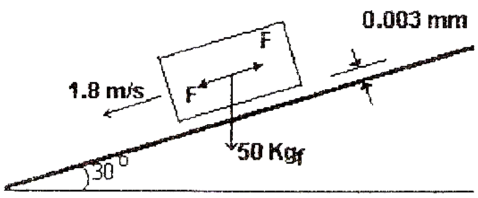
Newton's Law of Viscosity & Pressure Concept

Exercise 1 : Compute the unit change in the volume of water, if $E_{water}=2\times10^4$ kg_f/cm^2 and $\Delta P=100$ atm. Can we conclude that water is an incompressible fluid?

Exercise 2 : In a fluid flow, a difference of 1.5 cm/s is determined between the velocities of two consecutive layers which are 1 mm away from each other. The kinematic viscosity of the used fluid is 1×10^{-6} m²/s. Determine the shear stress between these two layers using both of the MK_fS and SI unit systems.

Exercise 3 : A block with a weight of 50 kg_f has a surface area of 0.2 m². This block slides down an inclined, smooth plane as shown in the figure given below. Between the block and the smooth surface, there is a 0.003 mm-thick oil layer which causes the block to slide down with a constant velocity of 1.8 m/s. Determine the velocity profile of the oil layer and compute the dynamic viscosity of oil.



Exercise 4 : In a fluid flow, the velocities of two layers –which are 1 cm away from each other– are 2 and 3 cm/s, respectively. Determine the value of the shear stress between these two layers by taking the specific weight of the fluid as 0.8 t/m³ and its kinematic viscosity as 1×10^{-4} m²/s.

Exercise 5 : The absolute vapor pressure of water at constant temperature is given as 0.23 t/m². Compute the relative value of this pressure in kg_f/cm^2 ($P_{atm}=1$ kg_f/cm^2).

Exercise 6 : Compute the absolute and relative pressure values at a distance of 1 km from the sea surface, i.e. at a depth of 1000 m, by assuming that the specific weight of sea water is 1.02 t/m³.

Exercise 7 : A diver works at a depth of 25 m. Compute the pressure difference that this diver will be subjected by descending from the surface to the given depth ($\gamma_{seawater}=1025$ kg_f/m^3).

Exercise 8 : Measurements made with a barometer indicated a height of 74 cm mercury at the foot of a mountain and 59 cm at its peak. Determine the height of this mountain ($\gamma_{air}=1.27$ kg_f/m^3).

Exercise 9 : A cylinder, which has a mass of 0.20 $kg_f s^2/m$, slides down through a vertical pipe as shown in the figure given below. A thin oil layer is placed between the cylinder and the inner wall of the pipe. The vertical axes of the cylinder and the pipe are superposed.

- Determine the velocity gradient and the shear stress in the oil layer ($\gamma_{oil}=820$ kg_f/m^3 ; $\upsilon_{oil}=6.10^{-6}$ m²/s).
- Determine the final (limit) value of the velocity that the cylinder can reach during its motion in the pipe by neglecting the effect of air pressure.