# Physics 416
## Problem Set 3
### Due Tuesday, April 28, 2009

1) The probability density function (*pdf*) (often called a Maxwellian Distribution) that describes the speed $v$ of molecules in an ideal gas is given by:

$$p(v) = \frac{4}{\sqrt{\pi}} \left( \frac{m}{2kT} \right)^{3/2} v^2 e^{-\frac{mv^2}{2kT}}$$

Here $m$ is the mass of the molecule, $k$ is the Boltzmann's constant, and $T$ is the temperature.
   a) Show this is a properly normalized *pdf*.
   b) Find the most probable speed.
   c) Find the average speed.
   d) Find the variance of the speed.

2) Taylor P3.22, page 83.

3) Taylor P3.24, page 83.

4) Taylor P3.28, page 85.

5) Taylor P3.46, page 90.

6) The decay of an unstable particle is described by the following probability density function in terms of the decay time ($t$) and the particle's lifetime ($\lambda$).

$$p(t, \lambda) = \frac{e^{-\frac{t}{\lambda}}}{\lambda}$$

Three measurements of $t$ ($t_1 = 7$ sec, $t_2 = 3$ sec, $t_3 = 4$ sec) are made.
   a) Write down the likelihood function for this problem.
   b) Use the Maximum Likelihood Method to calculate the value of $\lambda$ for this data set.