PROBLEMS

5.1 Consider a system of particles uniformly distributed in space, with a constant particle number density n_0, and characterized by a velocity distribution function $f(v)$ such that

$$f(v) = K_0 \quad for \quad |v_i| \leq v_0 \quad (i = x, y, z)$$

$$f(v) = 0 \qquad otherwise,$$

where K_0 is a nonzero positive constant. Determine the value of K_0 in terms of n_0 and v_0.

5.4 Consider the motion of charged particles, in one dimension only, in the presence of an electric potential $V(x)$. Show, by direct substitution, that a function of the form

$$f = f(\tfrac{1}{2}mv^2 + qV)$$

is a solution of the Boltzmann equation under steady-state conditions.

5.8 Consider a one-dimensional harmonic oscillator whose total energy can be expressed by

$$E = \tfrac{1}{2}(mv^2 + cx^2)$$

where c is a constant and x its displacement coordinate. Show that the trajectory described by the representative point of the oscillator, in phase space, is an ellipse.