



College of Engineering & Technology

Department: Mechanical Engineering
 Lecturer: Dr. Rola Afify
 Course Code: ME362

Marks: 15
 Time: 9:30 – 10:10
 Date: 27/3/2016

Name: Model Answer

R. N.:

Answer the following questions:

Question one (7 marks)

A) Define:

- Pressure:

It is the Normal force per unit area.

$$P = \frac{F}{A} \quad \text{Its unit is (Pa)}$$

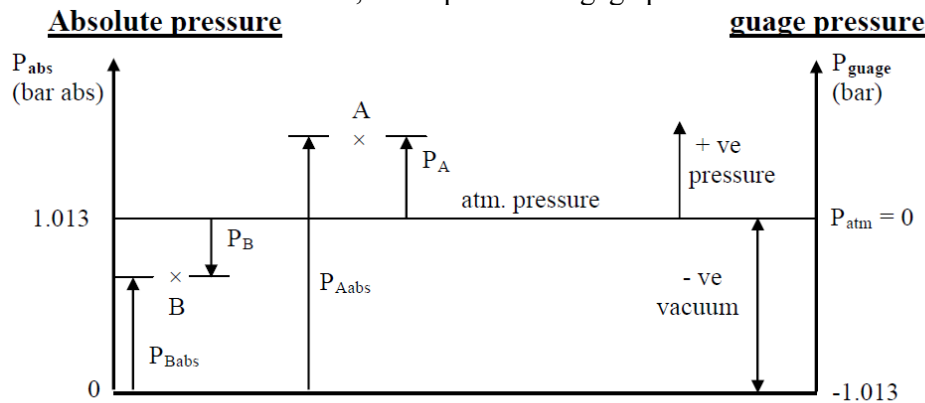
- Pressure Head:

It is the vertical length that can define the pressure.

$$P = \rho g h$$

Its unit is (meter of liquid)

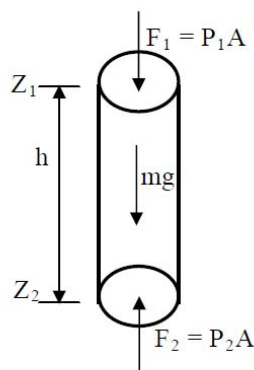
B) State the relation between absolute, atmospheric and gage pressure.



Absolute pressure = true pressure

$$P_{abs} = P_{guage} + P_{atm}$$

C) Prove that the pressure changes in the vertical direction



$$\rho = \frac{m}{V} \quad \therefore m = \rho V = \rho Ah$$

$$\sum F_y = 0 \quad \downarrow +$$

$$F_1 + mg - F_2 = 0$$

$$P_1 A + \rho A (Z_2 - Z_1) g - P_2 A = 0 \quad \div A$$

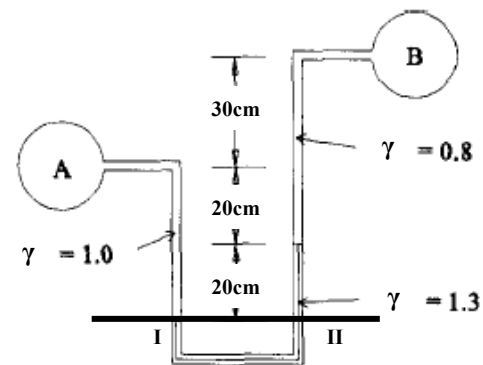
$$P_1 + \rho h g - P_2 = 0$$

$$P_2 - P_1 = \rho g h \quad \text{or} \quad P_2 - P_1 = \omega h$$

D) Inclined U-Tube Manometer measures pressures ranges (**higher than – lower than – the same as**) U-tube manometer.

Question two (8 marks)

A) A manometer is connected between two pipelines, A and B shown in figure. What is the pressure difference between A and B expressed as meters of water?



$$P_I = P_{II}$$

$$P_A + w_A h_1 = P_B + w_{man} h_2 + w_B h_3$$

$$h_1 = 40\text{cm}, h_2 = 20\text{cm}, h_3 = 50\text{cm}$$

$$P_A - P_B = w_{man} h_2 + w_B h_3 - w_A h_1$$

$$P_A - P_B = (1.3 \times 9800) \times (20 \times 10^{-2}) + (0.8 \times 9800) \times (50 \times 10^{-2}) - (1 \times 9800) \times (40 \times 10^{-2})$$

$$\Delta P = P_A - P_B = 2,548 \text{ Pa.s}$$

$$\Delta P = w_{water} h$$

$$h = \frac{\Delta P}{w_{water}} = \frac{2,548}{9800} = 0.26 \text{ m of water} = 26 \text{ cm of water}$$

B) Compare between:

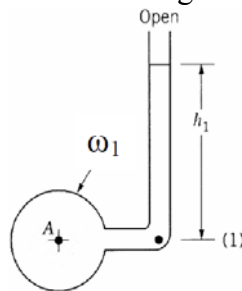
- Piezometer and U-tube manometer with one leg enlarged.

*** Piezometer**

Pressure tube or piezometer

Consists of a single vertical tube

$$P_A = \omega_1 h_1$$



*** U-tube with one enlarged**

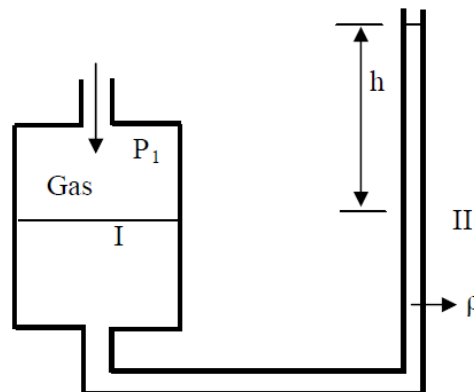
volume = volume

$$A * \ell \ell = a * h$$

$$\ell \ell = \frac{a}{A} * h$$

$$= \frac{\pi}{4} d^2 * h$$

$$\ell \ell = \frac{d^2}{D^2} * h$$



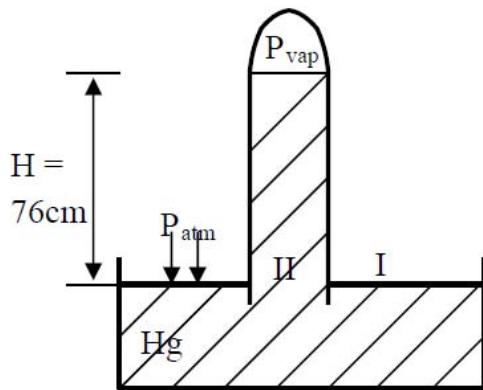
$$P_I = P_{II}$$

$$P_I = \rho g \ell \ell + \rho g h$$

$$= \rho g * \frac{d^2}{D^2} h + \rho g h$$

$$= \rho g h \left(\frac{d^2}{D^2} + 1 \right)$$

- Barometer and Bourdon tube gaug



$$P_{\text{vap}} = 1.7 * 10^{-5} \text{ bar}$$

$$= 1.7 \frac{\text{N}}{\text{m}^2} = 0 \quad \text{neglected}$$

$$P_{\text{I}} = P_{\text{II}}$$

$$P_{\text{atm}} = P_{\text{vap}} + \rho_m g H$$

$$= 13600 * 9.8 * 0.76$$

$$= 1.013 * 10^5 \text{ N/m}^2$$

$$= 1.013 \text{ bar}$$

*** Bourdon tube gauge**

It is used for measuring pressure in almost all ranges except minutely small pressure.

Disadvantages:

- 1 – Need s calibration on dead weight tester
- 2 – Accuracy is less than liquid Columns

