ENGR361/2 V 2011 Fall Midterm Exam

(Total Problems: 5; Total Pages: 7; Total Time: 75 minutes)

Closed Book and Notes

October 7th 2011

Name: _____ ID: _____

Problem 1 (25 Points) – Concepts and Definitions

(a) Write the equation to define Dynamic Viscosity, explain each term briefly (5 points)

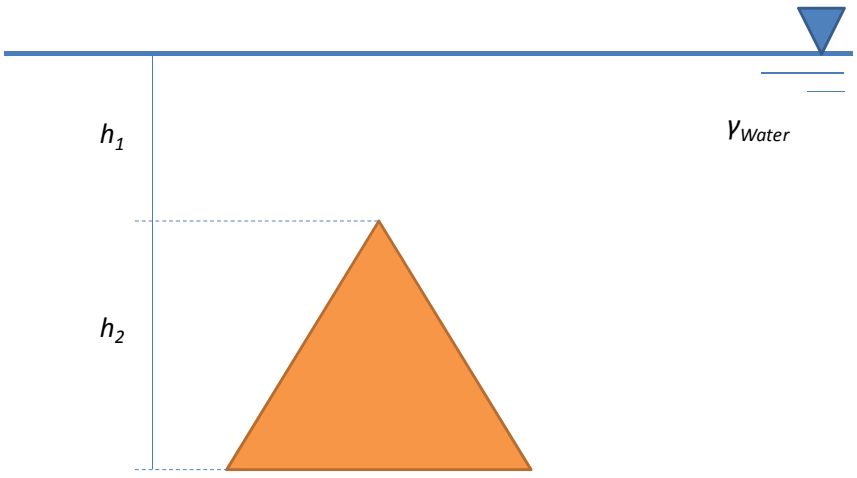
(b) Write the equation to define Kinematic Viscosity, explain each term briefly (5 points)

(c) What is the definition of fluids and Newtonian Fluids? (5 points)

(d) What is the difference of Bernoulli equation in the following two forms? What is each of three terms called on the left hand side of both equations? (5 points)

$$\frac{p}{\gamma}+\frac{v^2}{2g}+z=\text{constant} \quad \text{(Eq. 1)} \qquad\qquad p+\frac{\rho v^2}{2}+\gamma z=\text{constant} \quad \text{(Eq. 2)}$$

(e) Draw pressure distribution on EACH edge of the submerged object in the water. (5 points)



Problem 2 (20 Points)

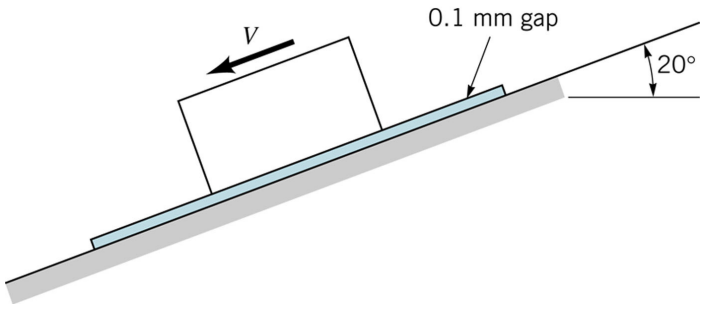
If u is a velocity, x is length, and t is time. What are the dimensions of the following equations:

(a) $\frac{\partial u}{\partial t}$; (b) $\frac{\partial^2 u}{\partial x \partial t}$; (c) $\int \frac{\partial u}{\partial t} dx$

Dimensions **might** be useful (Problem 1)	
V (velocity)	LT^{-1}
Force or Weight	F
Length	L
Force or Weight	F
p (pressure)	FL^{-2}
ρ (density)	$FL^{-4}T^{2}$
γ (specific weight)	FL^{-3}

Problem 3 (20 Points)

A 10-kg block slides down a smooth inclined surface. Determine the terminal velocity of the block if the 0.1-mm gap between the block and the surface contains SAE 30 oil at 60 °F. Assume the velocity distribution in the gap is linear, and the area of the block in contact with the oil is 0.1 m^2. (NOTE: SAE 30 oil viscosity: $\mu = 0.38\ \mathrm{N \cdot s/m^2}$; Equations might be used: $\tau = \mu \frac{du}{dy}$)



(Problem 3)

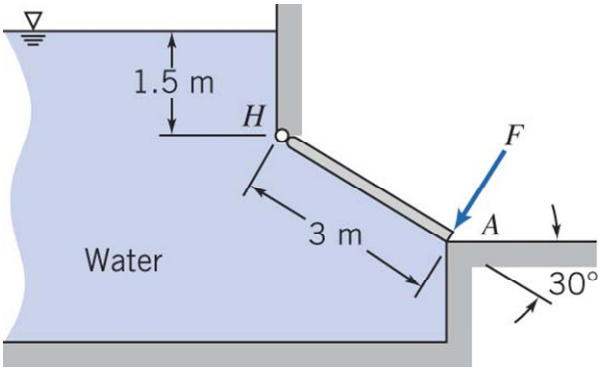
Problem 4 (15 Points)

Water flows through a hole in the bottom of a large, open tank with a speed of 8 m/s. Determine the depth of water in the tank. Viscous effects are negligible. (NOTE: Show steps of finding the equation to solve the problem. Using the final equation from the textbook will not get a full mark. $g = 9.81\ m/s^2$)

Problem 5 (20 Points)

The gate shown is hinged at *H*. The gate is *3 m* wide normal to the plane of the diagram. Calculate the force required at *A* to hold the gate closed. (Note: neglect the weight of the gate, *F* is perpendicular to the gate)

(**Equations might be useful**: $y_R = \frac{I_{xc}}{y_c A} + y_c$, $I_{xc} = \frac{1}{12} ba^3$, $\gamma = 9810\ kg \cdot m^{-2} \cdot s^{-2}$)



(Problem 5)

Name: _____ **ID:** _____

Mark (Total = 100): _____