NAME (print): ___________________________________

Instructor (Circle One): **501/Brumbelow** **502/Kanta** **503/Miller**

CVEN 311
Examination 1
October 5, 2010
7:00 pm – 8:40 pm

This is a closed-book examination. You are allowed to use one letter-sized (8 ½" x 11") formula sheet with hand-writing on both sides. ***To receive full credit on this examination, you must turn in your formula sheet with your examination.*** The formula sheet will be returned to you with your graded exam.

All exam problems have the value indicated. ***The total number of points is 100 for the 100 minute exam duration.*** For full credit, you must show ALL work for workout problems, including free-body diagrams, general and specific forms of equations, and all assumptions; be sure your work is legible and CLEARLY indicate your final answer. Multiple choice problems will be graded solely on your selected multiple choice responses.

Be sure to sign the Aggie Honor statement below and that you print your name above and on your formula sheet. Good luck!

I pledge that I have neither given nor received aid in completing this exam. I have followed the strictures of the Texas A&M University Aggie Code of Honor during this test period.

Signature: ______________________________

Grading

Part 1 _____ / 33

Part 2 _____ / 33

Part 3 _____ / 33

Bonus 1 / 1

Total _____ / 100

Properties of Liquids (BG Units)

Liquid	Temp. (^{0}F)	Density ρ (slugs/ft^3)	Specific Wt. γ (lb/ft^3)	Dyn. Viscosity μ (lb-s/ft^2)	Surface Tension σ (lb/ft)
Carbon Tetrachloride	68.0	3.09	99.50	2.00E-5	1.84E-3
Ethyl Alcohol	68.0	1.53	49.30	2.49E-5	1.56E-3
Gasoline	60.0	1.32	42.50	6.50E-6	1.50E-3
Glycerin	68.0	2.44	78.60	3.13E-2	4.34E-3
Mercury	68.0	26.30	847.00	3.28E-5	3.19E-2
SAE 30 motor oil	60.0	1.77	57.00	8.00E-3	2.50E-3
Seawater	60.0	1.99	64.00	2.51E-5	5.03E-3
Water	60.0	1.94	62.40	2.34E-5	5.03E-3

Properties of Liquids (SI Units)

Liquid	Temp. (^{0}C)	Density ρ (kg/m^3)	Specific Wt. γ (kN/m^3)	Dyn. Viscosity μ (N-s/m^2)	Surface Tension σ (N/m)
Carbon Tetrachloride	20.0	1590	15.60	9.58E-4	2.69E-2
Ethyl Alcohol	20.0	789	7.74	1.19E-3	2.28E-2
Gasoline	15.6	680	6.67	3.10E-4	2.20E-2
Glycerin	20.0	1260	12.40	1.50E+0	6.33E-2
Mercury	20.0	13600	133.00	1.57E-3	4.66E-1
SAE 30 motor oil	15.6	912	8.95	3.80E-1	3.60E-2
Seawater	15.6	1030	10.10	1.20E-3	7.34E-2
Water	15.6	999	9.80	1.12E-3	7.34E-2

Properties of Air:

Density at standard atmospheric pressure ρ: 2.38E-3 slugs/ft^3 (BG)
1.23E+0 kg/m^3 (SI)

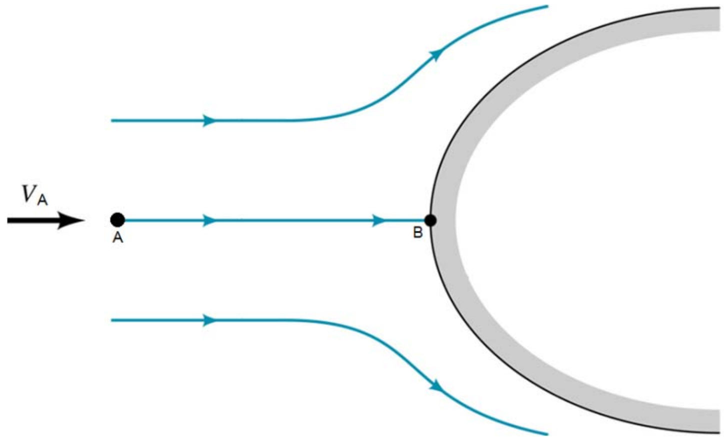
Specific Weight at standard atmospheric pressure γ: 7.65E-2 lb/ft^3 (BG)
1.20E+1 N/m^3 (SI)

