

Physics 129a  
Problem Set Number 8  
Due Tuesday, November 24, 2009

Reading: Start reading the course note on the calculus of variations.

34. Qualitative behavior of classical orthogonal polynomials: Exercise 6 in the Linear Differential Equations course note.
35. Green's function: Exercise 7 in the Linear Differential Equations note.
36. The Legendre polynomials,  $P_\ell(x)$ ,  $\ell = 0, 1, \dots$ , provide a system of classical orthogonal polynomials on  $[-1, 1]$  with weight  $w(x) = 1$  and standardization  $h_n = 2/(2\ell + 1)$ . Find the expansion of the following function in Legendre polynomials:

$$f(x) = 2\theta(x) - 1 = \begin{cases} 1 & x \in (0, 1) \\ -1 & x \in (-1, 0) \end{cases}. \quad (8)$$

37. Helmholtz equation, part I: Exercise 9 in the Linear Differential Equations note. Note that you can apply the separation of variables technique here just as well as we did in the "one-electron atom" example that we did in class. This problem will serve as an important example of various approaches and considerations. Thus, we will see it again in problem sets 9 and 10 [I'll post the solution to the present problem before you do problem set 9].
38. Using the Christoffel-Darboux formula: Exercise 15 in the Linear Differential Equations note.