Q.1. *READ Chapter-2 in he book by Fox and McDonald before you answer. Use your own words.*

a) Explain the differences in the viscosity of gases and liquids.
b) What is a shear stress?
c) What is the unit of dynamic viscosity and shear stress?
d) What are the differences between Newtonian and non-Newtonian fluids?
e) Some of the Non-Newtonian substances are:
i.) Modeling clay, ii.) Wax, iii.) Quicksand, iv) Toothpaste, v.) Starch

Which non-Newtonian group are these belong? Explain the viscosity characteristics of these groups.

Q.2. For each of the velocity field below

i.) $\vec{V} = ae^{-bxz}\hat{k}$,

ii.) $\vec{V} = axi + bx^2 e^{-cyzt}\hat{j}$,

iii.) $\vec{V} = az^2\hat{i} + bz\hat{k}$,

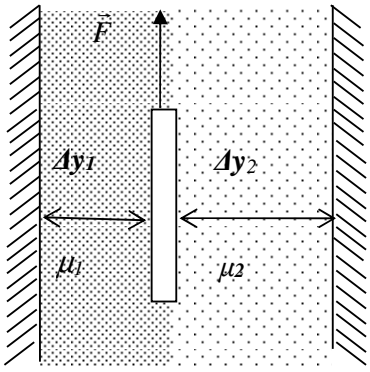
iv.) $\vec{V} = axi - by\hat{j} + (t - cz)\hat{k}$

determine

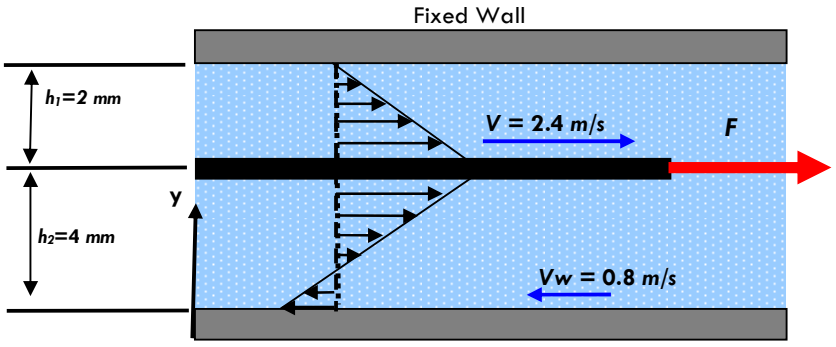
a. whether the flow field is one, two, or three dimensional and why?

b. whether the flow is steady or unsteady, why?

Q.3. In the diagram, the total distance between the stationary boundaries is 20 mm. A plate of infinite dimensions is pulled upwards between ethylene glycol fluid on the left-hand side and propylene glycol fluid on the right-hand side. Find the lateral position ($\Delta y_1, \Delta y_2$) of the plate when **it finds its equilibrium position**. The thickness of the plate is given as 1mm and μ_1=0.0162 [Ns/m²], μ_2=0.042 [Ns/m²].



Q.4. A thin 20cmx20cm flat plate is pulled at 2.4 m/s horizontally through a 6 mm thick oil layer sandwiched between two plates, one stationary and the other moving at a constant velocity of 0.8 m/s, as shown in the figure. The dynamic viscosity of oil is 0.027 kg/m·s. Assuming the velocity in each oil layer to vary linearly, determine the force that needs to be applied on the plate to maintain this motion. Here V_w refers to the velocity of the moving wall.



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