

**Name:**

**ENME 341 – Midterm 2 – March 19, 2015**

***Honor Code***

- 1) *The Honor Code is an undertaking of the students, individually and collectively:*
  - a. *That they will not give or receive aide in examinations; that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading;*
  - b. *That they will do their share and take an active part in seeing to it that others as well as themselves uphold the spirit and the letter of the Honor Code.*
- 2) *The faculty on its part manifests its confidence in the honor of its students by refraining from taking unusual and unreasonable precautions to prevent the forms of dishonesty mentioned above. The faculty will also avoid, as far as practicable, academic procedures that create temptations to violate the Honor Code.*
- 3) *While the faculty alone has the right and obligation to set academic requirements, the students and faculty will work together to establish optimal conditions for honourable academic work.*

*I acknowledge and accept the Honor Code.*

*(Signed)* \_\_\_\_\_

*Please label units in all calculations.*

*Useful equation:*

$$1 \text{ lbf} = 4.45 \text{ N}$$

$$1 \text{ ft}^3 = 7.481 \text{ gal}$$

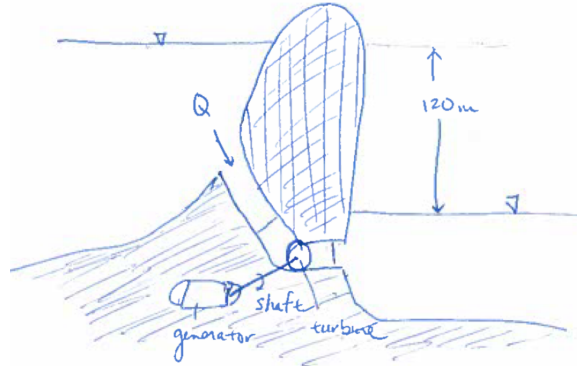
$$\rho_{\text{air}} = 1.2 \text{ kg} / \text{m}^3$$

$$\rho_{\text{water}} = 1.94 \text{ slug} / \text{ft}^3$$

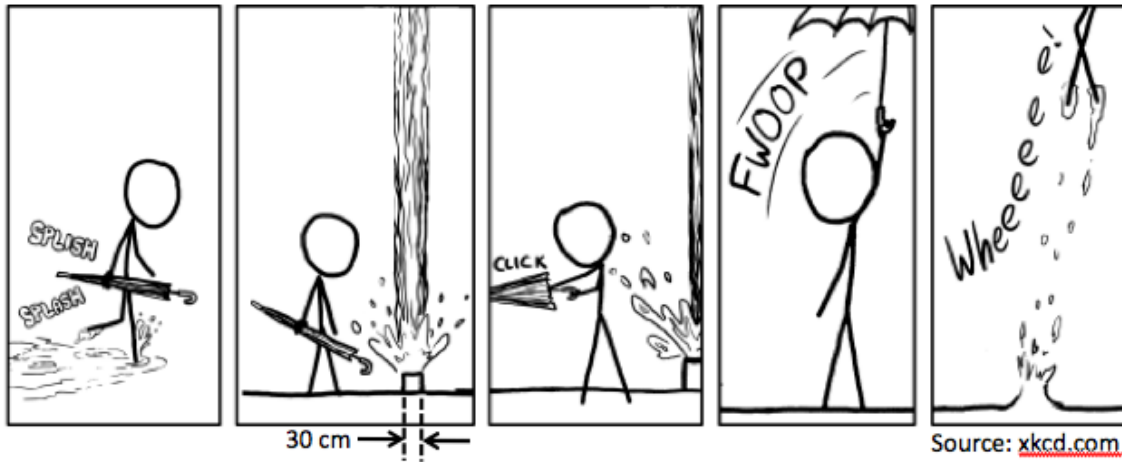
$$\text{SG}_{\text{seawater}} = 1.027$$

$$I_{x,circle} = \frac{\pi r^4}{4}$$

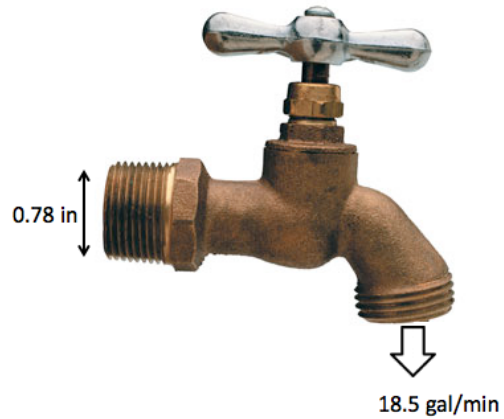
1. Hydroelectric power is generated from a dam with a steady flow rate of  $100 \text{ m}^3/\text{s}$ . The total head loss in the pipe system is equal to  $35 \text{ m}$ , and the efficiency of the turbine is  $80\%$ . What is the electric power output of the turbine?



2. Mu's little sister Alinna, a future fluid mechanic, decided to do an experiment in their neighbourhood fountain, which has a water jet of 8 m/s. Assuming she is 40 lbf and she got her 738 g fiberglass umbrella from Staples, how high will she fly? Assume the jet stays the same diameter all the way up and viscous losses are negligible. **DO NOT OVER THINK IT!!!!!!**



3. Water is flowing from the spigot as depicted below. The flow rate from the spigot is 18.5 gallons per minute, and the inner diameter of the pipe that comes out of the wall is 0.78 inches ( $=0.065$  ft). The pressure of the water entering is measured to be 13 psi gage. Given the total weight of the spigot and the water in it is 12.8 lbf, what is the reaction force on the flange to support this system?



4. The force  $F_P$  produced by a ship's propeller is a function of the following variables:
- $D$ , the diameter of the propeller
  - $\omega$ , the rotational speed of the propeller
  - $V$ , the velocity of the flow past the propeller (i.e. the ship velocity)
  - $\rho$ , the density of the water
  - $\mu$ , the viscosity of the water
- a) Applying the Buckingham Pi Theorem and using  $\rho$ ,  $V$ , and  $D$  as your repeating variables, derive the dimensionless groups in this problem. Be methodical and show all of your work.
- b) Relate the force produced by a model propeller  $F_M$  to the full-scale prototype force  $F_P$  if dynamic and geometric similarity are satisfied. The model is half the size of the prototype propeller and the test fluid is the same in both cases. (Your answer will simplify greatly if you express your result in terms of the original variables.)

5. EXTRA CREDIT: At the aquarium, an exhibit is a viewing window into the ocean, which is round with diameter of 2 m. The top of the window is 3 m along the slanted surface from the water surface, and the window is angled at 60 degrees with respect to the water surface. What is the hydrostatic force acting on the window and where is it applied?