

PY 452: Quantum Physics II Problem Set 2

Due date: Friday, September 17, by 5:00pm

Reading: This week we will finish the quantum theory of solids and then begin a brief presentation of quantum statistical mechanics. Please complete reading chapter 5 in the text by no later than the lecture this coming Thursday. For quantum statistical mechanics, there are two relevant mathematical topics that may be a bit unfamiliar to some of you — Stirling's approximation and Lagrange multipliers. Please consult Wikipedia for more information on these two topics. I've posted a useful (and slightly advanced) article about Stirling's approximation from the American Journal of Physics on the course website.

1. Text 5.6.
2. Text 5.23.
3. Use Lagrange multipliers to solve the following problems:
 - (a) Maximize the product of two numbers whose sum is 100.
 - (b) A rectangular box that is open at the top has a square bottom of linear size $x \times x$ and four sides of height y . The volume of the box is fixed to be V . What value(s) of x and y lead to the smallest surface area A ?
 - (c) Find the extrema of $f(x, y, z) = xyz$ subject to the constraints $x^2 + y^2 + z^2 = 1$ and $xy + yz + zx = 1$.
4. Text 5.27.
5. Text 5.36, parts (a) and (b) only.