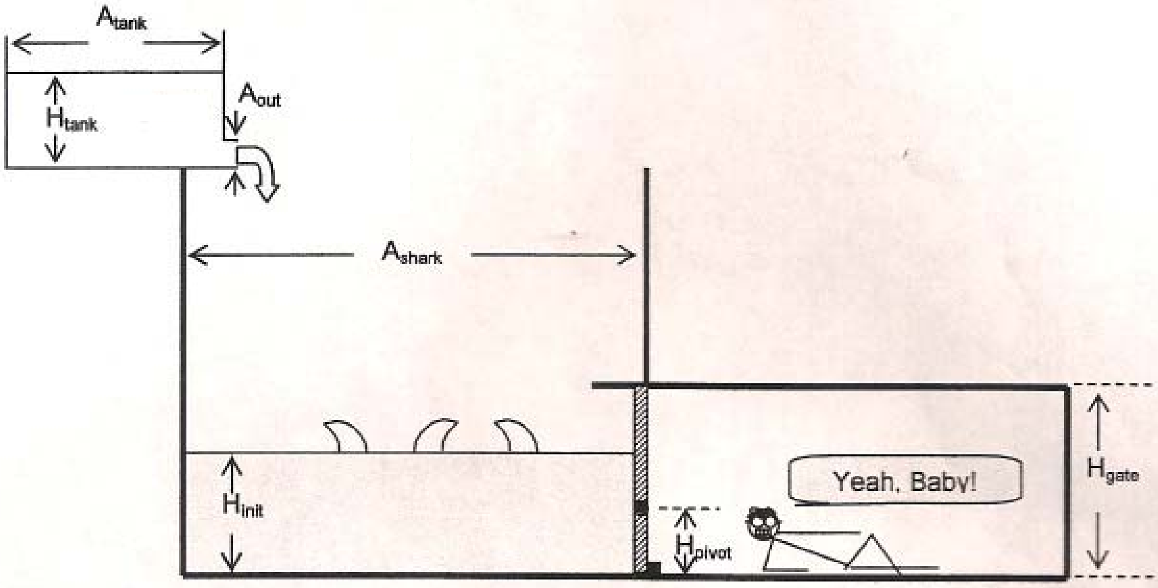
Problem 1 (45 points):

Yeah, Baby!!! Dr. Evil has captured Austin Powers and is scheming to do him in at long last with his sharks with laser beams. Austin is currently held in a small chamber behind a gate held in place by hydrostatic forces. On the other side of the gate swim the sharks.

Above the shark tank, Dr. Evil has set up a second tank that is maintained at a constant depth of H_{tank} but drains out of an opening (as a free jet) to add water to the shark tank. As the level of water in the shark tank rises, at some point the gate will open, allowing the shark-infested water to flow into the chamber holding Austin Powers.



The question is: How long does Austin have to develop an escape plan? (that is, when will the gate open?)

Data Provided:

- H_{tank} = 50 cm
- A_{tank} = 4 m^2
- A_{out}: Circular outflow with radius of 10 cm.
- A_{shark} = 100 m^2
- H_{init} = 1 m
- H_{pivot} = 0.9 m
- H_{gate} = 2 m
- Width of Gate (into/out of page): 5 m
- Density of all fluids = 1030 kg/m^3

Bonus Question: Suppose that this whole set-up was on another planet where the gravitational acceleration was reduced from 9.8 m^2/s to 1 m^2/s. Would Austin have more time or less time to escape? Why?

Problem 2 (5 points):

Explain the difference between the local and convective accelerations. Why do we need to include both in our analysis of accelerations in fluid motions?