Gas Constant *R*: 1.716E+3 ft-lb/slug-^{o}R (BG)
2.869E+2 J/kg-^{o}K (SI)

Standard Atmospheric Pressure: 2116.2 lb/ft^2, abs (BG)
101.33 kPa, abs (SI)

Part 1 Score: ______ /33

Problem 1) The pressure at Point B in the diagram below is: (*5 Points*)



a) Equal to zero.

b) The highest pressure along the streamline shown.

c) Equal to the pressure at Point A.

d) The lowest pressure along the streamline shown.

e) There is no way to know/not enough information given.

Problem 2) The Reynolds number (Re) is a *dimensionless* number which helps us determine if flow is laminar or turbulent. In pipe flow, it is defined as a function of density (ρ), velocity (V), pipe diameter (D), and dynamic viscosity (μ). Based on the dimensions, which of the following correctly describes the Reynolds number? Hint: The actual equation is the only one that is dimensionally homogenous, i.e. the units, or lack thereof, are the same on both sides of the equation. (*5 Points*)

a) Re = $\rho V D \mu$

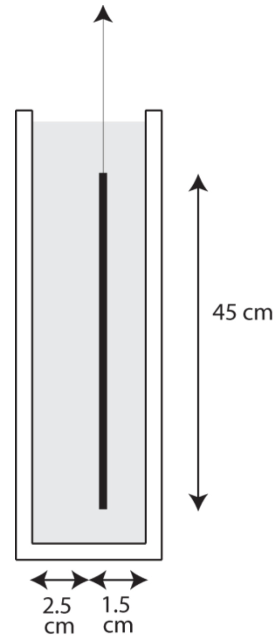
b) Re = $\frac{VD}{\mu\rho}$

c) Re = $\frac{\rho V D}{\mu}$

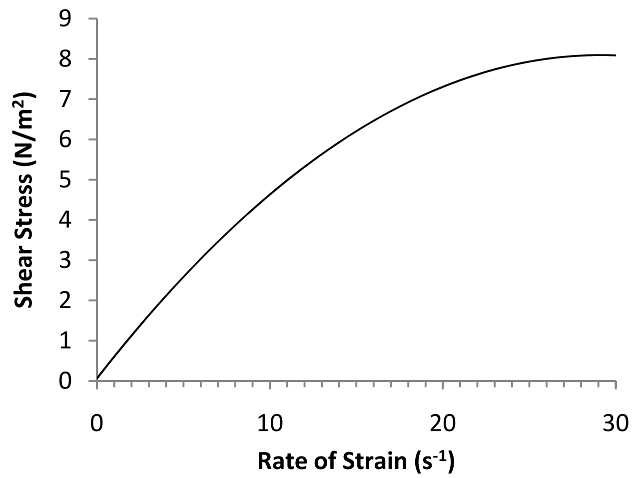
d) Re = $\frac{D}{\mu\rho V}$

3) Viscosity and Force

a) In industrial applications, thin coatings of material are often applied to metal sheets; for instance, liquid Teflon coating is often applied to cookie baking sheets. To the right is a diagram illustrating the application of Teflon coating to a thin metal sheet, using a conventional dipping technique. The sheet is being pulled out of the coating vat at a constant speed of 20 cm/s. It is 36 cm wide x 45 cm tall and its mass is 0.64 kg. The liquid Teflon has a viscosity of 0.025 N-s/m^2 at 24 ˚C. What is the tension in the thin wire line holding the sheet? Assume the fluid is Newtonian and neglect the force generated by the fluid on the wire itself.
(*18 Points*)



b) Instead of using Teflon, the metal sheet is now coated with a polymer, for use in another application. Estimate the new value of tension, assuming the coating is non-Newtonian and that its behavior follows the diagram at right. (*5 points*)



