Homework Grading Keys

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

- The principle is to give more points for understanding the main fluid dynamics concepts rather than for numerical calculations
- Typical grade points (out of 10):
  1) **1 point** for following the **format**, i.e. 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)
  2) **6 points** for the ASSUMPTIONS and ANALYSIS parts, i.e. for understanding the **main concept** of the problem, giving about:
     a. *4 points* for knowing the *correct equations* related to the concept and the remaining
     b. *2 points* for using the *correct assumptions/conditions* to simplify/reduce the equations to be solved
  3) **2 points** for **correct solving** of the equations for the variables of interest
  4) **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 partial points are assigned to the main concept (about 5-7 out of 10) and the remaining points (about 1-5 out of 10) 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

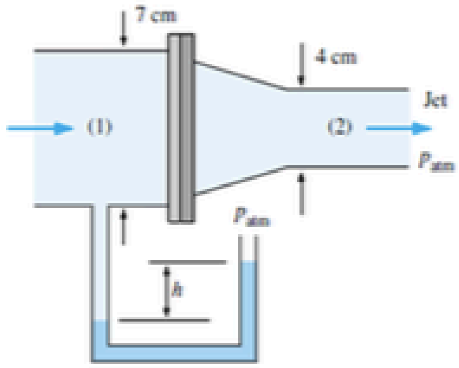
Example Grading Key

The following example problem requires knowledge on three basic concepts: (a) static pressure or the manometer equation, (b) continuity equation, and (c) the Bernoulli equation. The concept Bernoulli equation is the main concept and the others are the secondary concepts

Problem 3: Bernoulli equation (Chapter 3)

Information and assumptions

- ρ = 1.31 kg/m^3
- D_1 = 7 cm
- D_2 = 4 cm
- Ignore friction loss
- SG = 0.8 for the manometer fluid
- γ_{water} = 9,790 N/m^3
- h = 5 cm



Find

- Pressure at section (1)
- Relationship between the velocities at sections (1) and (2)
- Velocity at section (2)

Solution

(a) Pressure at section (1) is

$$p_1 = \gamma_{water} \cdot SG \cdot h$$

$$p_1 = \left(9{,}790\ \frac{\text{N}}{\text{m}^3}\right)(0.8)(0.05\ \text{m}) = 391.6\ \frac{\text{N}}{\text{m}^2} = 391.6\ \text{Pa}\ (gage)$$

Concept 1: (Partial point = 3/10)

2 points out of 3: Guide line 1) & 2)

1 point out of 3: Guide line 3)

(b) From the continuity equation

$$Q = V_1A_1 = V_2A_2$$

$$V_1 = \left(\frac{D_2}{D_1}\right)^2 V_2 = \left(\frac{4\ \text{cm}}{7\ \text{cm}}\right)^2 V_2 = 0.327\ V_2$$

Concept 2: (Partial point = 1/10)

0.5 point out of 1: Guide line 1)

0.5 point out of 1: Guide line 2) & 3)

(c) Bernoulli's equation,

$$p_1 + \frac{1}{2}\rho V_1^2 + \gamma z_1 = p_2 + \frac{1}{2}\rho V_2^2 + \gamma z_2$$

Since $z_1 = z_2$ and $p_2 = 0\ (gage)$,

$$p_1 = \frac{1}{2}\rho\,(V_2^2 - V_1^2)$$

Solve for V_2 and by using the relationship between V_1 and V_2,

$$V_2 = \sqrt{\frac{2p_1}{\rho\left(1-\left(\frac{D_2}{D_1}\right)^4\right)}} = \sqrt{\frac{(2)(391.6\ \text{N/m}^2)}{\left(1.31\ \frac{\text{kg}}{\text{m}^3}\right)\left(1-\left(\frac{4\ \text{cm}}{7\ \text{cm}}\right)^4\right)}} = 25.9\ \text{m/s}$$

Concept 3: (Partial point = 6/10)

3 points out of 6: Guide line 1a)

1 point out of 6: Guide line 1b)

2 points out of 6: Guide line 2) & 3)