. Suppose the initial distribution is given by

$$f(x, p, t = 0) = C\, e^{-x^2/2\sigma^2}\, e^{-p^2/2\kappa^2} \quad .$$

(a) Find $f(x, p, t)$ for all $t > 0$.

(b) Find the equation for the locus of points (x, p) for which $f(x, p, t) = \exp(-\alpha^2/2)$.

(c) Express your result in (b) in dimensionless form and plot it for various values of the dimensionless time.

(2) Consider an ideal gas of point particles in $d = 3$ dimensions with isotropic dispersion $\varepsilon(p) = Ap^\sigma$.

(a) Find the enthalpy per particle $h = \mu + Ts$, where μ is the chemical potential and s is the entropy per particle. (You may find it useful to review some of the material in chapter 4 of the notes.)

(b) Find the thermal conductivity κ within the relaxation time approximation.