Part 2 Score: ______ /33

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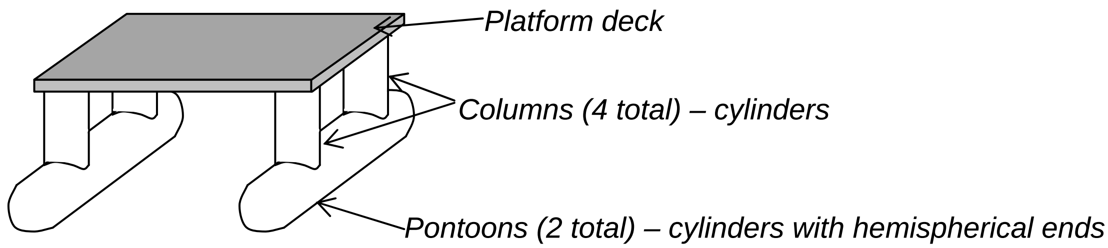
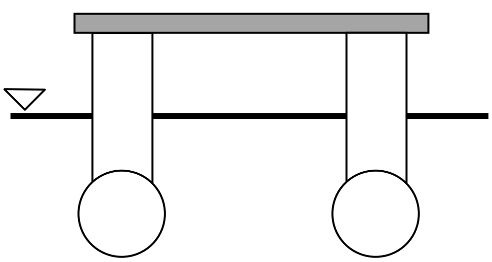
Problem 4) A semi-submersible oil platform uses the buoyancy of two horizontal pontoons and four columns to float (see figure below). If the weight of the platform (including the weight of the pontoons and columns) is 60×10^6 lb, what will be the height of the platform deck above the water surface (ft)? (*15 Points*)

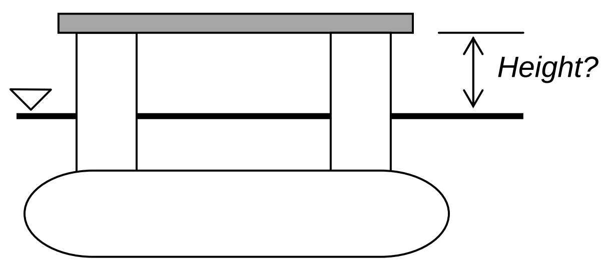
ISOMETRIC VIEW



FRONT VIEW



SIDE VIEW

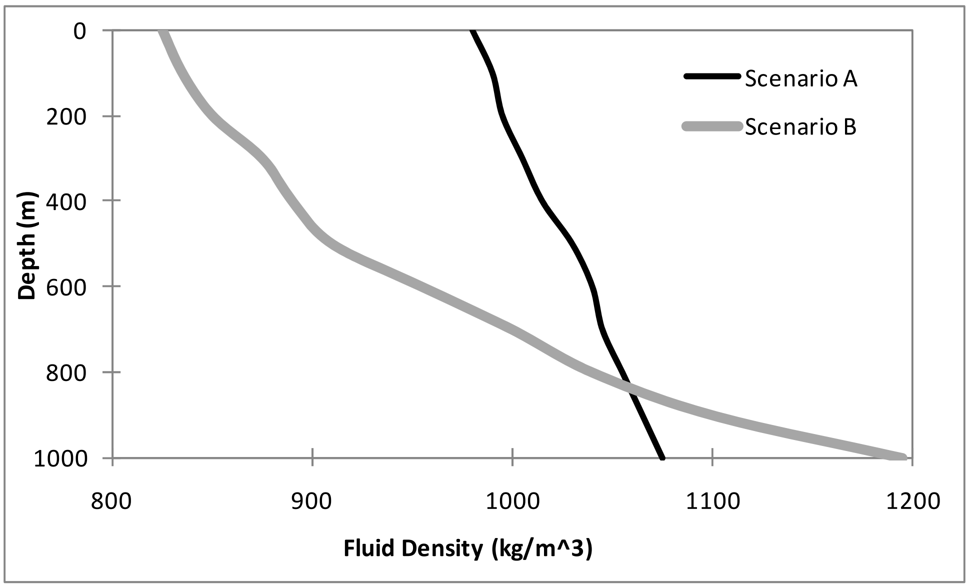


The pontoons and columns are hollow. The columns are cylinders 25 ft in diameter and 75 ft tall (i.e., from the top of the pontoons to the deck). The pontoons are cylinders with hemispherical ends; the diameter of each pontoon is 45 ft, and the length of each pontoon (including the hemispherical ends) is 300 ft. Assume the platform is floating in seawater.

