NAME____

MECH-322 FLUID MECHANICS

ASSESSMENT 2

1. What is the definition of Mechanical Engineering?
    - Mechanical engineering is the study of physical machines that may involve force and movement. It is an engineering branch that combines engineering physics, mathematics principles, computer modeling and analysis, and material science to design, analyze, manufacture, and to maintain multi-disciplinary engineering systems.

2. What is the definition of Fluid Mechanics?
    - Fluid Mechanics deals with the **behavior** of fluids at **rest** and in **motion**

3. What is the conservation law that governs the Bernoulli Equation and Under what conditions can the Bernoulli Equation be applied?
    - Conservation of Energy via Total Pressure. Can be applied under ISIS conditions (Incompressible, Steady, Inviscid, along Streamline, and no shaft work).

4. What is the difference between the Law of Hydrostatics and Pascal's Law?
    - Law of Hydrostatics governs the change in fluid pressure with a change in depth. Pascal's Law says that a fixed depth that pressure is not a function of lateral direction.

5. What is the definition of Stagnation Pressure?
    - Whenever an object is placed into a fluid flow, there is a location upon which the dynamic pressure and static pressure is converted to a total pressure with zero velocity at a point.

6. What is the definition of a Free Jet?
    - When a fluid stream exists a domain into the atmosphere, the fluid pressure be equalizes to the environmental pressure.

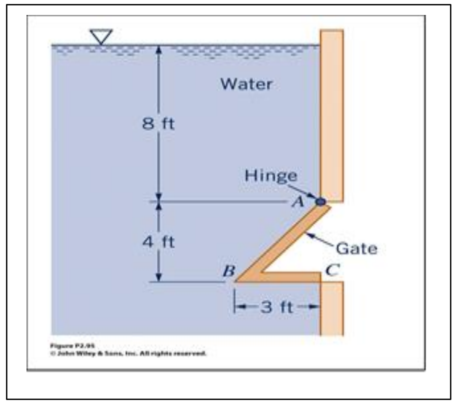
7. How can one determine the speed of an aircraft?
    - With a PITOT tube that measures the difference between stagnation and static pressure.

8. What is the definition of a manometer AND why is it so important to fluid problem solving?
    - ***A manometer measures the pressure difference between two points within a fluid. It is critical to most every fluid problem that requires a PRESSURE difference for the BERNOULI conservation of energy equation. As such, mastering MANOMETRY and hydrostatics is PARAMOUNT to any success in undergraduate Fluid Mechanics.***

9. What is the velocity at a Stagnation Point?
    - ZERO

10. What is the difference between a "static pressure tap", and a "stagnation pressure tap"?
    - Static pressure tap is parallel to the freestream. Stagnation pressure tap is normal to the freestream.

11. A gate having a cross section as shown closes an opening 5ft wide and 4 ft high as shown and weighs "w" lbs. The Center of Gravity is 1ft to the left of AC and 2ft above BC. Horizontal Surface BC is constrained by horizontal force (12000 lbs.) at vertical wall C.



a. Provide a properly defined detailed Free Body Diagram.
b. Define the terms "h_c", "y_r" and "y_c".
c. What is the magnitude of fluid pressure resultant force (lbf)?
d. Where is the magnitude of the Center of Pressure location (ft)?
e. What is the gate weight (lbs.).

Note: For all calculations, provide the parametric form first with validated unit checks. Numbers without units have "no" value?

