

PHYS 451: Quantum Mechanics I - Spring 2016
Homework #1, due January 21, in class

Review of elementary calculus and probability

1. Find the Taylor series expansion of $f(x, y) = \tan [\sin(x - y)]$ at point $x = 0, y = 0$ up to the third order (assume x and y to be about equally small)
2. (a) A family has two children, It has at least one female child. What is the probability that both children are girls? (b) Another family also has two children. The older child is a girl. What is the probability the the younger child is a girl? Assume the odds of giving birth to a boy or girl are equal.
3. Consider a measurement of a quantity that takes discrete values, $k = 0 \dots n$. The probability distribution of this measurement is given by

$$P(k) = A t^k (1 - t)^k,$$

where t is some real constant that lies in the interval $0 < t < 1$.

- (a) Find the normalization factor, A , which makes the total probability equal to unity.
 - (b) Calculate the average value of k , k^2 , and the standard deviation of k .
4. Suppose that we have a sample of 1000 electrons, each with the wave function (some units of length are assumed)

$$\psi(x, t) = A e^{-x^2} e^{-i\omega t}.$$

Measurements are made at time $t = t'$ to determine the locations of the electrons in the sample. Approximately how many electrons will be found in the interval $-1 \leq x \leq 1$?