2014/2015 fall Name: _____Neptune code:_____

A. Group

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

Convert the following quantities to the given dimensions!
165 hl/h = ? m^3/s
0.234 t/dm^3 = ? kg/m^3

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

Define absolute and relative error! How should the relative error of a quantity be calculated, if it was calculated from multiple measured quantities?

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

The volume flow rate of a water supply pipe network is measured using a lossless Venturi meter which lies in the horizontal plane. The diameter of the pipe system is D1=200mm, the smaller diameter of the Venturi meter is D2=150mm, and the fluid can be considered incompressible. The pressure drop across the Venturi meter is measured using an inverted (upside down) U-tube manometer. The density of water is ρ_{water}=1000kg/m3, the density of air is ρ_{air}=1.2kg/m3, and the displacement measured on the manometer was 500mm.
ASSIGNMENT:
Determine how many cubic meters of water pass through the pipe every hour!

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

A volume flow rate measurement was made using an inlet orifice. The volume flow rate for an inlet orifice having an inner diameter of 110 mm is 0.114 m3/s. The displacement of the water filled U-tube manometer was 25 mm. (ρ_{air}=1,2kg/m^3, ρ_{water}=1000 kg/m^3). The accuracy (absolute error) of the diameter measurement is 1 mm, and the accuracy of the manometer reading is 0.2 mm. Make an error calculation, determining the values for the relative and absolute errors for the volume flow rate!

2014/2015 fall Name: _____Neptune code:_____

B. Group

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

Convert the following quantities to the given dimensions!
165 l/min = ? m^3/s
55 µg/l = ? kg/m^3

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)**

We have determined the volume flow rate of the air passing through a pipe having an internal cross-sectional area of 160x200 mm by measuring the flow velocity in 4 points, assuming that the measured velocities are the average velocities measured for segments of equal area. The dynamic pressure in each point was measured with a Pitot-static (Prandtl) probe, which was connected to a water filled U-tube manometer. The displacement of the fluid, Δh, is given in the table. Determine the volume flow rate of the air passing through the pipe, if the temperature is 5°C, the pressure is 1010mbar, and the specific gas constant of air is 287 J/kg/K.

Δh_1=	20	mm
Δh_2=	29	mm
Δh_3=	17	mm
Δh_4=	22	mm

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

We are displacing water from a tank using a ping-pong ball of diameter D = 3.75cm. The diameter was measured using calipers having a precision of 0.1mm. Determine the preciseness of the value for the volume of the ball, V, due to the measurement error associated with the diameter measurement, D! Calculate the absolute and relative error for the value of V, and give the value of V, in any appropriate metric unit of your choice, together with the value for the measurement error, while utilizing an appropriate number of significant digits!