	Alexandria Higher Institute of Engineering & Technology (AIET)		
	Mechatronic Department		Third Year
	EME312	Fluid Mechanics	Midterm, Mars, 23, 2015
	Examiners:	Dr. Rola Afify and Committee	Time: 1.5 hours

Question one (6 marks)

A) Compare between:

1. Density and Specific weight of a fluid.

* Density : mass per unit volume $\rho = \frac{m}{V}$ Kg/m^3 gm/cm^3 lb/ft^3

DIM $\frac{M}{L^3}$, for water $\rho = 1000\ Kg/m^3$

* specific weight : weight per unit volume

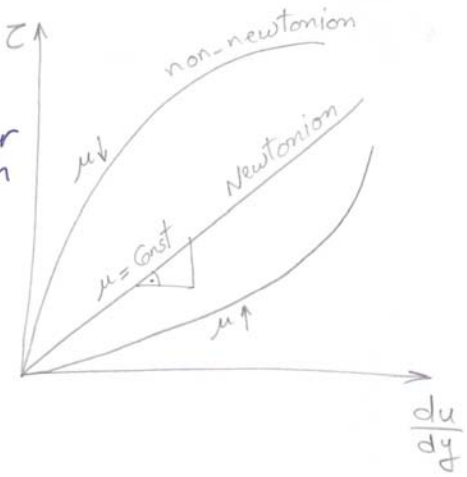
$w = \frac{\text{weight}}{\text{Volume}} = \frac{m*g}{V} = \rho g$ N/m^3 $dyne/cm^3$ lb_f/ft^3

Dim. $\frac{ML}{T^2}*\frac{1}{T^3}$, for water $w = 1000*9.8\ \frac{N}{m^3}$

2. Newtonian and Non-Newtonian fluids.

* Newtonion & Non-newtonion :

$\tau = \frac{F_{vis}}{A} = \mu \frac{du}{dy}$ (τ: shear stress, $\frac{du}{dy}$: rate of shear strain)



If $\tau \propto \frac{du}{dy}$

$\therefore \mu = Const.$

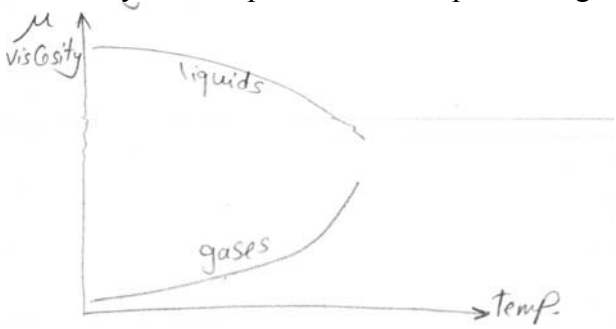
$\therefore$ It is a newtonion fluid

$\mu = 0 \longrightarrow$ Ideal Fluid

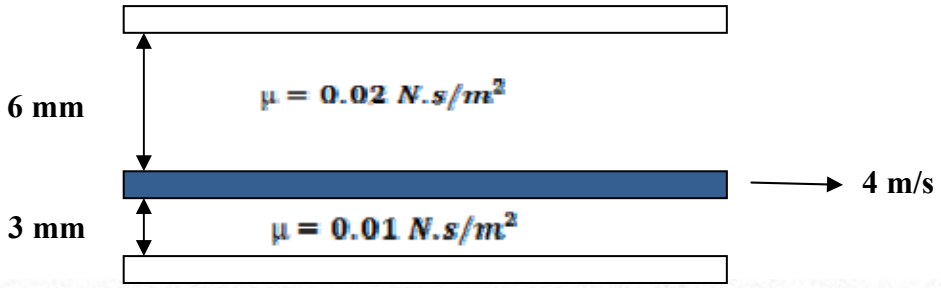
$\mu = Const. \longrightarrow$ Newtonion Fluid

$\mu \uparrow\downarrow \longrightarrow$ Non-newtonion Fluid

3. Relation between viscosity and temperature for: Liquids and gases.



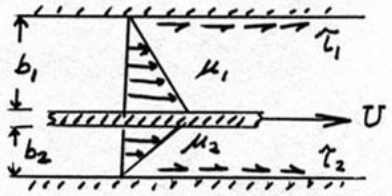
B) A large movable plate is located between two large fixed plates, as shown in figure. The viscosities of the two fluids contained between the plates are indicated. Determine the magnitude of the shearing stresses that act on the fixed walls when the moving plate has a velocity of 4 m/s. Assume the velocity distribution between the plates is linear.



