Rose-Hulman Institute of Technology

Foundation Coalition Sophomore Engineering Curriculum

ES202 – Fluid & Thermal Systems Winter 2001-2002

Circle one:
Mayhew -05, Mayhew - 06, Adams - 07, Adams - 08

Name _____ **CM**

Exam 1

Dec. 19, 2001

Problem 1	_____/ 40
Problem 2	_____/ 40
Problem 3	_____/ 20
Total	_____/ 100

Show all work for full credit.

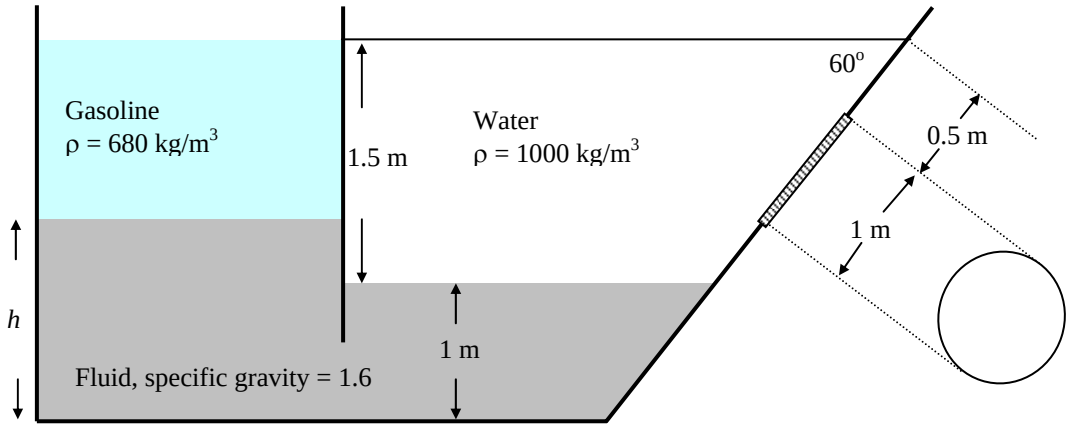
Open book, computer use for computational purposes.

Crunch numbers last!

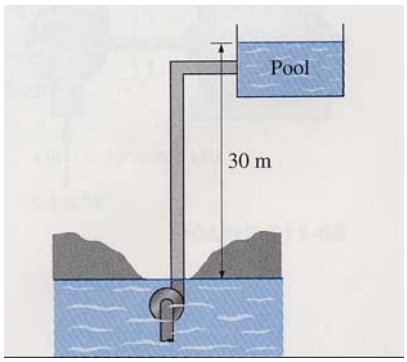
Problem 1 (40 points)

Water (ρ_{wat} = 1000 kg/m^3), gasoline (ρ_{gas} = 680 kg/m^3) and a mystery liquid (specific gravity = 1.6) fill the tank shown below. A 1-m diameter circular gate is located in the water portion. Neglecting atmospheric pressure,

a) find the resultant hydrostatic force of the water on the gate.
b) Find the location (i.e., the center of pressure) of the resultant hydrostatic force in part a).
c) Calculate the height *h* in meters.



Problem 2 (40 points)



Underground water (ρ=1000 kg/m^3) is to be pumped by an 80% efficient 3-kW submerged pump into a pool whose free surface is 30 m above the underground water level. The diameter of the pipe is 0.07 m, and the head loss in the piping system is 5 m. Determine:

(a) the flow rate of water (m^3/sec), and
(b) the pressure difference across the pump. Assume the elevation difference between the inlet and outlet of the pump is negligible

Problem 3 (20 points)

a) (4 points) An astronaut in orbit on the space shuttle is holding a mug full of root beer. If the specific gravity of root beer is 1.2 and the mug is a circular cylinder with diameter 2.5 inches and height 5 inches, what is the resultant hydrostatic force of the root beer on the mug?

b) (3 points) A lifejacket is floating on the surface of Speed Lake. Briefly explain why it takes effort to push the lifejacket below the surface of the water.

c) (3 points) Viscosity is a constant of proportionality between what two physical quantities?

d) (10 points) An incompressible fluid is flowing steadily through a horizontal nozzle as shown. Express the exit velocity, V_2, in terms of the pressure drop through the nozzle and the inlet and exit nozzle areas, A_1 and A_2. There are no losses in the system.