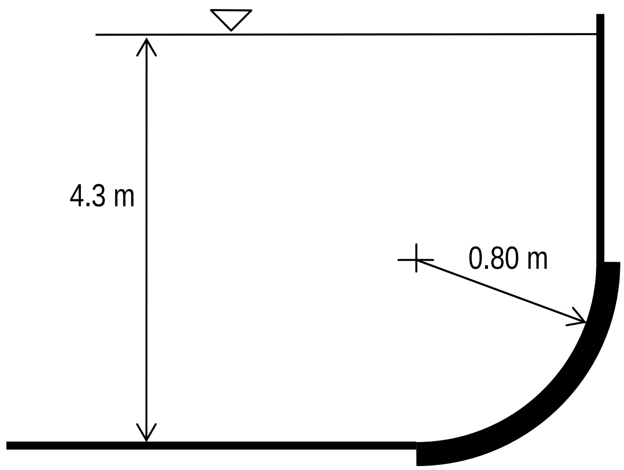
The formula for volume of a sphere is $V = {}^4/_3\, \pi r^3$, where r is the sphere radius.

Problem 4) Workspace

Problem 5) Shown in the graph below are vertical profiles of fluid density for two different scenarios, each of which involves a total fluid depth of 1000 m. For which scenario, *A* or *B*, will pressure at the bottom of the fluid column be *greater*? (You <u>must</u> fully explain your answer; simply writing "A" or "B" will receive no credit.) (*5 Points*)



Problem 6) A swimming pool will be built with a rounded transition between its vertical walls and horizontal bottom. The rounded transition will be in the shape of a quarter-circle and will require special fabrication; thus, the total fluid force acting on the quarter-circle surface needs to be calculated. The cross-section of the pool is sketched below, and the curved surface will extend 40 m (i.e., in the dimension in and out of the page). What will be the total pressure force acting on the curved surface? (*13 Points*)



Part 3 Score: ______ /33

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Problem 7) A clean glass tube ($\theta = 0$) is to be selected in the design of a manometer to measure the pressure of gasoline. The specific weight (γ) of gasoline is $6.6x10^3$ N/m^3 and the surface tension (σ) of gasoline is $2.2x10^{-2}$N/m. If the capillary rise is to be limited to 1 mm, the smallest diameter (cm) of the glass tube should be most nearly: [1 m = 100 cm = 1000 mm] (*5 Points*)

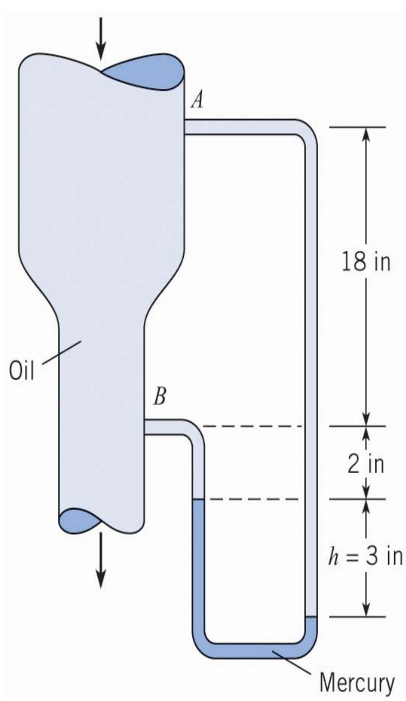
(a) 1.3

(b) 1.5

(c) 1.7

(d) 2.0

Problem 8) A vertical conduit is carrying oil (SG = 0.95) as shown in the figure below. A differential mercury manometer is attached into the conduit at points A and B. Determine the difference in pressure between A and B. (*10 Points*)



Problem 9) A circular viewing window of diameter D = 0.8 m is situated in a large tank of sea water (SG = 1.03). The top of the window is 1.2 m below the water surface, and the window is angled at 60° with respect to the horizontal. [Hint: $A = \pi R^2$; $I_{xc} = \frac{\pi R^4}{4}$]

(a) Find the hydrostatic force acting on the window (*10 Points*)

(b) Find the location of the center of pressure (y_R only) (8 *points*)