$\tau = \mu \frac{du}{dy} = \mu \frac{U}{b}$ so that

$\tau_1 = \mu_1 \frac{U}{b_1} = (0.02 \frac{N.s}{m^2})(\frac{4 \frac{m}{s}}{0.006m})$

$= 13.3 \frac{N}{m^2}$



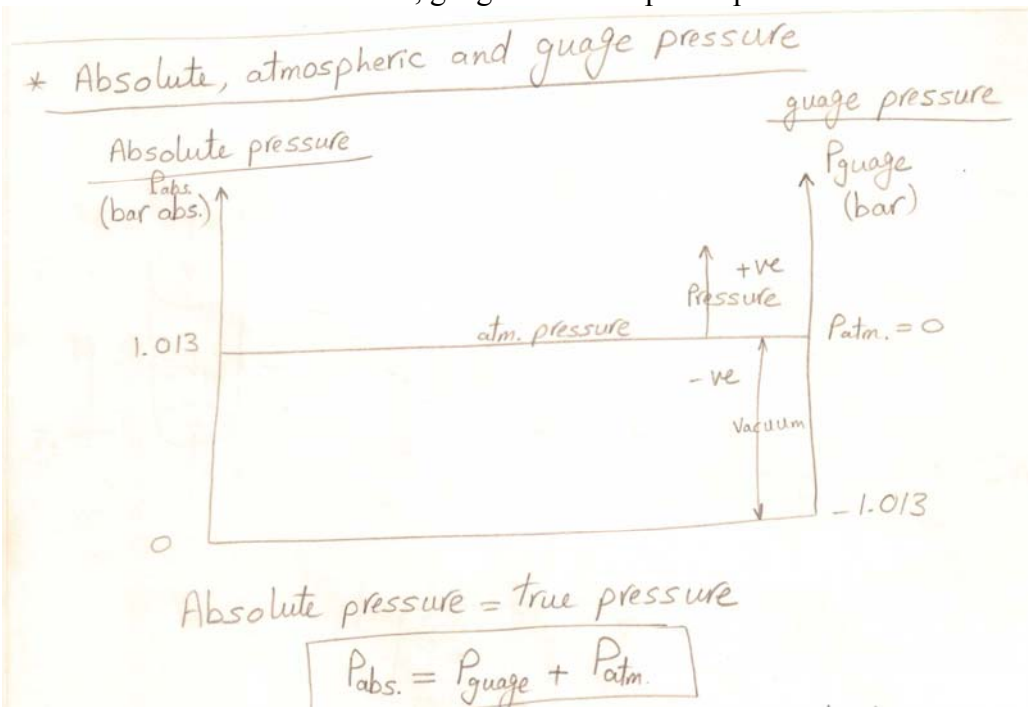
$\tau_2 = \mu_2 \frac{U}{b_2} = (0.01 \frac{N.s}{m^2})(\frac{4 \frac{m}{s}}{0.003m})$

