Homework 4 – due February 20, 2013

Problem 4.2, 4.6, 4.12, 4.14, 4.38, Problem 6 is not from textbook

P1 - 4.2) The components of a velocity field are given by

$u=x+y$ $v=xy^3+16$ $w=0$

Determine the location of any stagnation points (absolute velocity=0) in this flow.

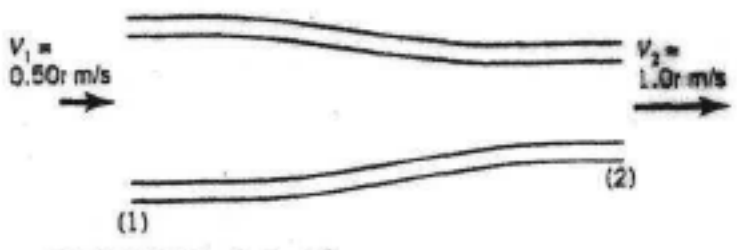
P2 - 4.6) A velocity field is given by $\mathbf{V}=x\,\hat{\mathbf{i}}+\ x(x-1)(y+1)\,\hat{\mathbf{j}}$ where velocities are in ft/s and x and y are in feet. Plot the streamline that passes through x=0,y=0 and compare this to the streakline and pathline passing through the origin.

P3 – 4.12) A velocity field is given by $u=cx^2$ and $v=cy^2$ where c is a constant. Determine the x and y components of the acceleration. At what points, if any, in this flow field is acceleration zero?

Recall – acceleration is the total derivative of velocity, i.e. $a_x=\frac{Du}{Dt}$ and $a_y=\frac{Dv}{Dt}$.

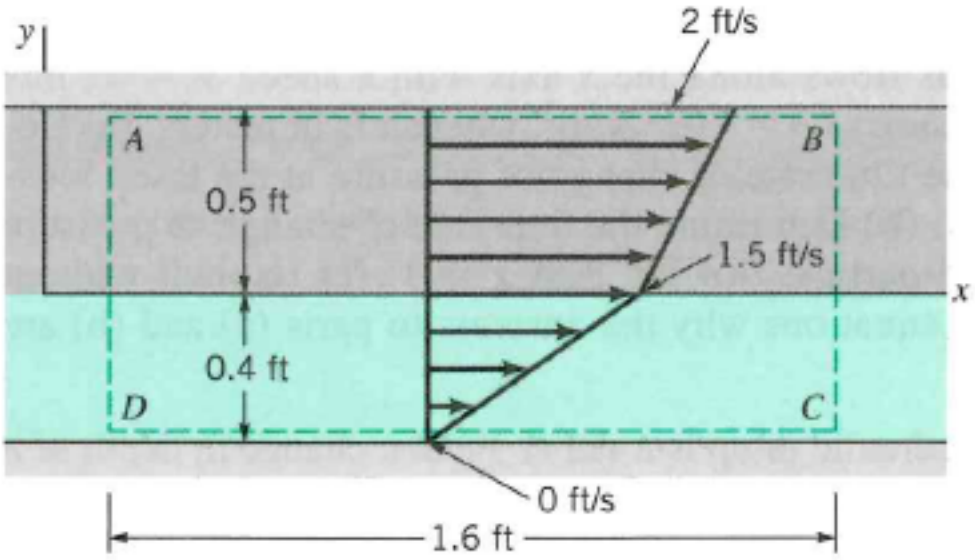
P4 – 4.14) The velocity of water in the pipe shown in the figure is given by V1=0.5 t m/s and V2= 1t m/s where t is time in seconds.

(a) Determine the local (Eulerian) acceleration at points (1) and (2).
(b) Is the average convective (Lagrangian), acceleration between these two points negative, zero or positive? Explain.



P5 – 4.38) Two liquids of different densities and viscosities fill the gap between parallel plates as shown in the figure. The bottom plat is fixed and the top plate moves at 2 ft/s. The velocity profile consists of two linear segments as depicted. The fixed control volume is depicted by ABCD and it coincides with the system at t=0. Make a sketch of

(a) The system at t=0.1s
(b) The fluid that has entered and exited the control volume in that period.



P6 – Using a program of your choice (Matlab, Excel, etc) plot the streamlines, streaklines and pathlines passing through x=0,y=0 for the following flow field

$u=(1-y^2)e^{-t/50}+ye^{t/100}$ $v=\cos(5t)$

Plot the streamlines, streaklines and pathlines at times t=25,t=50,t=75 and t=100.

Do you have any ideas what this flow might represent? Make your best educated guess