Lab 1B: Pressure

In this lab experiment, you will measure fluid pressure in a fluid at rest and perform some calculations on the atmospheric pressure in Madison. In general, pressure is defined as *a normal force exerted over a surface, P=F/A.* In fluids, pressure is a scalar quantity and describes the force per unit area in any given direction at a single point.

Learning outcomes:
- Employ a pressure transducer to measure the hydrostatic pressure variation in a water tank
- Recognize the principle of transduction where a measured quantity is converted to an electrical signal
- Identify typical values of atmospheric pressure at ground level and gain an appreciation of its variability

Part A: Fluid pressure in a water Tank

Objective:

Make measurements of fluid pressure at different depths in a water tank at rest.

Procedure:
(1) Ask the TA if the sensor is not functioning. Raise the pole completely out of the water.
(2) Place the pressure transducer into the water and slowly lower it, taking measurements at regular intervals using a yard stick to measure depth.
(3) Read the output (in Volts) from the laptop at different depths. Record the values in the table.

Depth (cm)	Volts (V)	Pressure (Pa)
0		
20		
40		
60		
80		
100		

Questions and analysis:
(1) The pressure transducer converts the energy from fluid pressure into an electrical voltage. From the values in the table, describe in words the relationship between the depth and the voltage output and what characteristics are desirable in this relationship. (5 pts)

(2) Calculate the pressure in Pa for the corresponding depths measured and fill in the last column of the table. Use the physical relation P=γh

(3) Plot the voltage in volts (x-axis) vs pressure in Pa (y-axis) on the graph above. Label axes with correct units. Using your calculator or excel, calculate the linear regression equation that describes the trend. (3 pts)

(4) Compute the error and percent error between your regression equation and your measurements at depth=80cm. How does this compare with the manufacturer specification of +/- 490.5 Pa? (5 pts)

Error = model-known = regression – known
The known values is the pressure from the table @ 80 cm and the regression value is obtained by plugging in the measured voltage @80cm depth into the regression equations.
%Error = Error/known *100

Part B: Atmospheric (air) pressure
Objective:
Understand the variation and units of the atmospheric (barometric) pressure in Madison today

Procedure:
(1) Look up the atmospheric pressure in Madison from two different sources:
https://www.wunderground.com/weather/us/wi/madison (weather underground)
https://www.weather.gov/ (National Weather Service)

Questions:
(1) What are the reported atmospheric pressures from the two sources (inHg)? (2pts)

(2) Convert inHg to psi. (2pts)

Atmosphere pressure reported from Source 1:

Atmosphere pressure reported from Source 2:

(3) Are the reported air pressures the same from the two sources? What might account for the differences? (2 pts)