
For this exam you may use:
- Two sides of an 8-1/2 x 11 sheet for notes
- Moody Diagram & other figures/tables provided
- The book of property tables
- Calculator
- Laptop for calculation purposes only

ES 202  
Examination 2  
February 6, 2012

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Show all work for credit.

Turn in your sheet of notes OR indicate here that you didn’t use one.

Use the closest table values unless the substance is saturated.

Use the back of the page if you need more paper.

Area Moments of Inertia for Common Shapes
Problem 1 (20 points)

A turbine receives water at $V_1 = 10 \text{ m/s}$ at atmospheric pressure and a volumetric flowrate of $\dot{V} = 0.1 \text{ m}^3/\text{s}$. The water exits the turbine at $V_2 = 1 \text{ m/s}$ at atmospheric pressure at an elevation $H = 3 \text{ m}$ below the inlet. If the total loss experienced by the system is $loss = 9 \text{ J/kg}$, find the power (in kW) produced by the turbine.
Problem 2 (40 points)

A flow rate of 0.125 ft³/s of ETHYL ALCOHOL passes through a CAST IRON pipe with 2” inside diameter and 50 ft length. The properties of the alcohol are ρ=1.53 slug/ft³ and μ=2.5 x 10⁻⁵ lbf-sec/ft².

a. Find the major head loss (in ft).

b. Find the minor head loss (in ft) if the pipe also has the following fittings:

1 – gate valve ½ closed
3 – flanged 90° elbows
1 – re-entrant exit
**Problem 3 (30 points)**

A **semicircular** shape of radius $r=0.6$ m is painted on the inclined wall of a swimming pool at the location shown in the figure.

a. Find the magnitude of the resultant hydrostatic force on the semicircular shape.

b. Find the location of the resultant hydrostatic force.

Water
$\rho = 1000$ kg/m$^3$

$\theta = 45^\circ$

$L = 0.4$ m

$r = 0.6$ m
Problem 4 (10 points)

1. A manometer contains two fluids as shown in the figure. Fluid 2 is exposed to the atmosphere and point A is sealed from the atmosphere. Given that \( \rho_1 < \rho_2 \), how does the pressure at 1 compare to \( P_{\text{atm}} \)?
   - \( P_1 < P_{\text{atm}} \)
   - \( P_1 = P_{\text{atm}} \)
   - \( P_1 > P_{\text{atm}} \)
   - Insufficient info to determine

2. A fluid enters a bend at velocity \( V \) and gage pressure \( P \). It is diverted upward through the bend and reaches a height \( h \). What is the velocity \( V \)?
   - \( V = \sqrt{2gh} \)
   - \( V = \sqrt{2 \left( gh - \frac{P}{\rho} \right)} \)
   - \( V = \sqrt{2 \left( gh + \frac{P}{\rho} \right)} \)
   - \( V = \sqrt{2 \left( gh + \frac{P_{\text{atm}}}{\rho} \right)} \)

3. Two cubes both have the same weight, \( W \). Cube A has a 2-m side length whereas Cube B has a 1-m side length. Both cubes are floating partially submerged in water as shown. How does the submerged volume beneath the surface compare for the two cubes?
   - \( V_A = \frac{V_B}{8} \)
   - \( V_A = \frac{V_B}{2} \)
   - \( V_A = V_B \)
   - \( V_A = 2V_B \)
   - \( V_A = 8V_B \)