Name: ____ Campus Mail Box: ____________

Problem 1 (20)__________

Problem 2 (40)__________

Problem 3 (40)__________

TOTAL (100) __________

General Comments

(1) Anytime you apply conservation or accounting principles in solving a problem, sketch and clearly identify the system you have selected. In addition, clearly indicate how your assumptions or given information simplifies the general equations. Numbered-symbols, e.g. P_1 ,in equations must make sense for the problem in question, i.e. they must match you figure and communicate information accurately.

(2) Closed book/notes; however, you may use any of the following:
- ... unit conversion page
- ... instructor handouts in test
- ... your equation page (single side of 8-1/2 x 11 sheet of paper)

(3) For maximum credit,
- ... solve problems symbolically first showing logic and reasoning for solution,
- ... substitute numbers into the equations clearly showing any required unit conversion factors
- ... then and only then crunch numbers on your calculator.

If I only have to punch your numbers into a calculator to get a correct answer (including units) you will receive full credit. **Don't make me guess what you are doing and why you chose to do it.**

(4) Watch the time and feel free to remove the staple and take the test apart so that you don't have to keep flipping pages around.

PLEASE REMOVE THE STAPLE AND USE EXTRA PAPER *INSTEAD* OF WRITING ON THE BACK OF PAGES AND THEN HAVING TO FLIP BACK AND FORTH TO FINISH THE PROBLEM. I'LL GLADLY RESTAPLE YOUR TEST!

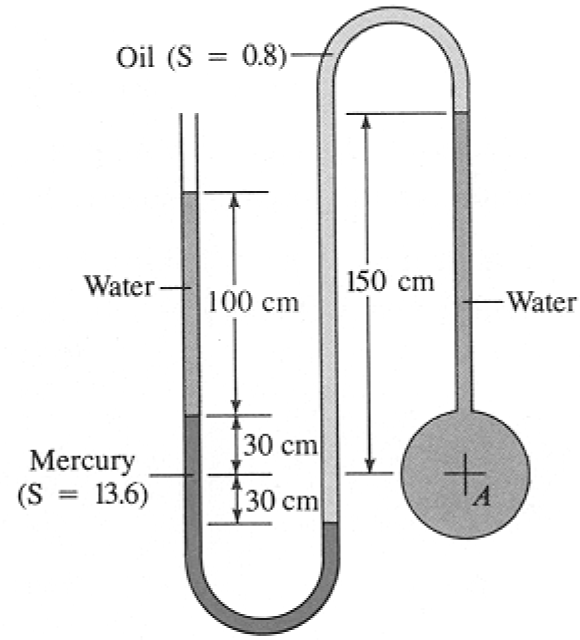
Useful Information

Acceleration of gravity: g = 9.81 m/s^2 = 32.174 ft/s^2

Density of water at room temperature: ρ = 1000 kg/m^3 = 62.4 lbm/ft^3 = 1.94 slug/ft^3

Problem 1 (20 points)

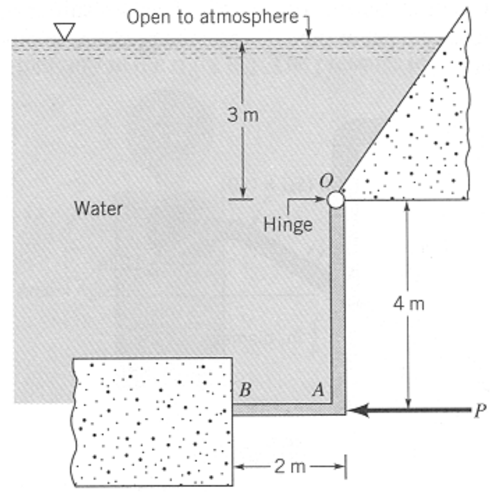
Determine the pressure at Point *A* in *either* kPa (gage) or kPa (absolute). Assume that atmospheric pressure is 100 kPa and the density of water at room temperature is 1000 kg/m^3. [S is the symbol for specific gravity.]



Problem 2 (40 points)

The rigid gate, *OAB*, shown in the figure is hinged at *O* and rests against a rigid support at *B*. The back of the gate as well as the free surface of the ware are exposed to the atmosphere.

Determine the *minimum* horizontal force *P* required to hold the gate closed if its width (into the paper) is $b = 3$ m. Neglect the weight of the gate and friction in the hinge.

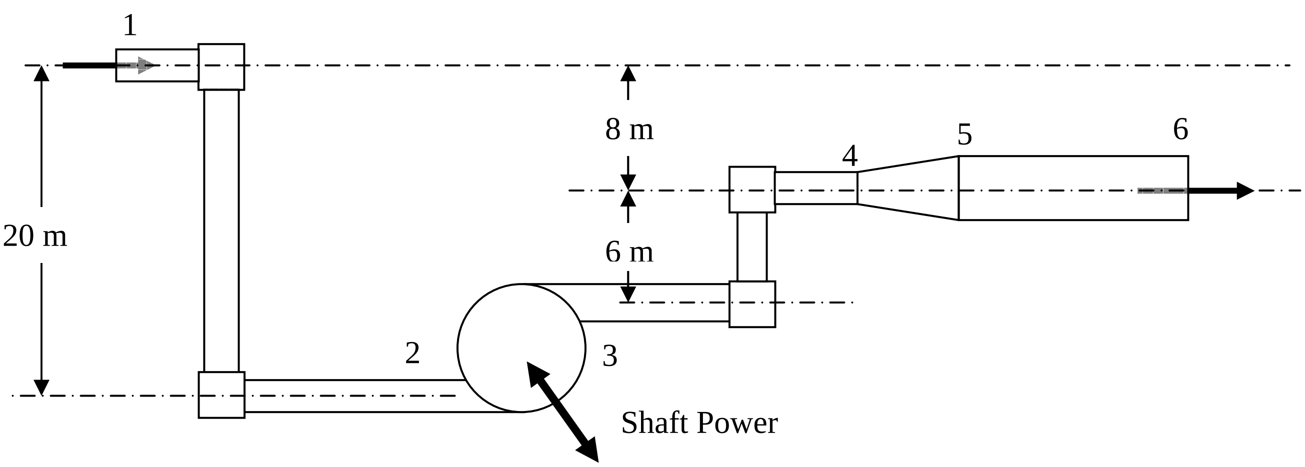


Problem 3 (40 points)

Water flows steadily through a device as shown in the figure below; however, it is unclear whether the device is a turbine or a pump. The known operating information and predicted head loss due to friction is shown in the accompanying table.

(a) Determine the shaft power for this device, in kW. Clearly indicate whether it is operating as a pump or a turbine.

(b) Does the pressure increase or decrease between points 4 and 5, e.g. is P_4 >, <, or = P_5 ? [You do not need a numerical answer; however, you must provide a correct and logical explanation of your reasoning.]



Predicted Friction Head Loss

Head loss between points 1 and 2	$h_{Loss,\ 1\text{-}2} = 6$ m
Head loss between points 2 and 3	$h_{Loss,\ 2\text{-}3} = 6$ m
Head loss between points 3 and 4	$h_{Loss,\ 3\text{-}4} = 6$ m
Head loss between points 4 and 5	$h_{Loss,\ 4\text{-}5} = 0$ m
Head loss between points 5 and 6	$h_{Loss,\ 5\text{-}6} = 2$ m

	Pressure (kPa gage)	Diameter (m)	Velocity (m/s)
1	300	1.0	10.0
2		1.0	
3		1.0	
4		1.0	
5		3.0	
6	0	3.0	