King Abdulaziz University
College of Engineering
Mechanical Engineering
Thermal Engineering & Desalination Tech. Dept.

MEP 365
Thermal Measurements
Fall 2022
HW. # 08
Ch. 9 Pressure measurement

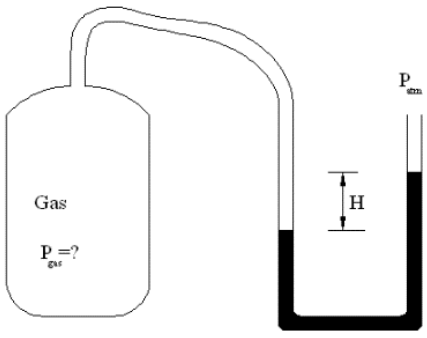
1-If the atmospheric pressure at one location is **95** kPa, how much this pressure is equivalent to in terms of a column of mercury (ρ_{HG}=13600 kg/m^3) or in terms of a column of water (ρ_w=1000 kg/m^3)

2-For what pressure range does the McLeod pressure gauge is used for? How much the expected uncertainty in using this gage?

3-For McLeod pressure device assume the followings are given:
-Manometer fluid used is Mercury ρ_m=13600 kg/m^3.
-Diameter of the measuring leg is d=5 mm
-The length of the mercury in the measuring leg is y=2 cm
-The initial volume of the measuring leg V_1=2.8445 cm^3
Calculate the pressure p_1.
If the smallest scale in reading y is 1 mm, calculate the uncertainty in measuring p_1 as a value and a percentage?

4-Draw a simple sketch for a barometer and explain how atmospheric pressure is measured using this device.

5- A manometer is used to measure the gas pressure in a tank as shown in the figure. The gas density is 1.4 kg/m^3. The manometer fluid is mercury (ρ_m=13600 kg/m^3). If the manometer reading H is **3.5** cm of mercury, what is the absolute pressure in the tank? Take P_{atm}=101.3 kPa.



6- If instead of a straight U tube manometer in problem No. 5, an inclined manometer with θ=30° is used, calculate the length L of the mercury fluid in the inclined manometer leg.

7- Draw a sketch of an inclined manometer. How this manometer is different than the U tube manometer. What is the sensitivity coefficient for the inclined manometer? Show that the static sensitivity of an inclined tube manometer is a factor of 1/sin(θ) higher than for a straight U tube manometer, where θ is the angle of inclination measured from horizontal.

8-List the elemental errors associated with using manometers?

9-Draw a sketch of a Deadweight tester. Explain how this device is used to calibrate a Bourdon pressure gage? For what range of pressures does this device is used?

10-List all types of pressure sensors and draw a sketch of Bellow and Diaphragm types.

11-List all types of secondary pressure transducers used for a diaphragm pressure sensor and draw a sketch where strain gage transducer is used with one pressure sensor.

12-Draw a sketch of voltage divider circuit. If the input voltage is E_i, the output voltage is E_o, the total resistance is R_t, and the divider resistance is R_x, show that the output voltage E_o as a function of E_i, R_t, and R_x to be given by $E_o=E_i(R_x/R_t)$. What will be the output voltage when accounting for voltmeter loading?

13-For a voltage divider circuit shown, the output voltage is measured using a voltmeter that has an internal resistance of R_m. If R_1=2000 Ω, R_2=3000 Ω, E_i=5 V, calculate the output voltage and the loading error for internal resistance R_m of **11,000** Ω, **110,000** Ω, and **1100,000** Ω. What do you conclude?