CE100
Midterm Examination
Spring 2010
Wednesday, February 24

Name _____

Student I.D. _____

This exam is open book and open notes. You will be given fifty (50) minutes to complete two problems. Space is provided on each page for your solution, the back of the pages may also be used. Note that the first problem is worth 35 points and the 2nd is worth 15; allocate your time accordingly.

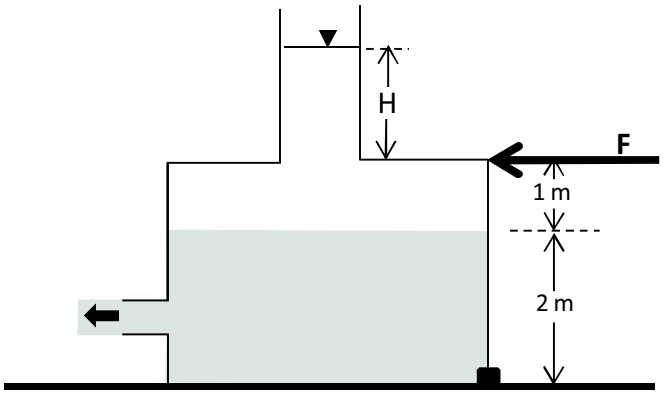
State clearly any assumptions you use in the solutions. Good Luck!

For reference:

Atmospheric Pressure = p_{atm} = 100 kPa
Gravitational Acceleration = g = 9.8 m/s^2
Density of Water = ρ = 1000 kg/m^3

Problem 1 (35 points):

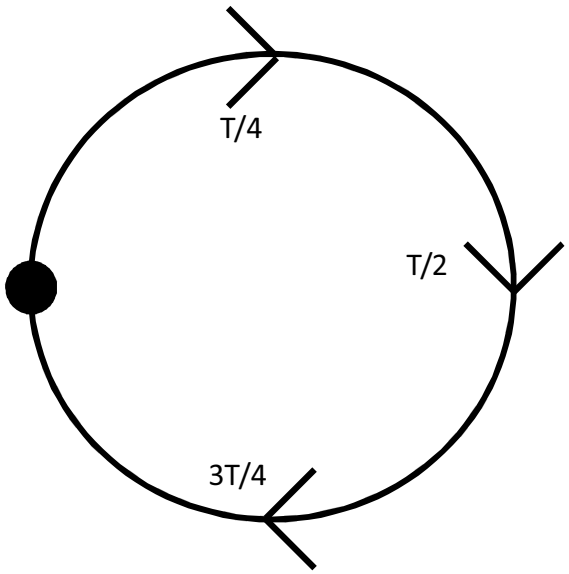
The tank shown in the following sketch is filled with two fluids of different density. The lower layer is water and the upper layer is an oil with specific gravity S = 0.9. The right-hand-wall of the tank is hinged at its lower end, but is held closed by a force applied at the upper end. On the left side of the tank, the lower fluid emerges as a free jet through an opening that is 1 meter above the bottom of the tank.



(a) To what height, H, must the upper fluid be added in order to produce an outflow velocity of 2.5 m/s? For the purposes of this calculation, you may assume that the outlet is very small compared to the tank.
(b) Under these conditions (assuming the depths are then held constant), what force, **F**, must be applied to keep the right-hand-wall closed?

Problem 2 (15 points):

A particle released in a flow that is unsteady (but spatially uniform) creates a circular pathline, returning to its starting point at time T, as shown in the following figure:



For this pathline, sketch the streamlines (assuming the flow is uniform in space) and draw a streakline at times T/4, T/2, 3T/4 and T.