2.20 Marine Hydrodynamics Homework #1(b)
Due: September 22, 2009

Question 1: Basic Flow Concepts

1. In an incompressible flow where $\frac{D\rho}{Dt} = \frac{\partial \rho}{\partial t} + \vec{v} \cdot \nabla \rho = 0$, then density ρ in general:
   (a) may vary in time at a particular point in the flow field.
   (b) must be constant at all points in the flow field.
   (c) may vary in space but not in time throughout the flow field.

   -Explain your logic.

2. For a steady one-dimensional flow with a velocity of magnitude u,
   (a) the velocity gradient $\frac{\partial u}{\partial x}$ must be zero at any point
   (b) the density ρ must be the same at all points in space
   (c) the density ρ may vary in space but not in time throughout the flow field

   -Explain your logic.

3. Solve Ba 3 from the supplemental problems

Question 2: Stream-, Path-, and Streaklines

1. Given the velocity field $\vec{v} = y\hat{i} + t^3 y^2 \cos(3x)\hat{j}$, calculate the equations for the streamlines and set up the governing differential equations for the pathlines.
2. Solve Ba 14 from the supplemental problems
3. Solve Ba 15 from the supplemental problems

Question 3: Flow Kinematics

1. Solve Ba 6
2. Solve Ba 7
3. Solve Ba 8