Homework problems based on PHET simulation

http://phet.colorado.edu/new/simulations/sims.php?sim=Optical_Tweezers_and_Applications

1. Click on the bead and pull it to the left and release. Neatly sketch the resulting position of the bead with respect to time \(x \text{ vs } t\) with the simulation set to water and to vacuum. Describe the two main qualitative differences between these cases and why.

2. Calibrating an optical trap. Click on the Histogram to make measurements. Measure the full width at half maximum value (FWHM) of the bead motion at 200, 400, 600 and 800 mW. Make sure you use enough points to have an accurate measurement. Using the equipartition theorem, calculate and then graph the trap stiffness as a function of laser power using units of pN/nm vs mW. Either use a graphing program or make a clearly labeled graph on graph paper. What curve best describes the data?
3. Neatly sketch the potential energy curve at these four different laser powers.

4. Set the trap to 200 mW. Turn on fluid controls. Measure the displacement of the bead from the center of the trap at 200, 400, and 600 microns/sec and then graph the displacement versus applied fluid flow and graph the answers. What curve best describes this data.

5. Grad students: Based on the data in problem #3 (trap stiffness) and problem #5 (hydrodynamic drag), calculate the size of the bead in nanometers using stokes drag at each 200, 400 and 600 microns/sec flow speed). Make sure you use the data all from one laser power.