PRIOR DISTRIBUTED STUDY AID

GATE STUDY AID (CLICK)

12. Air flows through the device as shown with the flow rate large enough to draw the water into the tube. Assuming inviscid flow and deploying Bernoulli and Manometry and Mass Conservation (i.e., $A_1V_1 = A_2V_2 = A_3V_3$):

1. What is the pressure at 2 (Pa)?
2. What is the velocity at 2 and at exit (m/s)?
3. What is the velocity at 1 (m/s)?

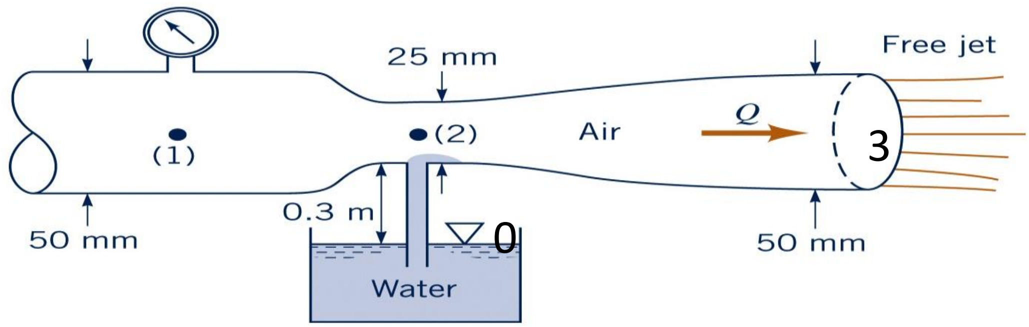


Figure P3.75

Pressure 2

MY TOOLS

Manometry (Used to find Pressure Difference)

$\rightarrow$ ALWAYS FIRST STEP

$\rightarrow$ APPLY POINT-BY-POINT ROAD MAP METHOD

Bermouli (Change is Velocity and Pressure along Streamline)

Mass Conservation (Change in Diameter)

Apply Manometry 2-0

$P_2 \pm \Delta P_{2-0} = P_0$

$P_2 + \gamma_{water} \Delta z = P_0 = 0$

$P_2 [PA] = -\gamma_{water} \Delta z = \left(-9800 N/m^3 \bullet 0.3m\right)[PA]$

Apply Mass Consrvation

$A_1V_1 = A_2V_2 = A_3V_3 = Q$

$V_2 = \frac{A_3 V_3}{A_2} = \frac{D_3^2}{D_2^2} V_3 = \frac{50^{\ 2}}{25^2} V_3$

Apply Bernoulli 2-3

$$\frac{P_2}{\gamma_{air}}+\frac{V_2^2}{2g}=\frac{P_3}{\gamma_{air}}+\frac{V_3^2}{2g}$$

$$But: \mathrm{V}_2=\frac{50}{25^2}^2\ \mathrm{V}_3$$

$$\frac{\overset{-\gamma_{water}\Delta z}{P_2}}{\gamma_{air}}+\frac{\left(\frac{50}{25^2}^2\ \mathrm{V}_3\right)^2}{2g}=\overbrace{\frac{\cancel{P_3}}{\cancel{\gamma}}}^{0\text{ FREE JET}}+\frac{V_3^2}{2g}$$

$$\frac{\overbrace{P_2}^{-\gamma_{water}\Delta z}}{\gamma_{air}}=\frac{V_3^2}{2g}(1-\left(\frac{50}{25^2}^2\right)^2)$$

$$\sqrt{\frac{\frac{\overbrace{P_2}^{-\gamma_{water}\Delta z}}{\gamma_{air}}}{1-\left(\frac{50}{25^2}^2\right)^2}}=V_3\rightarrow \text{and } \mathrm{V}_2=\frac{50}{25^2}^2\ \mathrm{V}_3$$

V_1

Mass Conservation

$$\cancel{A_1}V_1=\cancel{A_3}V_3$$

$$V_1=V_3$$

P_1

Apply Bernoulli 2-3

$$\frac{P_1}{\gamma_{air}}+\frac{V_1^2}{2g}=\xcancel{\frac{P_3}{\gamma_{air}}}+\frac{V_3^2}{2g}$$

$$\frac{P_1}{\gamma_{air}}=\frac{V_3^2}{2g}-\frac{V_1^2}{2g}=0$$

$P_1=0$ Gauge