Motion and Dynamics

1. A velocity field is given by $u = ax^2y$ and $v = -axy^2$.

a) Is conservation of matter satisfied?

b) Find the particle paths X(t), Y(t) in Lagrangian form.
Hint: Eliminate dt from dx/dt=u and dy/dt=v to obtain an equation for dy/dx which can be solved.

c) Find the Lagrangian form of the velocity components.

d) Find the acceleration components in both the Eulerian and Lagrangian formulations.

e) Find the pressure field.

2. A rectangular tank is supported so that it is horizontal and moves with constant acceleration down an incline which makes an angle θ with the horizontal. The tank is partially filled with a liquid. Find the equation for the pressure field in the liquid in the tank. Find the equation for the surface.

3. A cylindrical tank is partially filled with a liquid and rotates as per Example 3.4 in the notes. If the tank is 0.5 meter in diameter and is filled with water to a depth of 0.75m before it is rotated at 100rpm, find

a) The depth and the pressure on the bottom at the centerline.

b) The depth and the pressure on the bottom at the side of the tank.