$= 13.3 \frac{N}{m^2}$

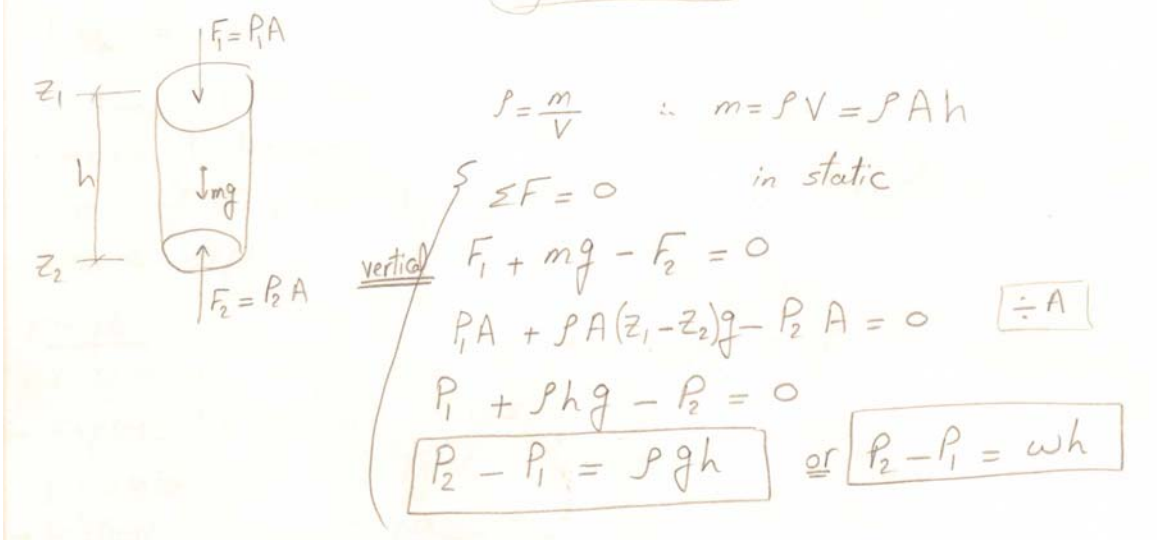
Stresses act on fixed walls in direction of moving plate.

Question two (7 marks)

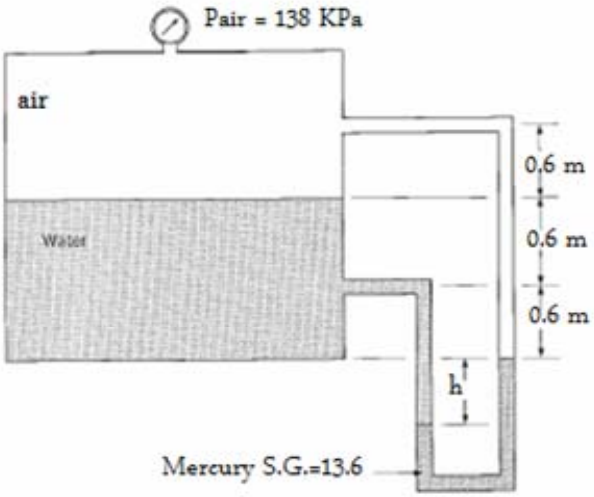
A) State the relation between absolute, guage and atmospheric pressure.



B) Prove that the pressure changes in the vertical direction.



C) A U-tube mercury manometer is connected to a closed pressurized tank, as shown in figure. If the air pressure is 138 KPa, determine the differential reading, h. The specific weight of the air is negligible.



Question three (7 marks)

A) Compare between:

1- Streamline and Stream tube.

* Definitions

* streamline: is a smooth imaginary curve represents one particle in the flow. The tangent of this line gives the direction of velocity at any point.

- streamlines can never intersect
- They can never have sudden change in direction.

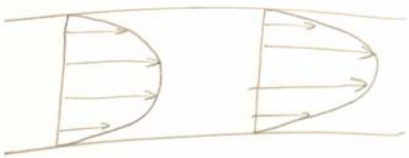
Intersection or sudden change in direction means that there is a point where the velocity vector has two directions in the same time which is impossible.

* stream tube: is a tube formed of an infinite number of streamlines which are drawn passing through a closed curve in the flow.

No flow can go in or out of the sides of this tube.

2- Uniform and Non-uniform flows.

③ uniform and non-uniform flow [from point to point]



uniform flow

non-uniform flow

* uniform flow: The velocity at a given instant is the same in magnitude and direction at every point in the fluid.

* non-uniform flow: The velocity at a given instant changes from point to point.

B) Oil (specific weight = 8900 N/m^3) flows through a horizontal 23 mm diameter tube, as shown in figure. A differential tube manometer is used to measure the pressure drop along the tube. Determine head loss in the pipe if the value for h equals 20 cm.