ES 202 Winter 2000-01 T. M. Adams, A. R. Mech

Exam I

NAME _____ DATE 20 December 2000 .

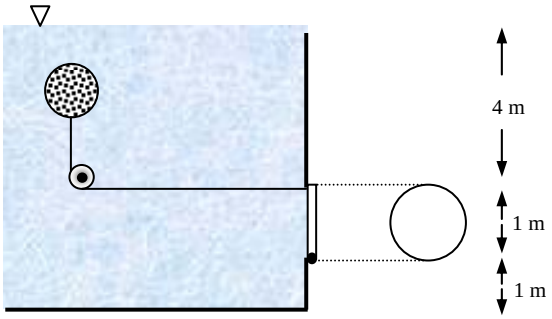
SCORE

Problem 1	/40
Problem 2	/60
Total	/100

Closed Book / 8 ½ x 11 Equation Sheet
Properties and Additional Information Provided.

NOTES:
1. Write your name on the top of each answer sheet.
2. Start each problem on a new sheet.
3. Show all work for full credit!

1. (40 pts) A 1-m circular hole in the side of a water tank is covered with a 1-m circular gate as shown in the figure. The gate is hinged at the bottom, and a cable is attached to the top.

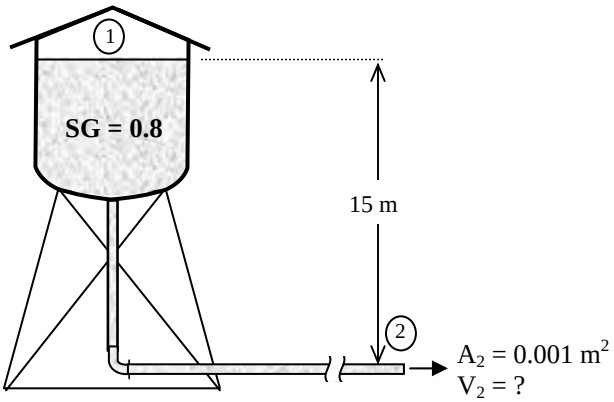


(a) (15 pts) Find the resultant static fluid force on the gate and give its location.

(b) (20 pts) The other end of the cable is attached to a completely submerged Styrofoam float, (ρ = 30 kg/m^3.) Assuming the pulley to be frictionless, find the required volume of the Styrofoam to keep the gate from opening.

(c) (5 pts) Suppose the *circular hole* is covered with a 1-m *square gate* instead. Will the force in part (a) be bigger, smaller, or the same? How will its location change?

2. (60 pts) A tower supplies a liquid solvent **(SG = 0.8)** to a lab (location 2) at an elevation 15 m below the tank liquid level (location 1).



(a) (12 pts) Given $P_1 = P_2 = P_{atm}$, what is the maximum velocity the tank can supply without help?

(b) (40 pts) Actually, P_2 = 20 kPa gage and losses equal to 2.8 $V_2^2/2$ exist, so a pump is added.

What pump power (in Watts) would be necessary to provide 0.015 m^3/s under those conditions? Assume the flow at location 2 is turbulent.

(c) (6 pts) Circle one response for each case. How would the required pump power change IF:

(1) the exit flow is laminar?	increase	decrease	no change
(2) the supply tank pressure increases?	increase	decrease	no change
(3) the fluid specific gravity increases?	increase	decrease	no change

(d) (2 pts) What term accounts for any heat transfer for this analysis?

Useful Information

Density of water: ρ_{water} = 998 kg/m^3
Gravitational acceleration: g = 9.81 m/s^2

Centroids and area moments for common shapes: