Quiz Grading Keys

This document provides the general principles of making quiz grading keys:

- The principle is to give more points for understanding the main fluid dynamics concepts rather than for numerical calculations and to encourage class attendance
- Typical grade points (out of 10) and guidelines:
  1) **2 points** for **attendance**
  2) **1 points** for following the **format** similar to the format used for homework, i.e. in the order of NAME and Fluids ID; KNOWN; FIND; ASSUMPTIONS; ANALYSIS (See the 'Information' page on the class website, www.engineering.uiowa.edu/~fluids for more details of the format)
  3) **4 points** for the ANALYSIS parts, i.e. for understanding the **main concept** of the problem, giving about:
     a. *2.5 points* for knowing the *correct equations* related to the concept and the remaining
     b. *1.5 points* for using the *correct assumptions/conditions* to simplify/reduce the equations to be solved
  4) **2 points** for **correct solving** of the equations for the variables of interest
  5) **1 point** for **correct evaluations** by using the given variables/properties values
- The grade points listed above are only the *typical values* and those values ***may vary for each specific problem***
- If multiple concepts are asked, then more points are assigned to the main concept and the remaining points to the secondary concepts with a distribution based on their relevance/significance/contribution to the main concept. See an example given at the following page

Example Grading Key

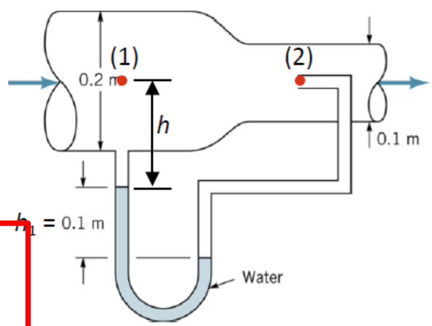
57:020 Mechanics of Fluids and Transport

September 25, 2009

NAME **Attendance: +2 points (Guideline 1)**

Fluids-ID

Quiz 3. Air (γ = 12.0 N/m^3) flows steadily through the variable area pipe shown at the right. Determine the flow rate Q if viscous and compressibility effects are negligible. Note: γ = 9.80 $\times 10^3$ N/m^3 for water.



Answer:

KNOWN: γ_{air} = 12.0 N/m^3; γ_{H2O} = 9.80 $\times 10^3$ N/m^3;
D_1 = 0.2 m; D_2 = 0.1 m, h_1 = 0.1 m

FIND: Q **Format: +1 point (Guideline 2)**

ASSUMPTIONS: Viscous and compressibility effects are negligible

ANALYSIS:

1) Bernoulli equation

Concept 1: +3.5 points

$$\frac{p_1}{\gamma_{air}} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\gamma_{air}} + \frac{V_2^2}{2g} + z_2$$

+2.5 out of 3.5: Guide line 3a)

Since $z_1 = z_2$ and $V_2 = 0$,

$$\frac{p_1}{\gamma_{air}} + \frac{V_1^2}{2g} = \frac{p_2}{\gamma_{air}}$$

or

$$V_1 = \sqrt{2g \times \frac{p_2 - p_1}{\gamma_{air}}} \quad (1)$$

+1 out of 3.5: Guide lines 3b) & 4)

2) Manometer

Concept 2: +2 point

$$p_1 + \gamma_{air} \cdot h + \gamma_{H_2O} \cdot h_1 = p_2 + \gamma_{air}(h + h_1)$$

+1 out of 2: Guide line 3a

or

$$p_2 - p_1 = \gamma_{H_2O}\left(1 - \frac{\gamma_{air}}{\gamma_{H_2O}}\right) \cdot h_1$$

Since $\gamma_{H_2O} \gg \gamma_{air}$,

$$p_2 - p_1 \approx \gamma_{H_2O} \cdot h_1 \quad (2)$$

+1 out of 2: Guide lines 3b) & 4)

3) Flow rate

Concept 3: +1.5 points

$$Q = V_1 A_1$$

+0.5 out of 1.5: Guide line 3a)

By using (1) and (2),

$$Q = \sqrt{2g \times \frac{\gamma_{H_2O} \cdot h_1}{\gamma_{air}}} \cdot \frac{\pi D_1^2}{4}$$

+1 out of 1.5: Guide line 5)

Thus,

$$Q = \left(\sqrt{2\left(9.81\frac{m}{s^2}\right)\left(\frac{9.80 \times 10^3\,N/m^3}{12.0\,N/m^3}\right)(0.1\,m)}\right)\left(\frac{\pi}{4}\right)(0.2\,m)^2 = 1.26\,m^3/s$$