FYS 4130 Statistical Mechanics

Homework 14 May 18, 2010

1) Diffusion (exam problem from 2009)

Diffusion of a local particle density $C(x,t)$ in one dimension is governed by the equation

$$\frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2}$$

Where D is the diffusion constant.

a) Show that

$$C(x,t) = \sqrt{\frac{1}{4\pi Dt}}e^{-x^2/4Dt}$$

b) At time $t = 0$ the concentration is given as $C_0(x) = Ke^{-x^2/L^2}$ where L is a fixed length. Find the constant K from the requirement that there are in total N diffusing particles.

c) What is the current of particles for $x = L$ at this time?

d) Calculate the concentration of particles at a later time $t > 0$.