

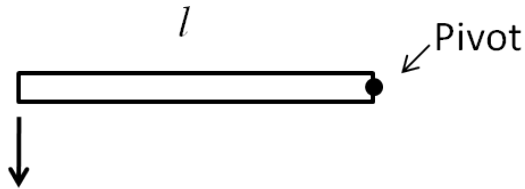
Physics 480: Final Exam Part 2
Due: December 16, 2010
70 points

This part of the final exam is to be completed independently by each student. Please acknowledge this by signing the statement below and returning this page with your final exam solutions.

I certify that I worked independently on this exam and that I did not discuss the exam with other students.

Name: _____ Date: _____

- (20 points) The MATLAB file 'WLCdata.mat' contains a set of variables, x, y, z that describe a particular configuration of a length of polymer. The units are in nanometers. The polymer is free in solution at 300 K. Find the persistence length. Describe your approach and give the result. Attach, as a separate page, a printout of the MATLAB code that calculates your answer.
- (20 points) Polystyrene beads with radius $R=5$ nm, are suspended in water. The solution fills a tube and the tube is spun in a manner similar to that of a centrifuge as shown in the figure below. The tube has length $l=10$ cm. The tube is rotated around the pivot point with an angular velocity of $\omega=100$ rad/s. Give the expression for the bead concentration as a function of the distance from the pivot point (r). Normalize with respect to the concentration at $r = l$ (find $c(r)/c(l)$). The density of polystyrene is $\rho=1.04$ g/cm³. Ignore the effect of gravity. Assume $T=300$ K.



- (15 points) The hydrolysis of ATP into ADP and inorganic phosphate (Pi) releases 30.5 kJ/mole. Estimate the amount of free energy contained in 1 mL of solution that has a 1 M concentration of ATP, ADP and Pi.
- (15 points) The trap stiffness of a laser tweezers can be calibrated by flowing water past a trapped bead that has a known diameter. If a calibration is to be done at a force of 100 pN using a 500 nm radius bead, is there any danger of non-laminar flow? Explain.