Homework 3

Phys 139A, Spring 2008, UCSC

Due April 25, 1 pm

1. [10 points] For each definition below, is $\hat{O}$ linear? Give a brief reason for each of your answers. Recall that an operator $\hat{O}$ is linear if $\hat{O}\left[c_1\psi_1(x) + c_2\psi_2(x)\right] = c_1\hat{O}\psi_1(x) + c_2\hat{O}\psi_2(x)$ for any functions $\psi_1(x)$, $\psi_2(x)$ and any constants c_1, c_2. [NOTE: all numbers in this class are always assumed to be complex, unless otherwise noted. So, c_1 and c_2 here are also complex.]
   (a) $\hat{O}\psi(x) = x^3\psi(x)$ (b) $\hat{O}\psi(x) = Cx^7\frac{d}{dx}\psi(x)$ (c) $\hat{O}\psi(x) = C\psi(x)^*$
   (d) $\hat{O}\psi(x) = \exp(\psi(x))$ (e) $\hat{O}\psi(x) = \frac{d^2\psi}{dx^2} + C$ (f) $\hat{O}\psi(x) = \int_{-\infty}^{x} dy y^3\psi(y)$
   where C is a non-zero constant.

2. [10 points] Problem 2.3

3. [15 points] Problem 2.36

4. [15 points] Problem 2.37

5. [20 points] Problem 2.38