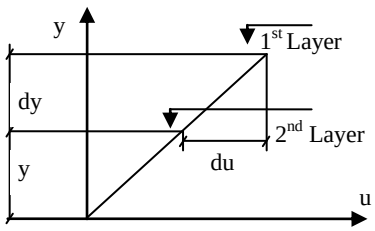
Newton's elemental law of shear stress – concepts of pressure

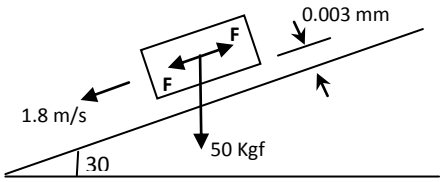
Question 1: Calculate the ratio of change in the volume of water using E_{water}=19.62x10^4 N /cm^2 and Δp=100 atm and explain if the water could be considered as incompressible or not depending on your result. (E = Volumetric Elasticity Modulus)

Question 2: There is a 1.5 cm/s speed difference between two layers of a fluid, where the spacing between the two layers is 1 mm. The fluid is water and its kinematic viscosity is υ_{water} = 1·10^{-6} m^2/ s. Find the shear stress between the two layers in SI Unit system.

Answer: τ_{SI}=0.015 N/m^2



Question 3: At an unloading station, blocks weighing G=490.5 N are released from a smooth surface at an angle of 30° with a horizontal surface. Surface area of the blocks is A=0.2 m^2. The surface is greased with a pellicle having a thickness of 0.003 mm in order to get the blocks sliding with a constant downward speed of U=1.8 m/s. Find the velocity profile and dynamic viscosity of the pellicle (Thin oil layer between the block and the surface) . ***Answer: 2.04x10^{-3} Ns/m^2***



Question 4: In a flowing fluid having a specific weight 0.8 t (ton-force), the speeds of the layers that have 1 cm spacing between them are U_1=2 cm/s ve U_2=3 cm/s, respectively. Find the shear stress in this region in terms of N/m^2**.** (γ_{oil} =0.8 t/ m^3; υ_{oil}=1·10^{-4} m^2/s) ***Answer: τ_{SI}=8x10^{-2}N/m^2***

Question 5: Given the absolute vapor pressure in a certain temperature of water is $p_{water,ab}$=0.23 t/ m^2, find the gage value of this pressure in terms of N /cm^2. (p_{atm}=9.81 N /cm^2) ***Answer: P_{gage}=-9.58 N/cm^2***

Question 6: Assuming that the specific weight of the sea water is 1.02 t/m^3, find the absolute and gage pressure values at depth z=1000 m in terms of N /cm^2. (p_{atm}= 9.81 N/ cm^2) ***Answer: P_{gage}= 1000.62 N/cm^2, $P_{absolute}$ = 1010.43 N/cm^2***

Newton's elemental law of shear stress – concepts of pressure

Question 7: A diver is working in water at 25 m depth. How large is the pressure at this depth relative to the pressure at the surface of the water? (γ_{sea}=10055.25 N /m^3) ***Answer: $P_{25\ gage}$= 25.625 t/m^2, $P_{25\ absolute}$= 35.625 t/m^2***

Question 8: A barometer reads h_1=74 cm at the foot of a mountain and it reads h_2=59 cm (mercury column) at the mountain peak. Find the height of the mountain.
Answer: $h_{mountain}$= 1606 m

Question 9: A cylinder with a mass *m*=1.962 N s^2/m is sliding downwards through a vertically positioned pipe. A thin oil layer exists between the cylinder and the pipe's internal surface. Axes of the cylinder and pipe overlap. (γ_{oil} =8044.2 *N* /m^3; υ_{oil}=6·10^{-6} m^2 /s)

a) Find the change in the speed of the cylinder in the pipe with respect to its unit displacement and the shear stress that acts upon the oil layer.

b) Find out the cylinder's terminal velocity inside the pipe. (Air pressure effect is neglected.)