LAB 1: Density, Specific Gravity, Pressure, Surface Tension, and Viscosity

Lab 1A: Density and Specific Gravity

In this lab experiment, you will measure (i) *density* (ρ), (ii) *specific weight* (γ), and (iii) *specific gravity* (SG = ρ/ρ_{water} = γ/γ_{water}) of different fluids. Density and Specific Gravity are two characteristics of any fluid, important in many engineering design problems:

- *density, ρ, is the amount of mass per unit volume of a substance*
- *specific gravity, SG, is the ratio of a substance's density or specific weight with water*

Given that fluid volume changes with temperature, all experiments will be conducted at "room temperature" (approximately 20˚C).

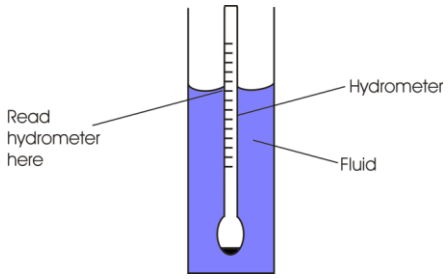
Learning outcomes:

- Employ a hydrometer to measure the specific gravity of multiple fluids
- Use measurements of mass and volume to compute densities of multiple fluids
- Identify potential sources of error and uncertainty in measurements of fluid density

Part A: Hydrometers

Objective:

Measure the specific gravity of multiple fluids using a hydrometer and determine the density and specific weight.



Procedure:

(1) Water, salt water, and oil are provided in the cylinders
(2) Place a hydrometer in each cylinder and record the ***specific gravity*** from the scale. *(Keep the oil hydrometer separate from other fluids).*
(3) Record the readings in the table below:

Fluids	Water	Salt Water	Oil
Reading			

Questions and analysis:

(1) Fill in the table with the **measured** density, specific weight, and SG of each fluid? Use the accepted value for water density at room temperature to be 998 kg/m^3 for your calculations. (5 pts)

Fluids	Water	Salt Water	Oil
Density			
Specific Weight			

(2) Explain the principle of hydrometers. How are they used to determine densities? Give an example of a situation in which you (an engineer) might need to use a hydrometer. (5 pts)

Part B: Weight and Volume

Objective:

Obtain independent measurements of ρ, γ, and SG for the fluids from part A using measurements of mass and volume

Procedure:

(1) Mass a small dry beaker for each fluid measurement.
(2) Fill the beaker with a known volume of liquid from Part A, measured in a graduated cylinder. Measure the total mass of the fluid in the beaker.
(3) Calculate ρ, γ, and SG for each of the three fluids.

	Water	Salt Water	Oil
Empty beaker mass			
Volume			
Total mass			
Fluid mass			
ρ			
γ			
SG			

Questions and analysis:

(1) Compute the values of ρ, γ, and SG for each fluid from measurements of mass and volume and fill the table above (5 pts)
(2) Compare the values of SG for each fluid from Part A (hydrometer) and Part B (mass and volume). Comment on the similarities and differences of the values. Why do you expect the values to compare well and why might they be different? (5 pts)

(3) What could you do to decrease the difference between the measured values from Part A and Part B? Give two reasons. (5 pts)