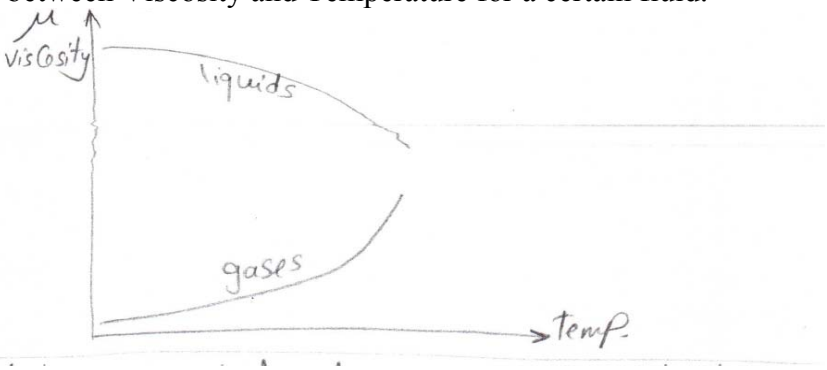
Alexandria Higher Institute of Engineering & Technology (AIET)			
Department of: Industrial		Second Year	2nd Year
ME251	Fluid Mechanics		Midterm-of-Semester-1 Exam, Nov., 24, 2015
Examiners:	Dr. Rola Afify and committee		Time: 1.5 hour

Answer the following questions:

Question one (6 marks)

A) 1. Discuss the relation between Viscosity and Temperature for a certain fluid.



2. Define Kinematic viscosity

* Kinematic viscosity (ν): is defined as the ratio of dynamic viscosity to density

$\nu = \frac{\mu}{\rho}$

$= \frac{Pa.s}{kg/m^3} = \frac{kg.m.s\ m^3}{s^2 m^2 . kg} = (m^2/s)$

stoke $= cm^2/s$

for water

$\nu = 0.01\ cm^2/s$

$= 0.01$ stoke

$= 1$ centistoke

and Vapor pressure of liquids.

* Vapour pressure of liquids ($P_{vap.}$): It is the pressure at which a liquid starts to boil at working temperature.

Boiling temp. increases by increasing pressure on liq. surface

~ ~ decreases ~ decreasing ~ ~ ~ ~

B) Choose the correct answer:

1. The absolute viscosity of a fluid is primarily a function of:
   (a) Density, (b) Temperature, (c) Pressure, (d) Velocity, (e) Surface tension

Ans. (b) Temperature

2. Two parallel plates, one moving at 4 m/s and the other fixed, are separated by a 5-mm-thick layer of oil of specific gravity 0.80 and kinematic viscosity 1.25 *10^{-4} m^2/s. What is the average shear stress in the oil?
   (a) 80 Pa, (b) 100 Pa, (c) 125 Pa, (d) 160 Pa, (e) 200 Pa

