Fluid Mechanics Retake Measurement Midterm Exam points:

BMEGEÁT-AG11 2014-10-16 18:00

2014/2015 fall Name: _____ Neptune code: _____

Group A.

A / Problem 1. **(0.5 p)**

Convert the following quantities to the given dimensions!
195 mmHg (millimeters of mercury) atmospheric pressure = ? Pa (The density of mercury is 13600 kg/m3, and gravitational acceleration is 9.81 N/kg)
2 hl/h = ? l/min

A / Problem 2. **(0.5 p)**

Describe how velocity can be measured using a Pitot-static probe (Prandtl probe)! Use a sketch to help visualize your description!

A / Problem 3. **(1.5 p)**

Methane gas is flowing through a circular cross-sectioned pipe (D=230mm). A Pitot-static probe (Prandtl probe) is installed along the axis of symmetry of the pipe. The dynamic pressure measured with the probe is 24 Pa. The absolute pressure of the fluid is 2.2 bar, the value of its gas constant is R=554 J/kg/K, and the temperature of the fluid is 25 °C. The maximum velocity along the axis is 25% larger than the average velocity.
Determine the volume flow rate of the fluid!

A / Problem 4. **(1.5 p)**

A Pitot-static tube (Prandtl tube) is used to measure velocity with the help of a digital manometer. The dynamic pressure which was measured was 60 Pa. The measured fluids temperature is 50 °C, while the atmospheric pressure is 10^5Pa. (R_{air}=287 J/kg/K) Determine the uncertainty of the results, taking into account the uncertainty resulting from the measurement of the dynamic pressure and the temperature, where the absolute error of the dynamic pressure is ±2Pa and of the temperature is ±1K! Determine the absolute and relative error of the results! Determine which of the measured quantities is the larger source of uncertainty with regard to the calculated quantity!

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Group B.

B / Problem 1. **(0.5 p)**

Convert the following quantities to the given dimensions!
125 N/mm^2 = ? Pa
345 cm/h = ? m/s

B / Problem 2. **(0.5 p)**

How does an inverted (upside down) U-tube manometer work and when would one be used?

B / Problem 3. **(1.5 p)**

The volume flow rate being transported by a water supply pipe system is measured using a through flow orifice. The diameter of the pipe is D=200mm, the diameter of the orifice is d=100mm, the contraction ratio is 0.621, the fluid can be considered as incompressible. The pressure drop occurring across the orifice is measured using a U tube manometer, which is filled with mercury. The density of water is ρ_{water}=1000kg/m^3, and the density of mercury is ρ_{Hg}=13600kg/m^3. The difference in levels measured using the manometer is 35mm.

ASSIGNMENTS:

Determine how many kilograms of water flow through the through flow orifice every hour!

B / Problem 4. **(1.5 p)**

The change of level occurring in a vertical cylinder of circular cross-section is being examined. During the measurement, the level rose by ΔH = 21.5 cm. The inner diameter of the cylinder is D = 6.5 cm. The error associated with the measurement of the length is 1 mm, as well as that of the error associated with using a vernier caliper to measure the diameter, which is also 1 mm. Determine the volume of the water which has flown into the cylinder, V, as well as the absolute and relative uncertainties (errors) of the result! Give the value of V, together with the error, in a metric unit of choice! (Give the results with the correct choice of significant figures!) Determine which component of the relative uncertainty of the volume measurement, resulting from the geometric measurements, is greater!