Homework 3

(due at 2:00 pm on May 25, 2009)

Problem 1. *Propagation of disturbances in a critical layer.*

Consider propagation of disturbances in the boundary layer with the speed $c \ll 1$ (in non-dimensional variables). Provide an estimate of the amplitude of such disturbances when nonlinear effects may become important based on consideration of the critical layer.

Problem 2. *Kelvin-Helmholtz instability.*

Develop a theory of the Kelvin-Helmholtz instability in the presence of interfacial tension.

Problem 3. *Collapse of cavitation bubbles.*

Consider the problem of collapsing underwater bubbles and show that the Rayleigh-Taylor instability is reversed in this case. For simplicity, treat the case of negligible surface tension and when the density of the water phase is much larger than that of the collapsing bubbles.

Problem 4. *Stability of a gas jet.*

Consider a gas jet of radius a surrounded by a liquid phase. Deduce an appropriate dispersion relation and stability characteristics of this physical system.