HOMEWORK #2

1. You have been assigned to assess the strength of ancient oceanic circulation in a core taken from the Cretaceous (i.e., 65 million years ago). Using a common paleoceanographic technique (the sortable silt approach), you estimate the shear velocity from the mean grain size at each height in the core. This technique assumes that mean grain size is reflective of the size of material that can just be moved by the flow (the D which corresponds to τ_{*c}). Use the Ikeda-Coleman-Iwagaki (ICI) model to estimate the critical shear velocity for two samples – A) 30 µm B) 45 µm. Assume that $\mu = 0.84$, $c_L = 0.85c_D$, $R = 1.65$. Perform the analysis assuming a water temperature of 4° ($\nu = 0.018$ cm^2/s) and 30°C ($\nu = 0.008$ cm^2/s). What is the possible error in the result due to the unknown T for each of the samples?

2. When I was in graduate school, a colleague of mine ran some simple experiments in an attempt to determine the flow conditions under which the effective settling velocity of a particle would be reduced significantly by fluid accelerations associated with turbulence. The experiments consisted of a tube filled with water with a particle released from within the tube (see diagram below). This is the equivalent of a simple 1D system with motion only in the vertical direction. Ignoring the complicated Basset history term, determine what pattern of periodic shaking would cause the most reduction by examining the BBO equations. Why do arrive at the result you did (i.e., what term becomes most important)? Roughly speaking, how severe would the maximum accelerations have to be to cause levitation (i.e., phase-averaged $(dU_p/dt)_{max}$ to make $U_p \sim 0$)? Is this relevant to most natural problems?