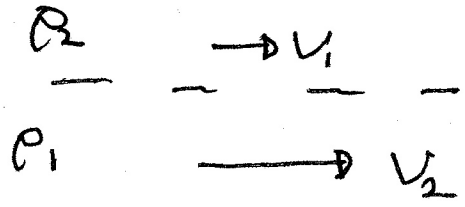
Physics 218A Plasma Physics Winter 2015

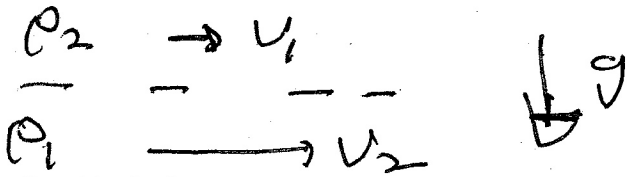
Problem Set II: Due Wednesday, January 21, 2015

1.) Consult the book of your choice, to learn about the Kelvin-Helmholtz instability.

a.) Calculate the growth rate for



b.)



Consider both $\rho_2 > \rho_1$, $\rho_2 < \rho_1$.

c.) Discuss your result.

d.) Now include surface tension in part b.).

2.) You toss a small rock in a pond.

a.) Describe quantitatively the long time behavior of the ripples, propagating away from the splash zone. What is the speed of the slowest ripple?

b.) If a large, asymmetric rock were tossed in, how long would it take for the radiated ripples to asymptote to what was described in a.)?

3.) Consider a system with $\partial \rho_0 / \partial z > 0$ and g downward.

a.) If ν, $D \neq 0$, derive the condition for Rayleigh-Taylor marginality. Take the system in a box of height h, width L.

b.) If $\nu >> D$, $\nu << D$, what are the forms of the growth rate?

4.) Consider 3.), now with a mean flow $\langle v_x(z) \rangle \hat{x}$.

a.) Derive the eigenmode equation for perturbations.

b.) Try to construct a criterion for characterizing this system with velocity shear and unstable stratification. [Hint: Explore the Richardson number.]. Map out regimes. [N.B. See Chandrasekhar or Drazin for Ri.]

5a.) Consider the system of 3.) with $\nu = D \neq 0$. Use mean field theory and linear response to estimate the flux of mass. The system in a box of height h, width L.

b.) How might you estimate amplitudes?