ChE 548
Final Exam
Spring, 2004

Problem 1.
Consider a single-component, incompressible fluid moving down an uninsulated funnel. Derive the energy balance for this system. Show all work involved in each step of the derivation. Express the energy balance in such a form that the left-hand-side contains only the time derivative of the temperature. State any assumptions that you make. Introduce variables such as the density, heat capacity, thermal conductivity, etc as necessary. The fact that the fluid is incompressible can be expressed by making the velocity a function of axial position; do so. Assume the surroundings are hotter than the fluid inside the funnel. Qualitatively sketch the steady state profile for two values of the heat transfer coefficient, zero (insulated) and non-zero for your boundary conditions. For the insulated case, one can obtain an analytical solution for the steady state profile. Time permitting, obtain it.