Physics 301-001

Homework #2: Probability and Statistics II

Due See Moodle

Reading Assignment:

During this week, you should be reading the following (in order):

1) Boas, ch.15
2) Boas, ch.9

Homework Assignment:

Late homework will ***not*** be accepted. Please write your answers to these questions on a separate sheet of paper with **your name and this class's section number, 001.** You are encouraged to work with your classmates on these assignments, but please **write the names of all your study group members** on your homework.

Practice Problems:

We have listed problems from the textbook that involve related skills and concepts; answers to these problems may be found in the back of the text. You should use these extra problems for practice and review, but they do *not* need to be turned in.

Selected Practice Problems from Boas: 6.5, 6.15, 7.1, 7.7, 7.13, 8.3, 8.13, 9.5, 9.9, 9.13, 10.5, 10.9

1. In book problems (76 pts)

5.1 (4 pts)	5.2 (4 pts)	5.8 (4 pts)	5.10 (4 pts)	6.1 (12 pts)
6.4 (4 pts)	6.14 (4 pts)	7.2 (4 pts)	7.8 (4 pts)	7.12 (4 pts)
8.4 (4 pts)	8.14 (4 pts)	9.6 (4 pts)	9.8 (4 pts)	9.12 (4 pts)
10.8 (8 pts)				

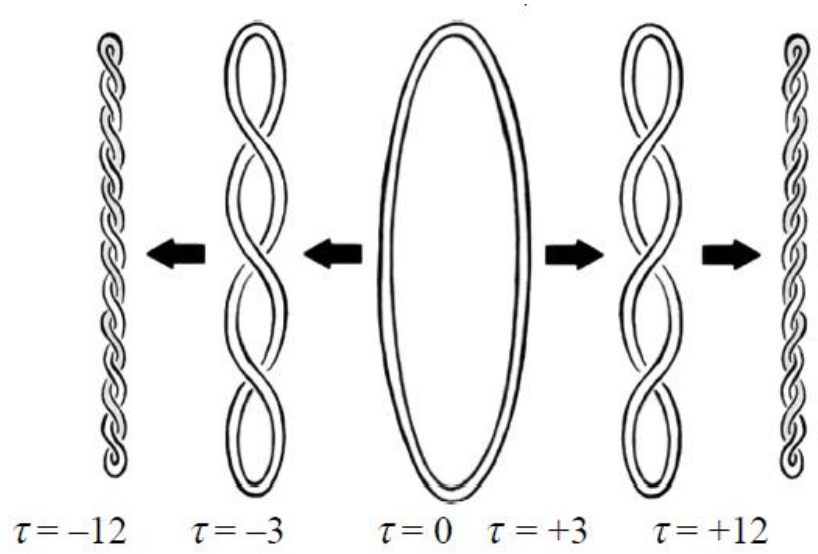
2. Maxwell Boltzmann distribution (20 pts]:

a. Find $\langle v_x \rangle$ – Mean velocity in 1-D
b. Find $\langle v \rangle$ – The Means 3D velocity (hint $v^2 = v_x^2 + v_y^2 + v_z^2$ and $dV = dv_x\, dv_y\, dv_z = 4\pi\, v^2 dv$
c. In the equations shown below make a plot of $f(v)$ and $g(v)$

$$f(v)\, dv = \exp\left(-\frac{mv^2}{kT}\right) dv$$

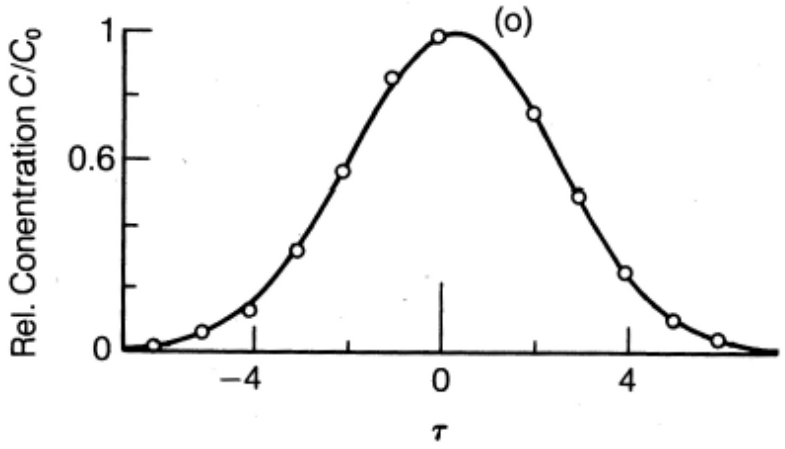
$$g(v)\, dv = v^2 \exp\left(-\frac{mv^2}{kT}\right) dv$$

4. Twisted DNA (30 pts): Closed circular DNA can exist in several different forms, each with a different number of superhelical turns, as illustrated below. We use the symbol τ to represent the number of turns; positive values of τ represent right-handed turns, while negative values of τ represent left-handed turns. Here are some examples:



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The following graph shows the measured populations of these various coiled states at thermal equilibrium at body temperature (37°C):



a) It appears that a Gaussian distribution is an excellent fit to the relative populations at equilibrium:

$$P_n = A \exp\left(-\frac{(\tau)^2}{2\sigma^2}\right)$$

where μ is the mean of the Gaussian, σ is the standard deviation, and A is a normalization constant. From the graph, estimate the value of σ for this distribution. (Note: Relative concentration means relative probability)

b) Given this observed distribution, find an expression for the potential energy of these coiled states in terms of the number of turns τ.

c) Based on your answers, calculate a numerical value for the difference in potential energy between the $\tau = 0$ and $\tau = 3$ states. Which state has lower energy, twisted or untwisted?

5. Matlab Problems [40 pts]: Do these:

Download the code found at:
https://www.mathworks.com/matlabcentral/fileexchange/4623-yahtzee

Explain the logic behind the game. Make sure you explain each section.

Determine how you might build an AI to play the game. What choices might you make? I don't need code. I need some logic behind how you might approach this. Don't spend more than 20 minutes thinking about it.