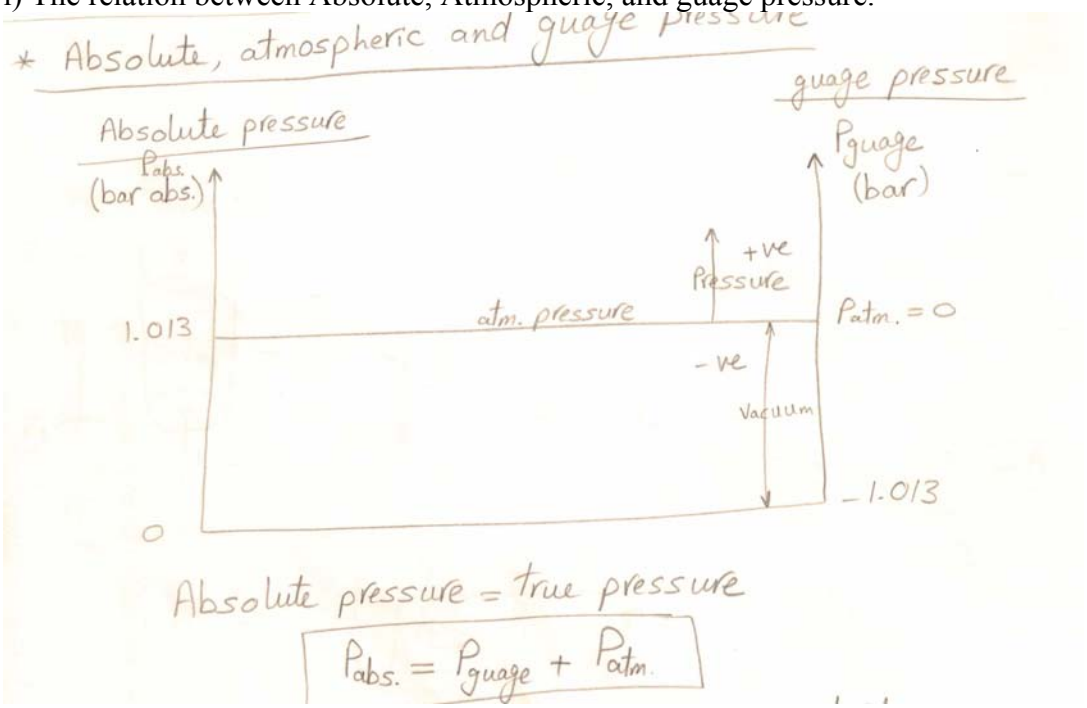
Ans. (a) 80 Pa

$$\tau = \mu\frac{du}{dy} = \upsilon\rho\frac{4}{5x10^{-3}} = 1.25x10^{-4}x0.8x1000x\frac{4}{0.005} = 80Pa$$

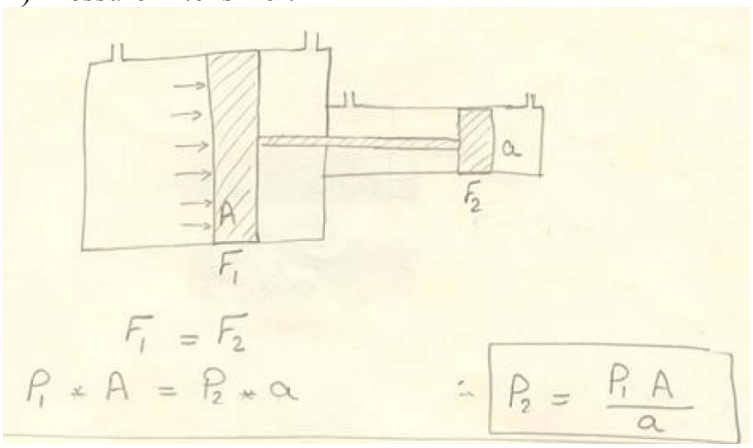
Question two (6 marks)

A) Show using neat sketch of the following:

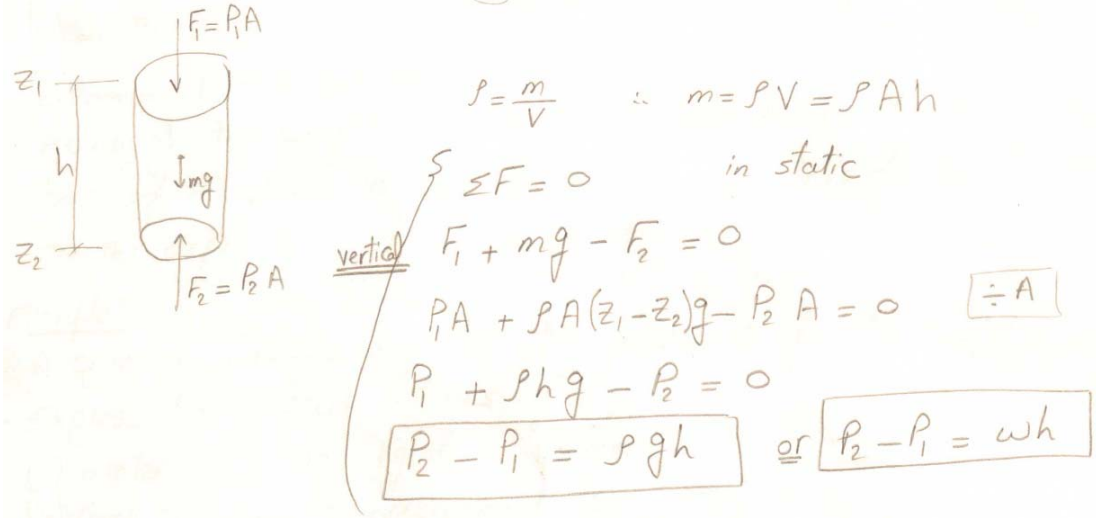
i) The relation between Absolute, Atmospheric, and guage pressure.



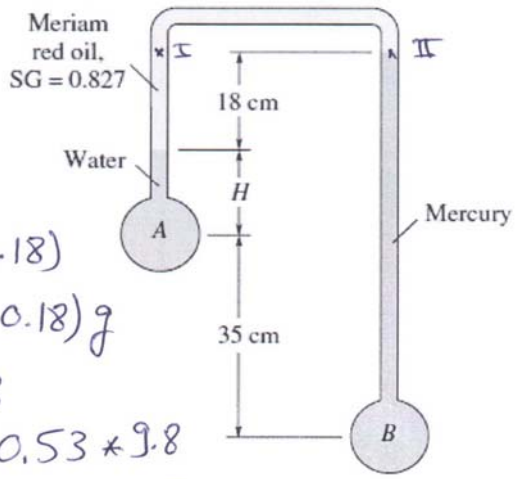
ii) Pressure Intensifier.



