Homework-I

Notes about submitting the homeworks:

- Deadlines of submitting the homeworks: ***18.03.2019***
- Homeworks should be done in a format according to the standards of engineering (smooth, clean and comprehensible).

1. Define the terms fluid, continuum medium, ideal fluid and viscous fluid. Why is the assumption of continuum medium made in terms of fluid mechanics?

2. Derive Archimedes principle with the help of hydrostatic pressure law and interpret the result.

3. What is dimensional homogeneity? Write the advantages of homogeneous formulas.

4. Define viscosity and express the dimensions of dynamic and kinematic viscosity.

5. Can liquids and gases be assumed as incompressible? Explain in detail.

6. Show that the pressure at a point is independent of direction for a static fluid condition.

7. Derive the variation of pressure with respect to depth for a static fluid situation and interpret the results. Explain absolute pressure and gage pressure.

8. Define viscosity and shear stress. What is the relation between them? What are their units in SI and MK_fS unit systems? How do they differ in case of solids, liquids and gases ? Define Newtonian and Non- Newtonian concepts and give examples.

9. Define the Euler and Lagrange methods used in fluid mechanics. Define the relationship between dependent and independent variables for each approach. Write the equations of translations between one approach's dependent variables to the other one's dependent variables.

10. Plot the variation of dynamic viscosity with respect to temperature and interpret the graph.

11. Approximate formula of the pressure difference (Δp) in a blood vessel between two cross sections, where one of them is semi-clogged is given below.

$$\Delta p = K_v \cdot \frac{\mu \cdot V}{D} + K_u \cdot \left(\frac{A_0}{A_1} - 1 \right)^2 \rho \cdot V^2$$

In this equation, V is blood's speed, μ is it's dynamic viscosity, ρ is it's density, D is blood vessel's diameter, A_0 is the cross-sectional area of unclogged blood vessel, A_1 is the cross-sectional area of the semi-clogged blood vessel, and K_V and K_U are the constants of the equation.

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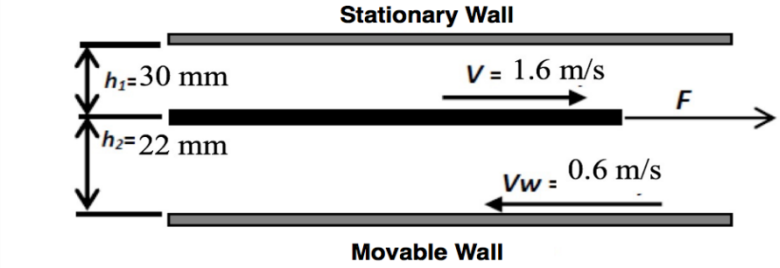
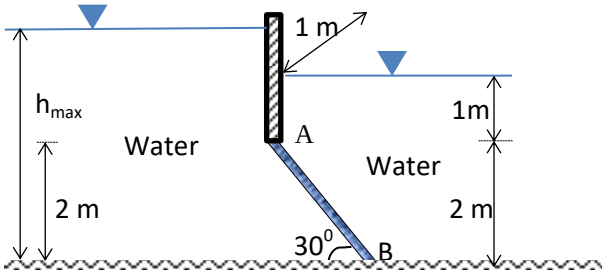
a. Define the dimensional homogeneity shortly and control the dimensional homogeneity of the formula.

b. Can the equation be used in other unit systems? Explain.

12. As shown in the figure given below, there are two infinitely long walls, where one is stationary and the other one is movable. Between them is oil with a dynamic viscosity of 0.027 kg/m.s. A very thin plate with a 20cmx20cm surface dimensions is pulled by a constant velocity of 1.2 m/s between the two walls. Find the desired force in order for this movement to happen with the assumption of velocity gradient is linear between the layers.



13. The width of the rectangular gate AB with a ball joint from point A is 3m and it's weight is 120 kN. What should be the depth (h) of the water on the left side to prevent the opening of the gate by itself? (Sketch the schematic of the horizontal and vertical forces acting on the surfaces)



14. In order for the system to be in equilibrium, what should be the values of Px and Py?