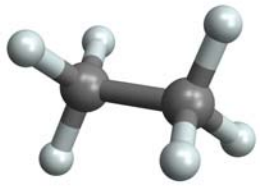
PHYS 328
HOMEWORK #4

Due : 20 Sept. 2013

1. Perpetual astronomy graduate student, Ptolemy Schwartz, has discovered an extra - solar planet whose mass, radius and surface temperature are equal to Earth' s. Further spectroscopic analysis reveals a thin atmosphere consisting solely of ethane gas ($C_2 H_6$). (My free hand sketch of the structure of ethane below*:)



How will the dry adiabatic lapse rate on the newly discovered planet compare to the dry lapse rate on the Earth? Explain your reasoning fully (make sure you identify what factor (s) contribute to any possible difference in the lapse rate, and the reason (s) why those factors effect the lapse rate as they do.) Avoid purely mathematical arguments (e.g., g appears in the numerator, so if g increases then the magnitude of dT/dz increases).

2. This problem is motivated by problem 1.55 in the text (parts of which you will do next). Find the total gravitational potential energy of a spherical star of uniform density, and of total mass M and radius R. (Hint : Imagine the star being composed of a series of spherical shells that accrete sequentially onto the forming spherical protostar). Part d) of 1.55 asks you to do this by dimensional analysis; so you know what the functional portion of the expression should be. I want you to do a complete analysis and find the coefficient of GM^2/R.

3. Problem 1.55, parts a), b) and c). 10 points for a); 5 pts for b); 10 pts for c).

4. Problem 2.3, parts a), b), c), f). 5 pts for each part.

5. Write a short Mathematica program to plot the probability of n heads (out of 50 flips). Show both your code and output. Your grade on this question will be based both on the accuracy of your results and the quality of programming; the more efficient and elegant, the better.

*If you are not already familiar with this part of Mathematica, check out "ChemicalData".