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



C) For the inverted manometer shown figure, all fluids are at 20°C. If $P_B - P_A = 97$ kPa, what must the height H be in cm?



$$P_I = P_{II}$$

$$P_A - \rho_w g H - \rho_o g * 0.18 = P_B - \rho_m g (0.35 + H + 0.18)$$

$$\rho_m g H - \rho_w g H = P_B - P_A - \rho_m (0.35 + 0.18) g + \rho_o g * 0.18$$

$$H = \frac{1}{\rho_m g - \rho_w g} [97 * 10^3 - 13600 * 0.53 * 9.8 + 0.827 * 1000 * 9.8 * 0.18]$$

$$= \frac{27820.428}{(13600 - 1000) 9.8} = 0.225 \text{ m}$$

$$= 22.5 \text{ cm}$$

Question Three (8 marks)

A) Differentiate between:-

I. steady and unsteady flow.

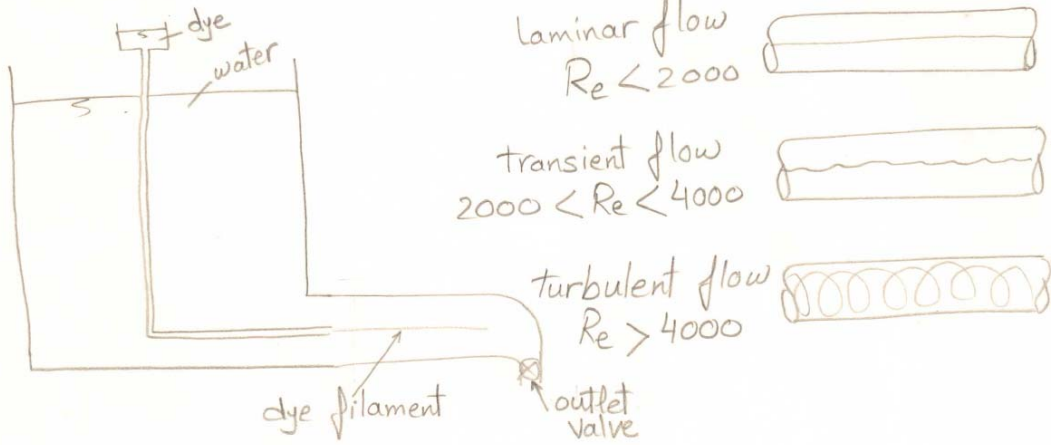
② steady and unsteady flow (with respect to time)
[from time to time)

* steady flow: pressure, velocity, flow rate (flow parameters) are constant with respect to time.

* unsteady flow: any of the flow parameters change with time.

II. Lamina, transient, and turbulent flow.

④ Laminar, transient and turbulent flow



* Laminar flow: (viscous flow, streamline flow)
The particles move in parallel lines (layers).

* Transient flow at which the dye filament begin to oscillate.

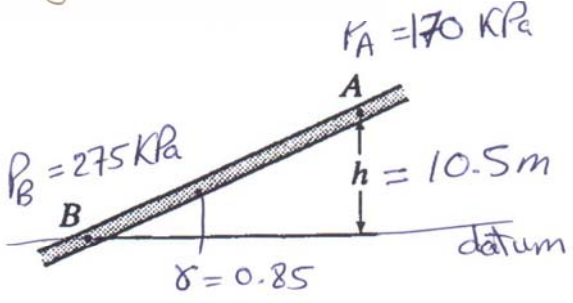
* Turbulent flow the dye color is diffused over the whole cross-section.

$$Re = \frac{\rho V d}{\mu}$$ Reynolds number

B) If h = 10.5 m, as shown in figure, and the pressure at A and B are 170 and 275 kPa respectively. Assume the liquid has a specific gravity of 0.85. Find:-

I. The head loss in meters of liquid.

II. The direction of flow.



Assume the flow from A to B

$$E_A = E_B + h_{loss}\ _{A\to B}$$

$$\frac{P_A}{\omega} + z_A + \frac{V_A^2}{2g} = \frac{P_B}{\omega} + z_B + \frac{V_B^2}{2g} + h_{loss}\ _{A\to B}$$

$z_B = 0$ on datum

same Area
same diameter

$$\frac{P_A - P_B}{\omega} + z_A = h_{loss}\ _{A\to B}$$

$$\frac{(170 - 275)*10^3}{0.85*1000*9.8} + 10.5 = h_{loss}\ _{A\to B}$$

$$-2.105\ m = h_{loss}\ _{A\to B}$$

∴ $h_{loss}\ _{A\to B}$ has to be +ve

then the flow is from B to A

& $h_{loss}\ _{B\to A} = 2.105$ m of liq.

Good Luck 4/4

Dr. Rola Afify