Name: ______________________________

Date: ______________________________

Collaborators: ____

(Collaborators submit their individually written assignments together)

Question:	1	2	Total
Points:	20	30	50
Score:			

Instructor/grader comments:

Dimensional analysis

1. (a) (15 points) Use dimensional analysis to find the mass flow rate G of an ideal heavy fluid per unit width of a vertical dam with sharp edge and free stream (see Figure 1). The height of the level of the fluid in the reservoir above the edge of the dam far from it equals h.

   (b) (5 points) How G is gointg to change if h gets four times bigger?

   Hint: $[G] = M/(T\,L)$.

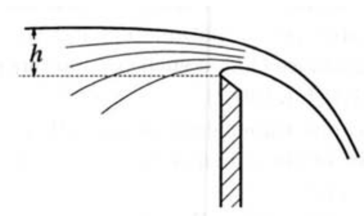

Figure 1: Sketch of the flow

Elastostatics

2. During emergency repairs in zero gravity condition a swimming pool on the starliner "Axiom" had been filled up to the brim with a soft non-sticking material of density ρ_0 and Lamé elastic constants λ and μ. (The pool was shaped as a rectangular parallelepiped, of the depth H.) When the normal gravity (gravitation acceleration g) was restored, a recess was formed at the place of the former pool.

   (a) (20 points) What is the depth of the recess, $h = h(H, \rho_0, \lambda, \mu, g)$?

   (b) (10 points) Lamé elastic constants can be expressed as following.

$$\lambda = \frac{\nu E}{(1+\nu)(1-2\nu)}, \quad \mu = \frac{E}{2(1+\nu)},$$

   where E and ν are the material's Young's modulus and Poisson's ratio. What is h as a function of E and ν? What should be the Poisson's ratio of the pool filling so that no recess is formed? (That is, what is the Poisson's of incompressible materials?)