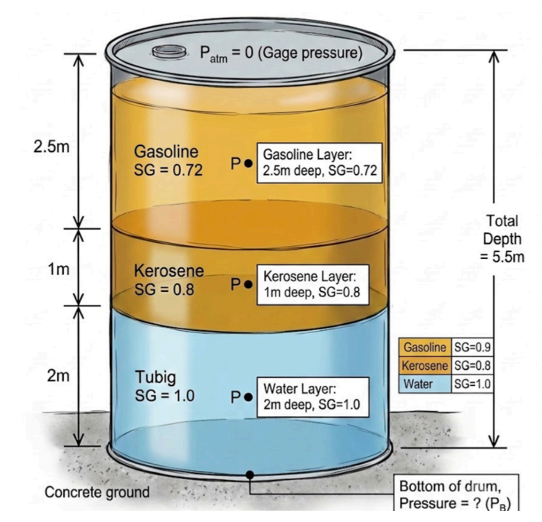
In fluid mechanics, computing the pressure exerted by a fluid at rest relies on the principles of **hydrostatics**. The fundamental hydrostatic equation states that the variation of pressure (P) with depth (h) in a continuous, incompressible fluid is linear and depends entirely on the specific weight (γ) of the fluid. This is expressed mathematically as:

$$P = \gamma h = \rho \frac{g_o}{g_c} h$$

Where ρ represents the mass density and g_o is the acceleration due to gravity and g_c is the proportionality constant. When multiple immiscible fluid layers (fluids that do not mix, such as oil and water) are stacked on top of each other inside a vessel, they naturally arrange themselves according to their densities—the heaviest fluid settles at the bottom, while the lightest floats at the top.

Because pressure is a scalar quantity and acts downward cumulatively, the total pressure at any depth is the sum of the pressures exerted by each individual fluid layer situated above that point, plus any external pressure acting on the surface. When a container is specified as "exposed to the atmosphere," we compute the **gage pressure**, meaning the baseline atmospheric pressure at the open surface is treated as zero (P_{atm} = 0).

<u>Step 1:</u> Before proceeding to the computation, we must analyze the arrangement of the fluids provided in the problem statement text and the attached handwritten illustration:



Gasoline: h_1 = 2.5 m, SG_1 = 0.72

Kerosene: h_2 = 1 m, SG_2 = 0.8

Water: h_3 = 2 m, SG_3 = 1.0

<u>Step 2:</u> Standard Hydrostatic Formula

The total gauge pressure at the bottom of a multi-fluid tank exposed to atmospheric pressure (P_{atm} = 0) is equal to the sum of the pressures exerted by each individual fluid column:

$$P_{Bottom} = P_{Gasoline} + P_{Kerosene} + P_{Water}$$

<u>Step 3:</u> Calculate the pressure from each liquid layer

- **Gasoline pressure contribution:**

$$P_{Gasoline} = \left(9.81\ \frac{kN}{m^3}\right)(0.72)(2.5) \ = \ 17.658\ kPa$$

- **Kerosene pressure contribution:**

$$P_{Kerosene} = \left(9.81\ \frac{kN}{m^3}\right)(0.80)(1.0) \ = \ 7.848\ kPa$$

- **Water pressure contribution:**

$$P_{Kerosene} = \left(9.81\ \frac{kN}{m^3}\right)(1.0)(2.0) \ = \ 7.848\ kPa$$

<u>Step 4:</u> Sum the component pressures together

$$P_{Bottom} = 17.658\ kPa + 7.848\ kPa + 7.848\ kPa$$

$$P_{Bottom} = 45.126\ kPa$$

When civil or mechanical engineers design industrial storage facilities or fuel farm containers, they cannot simply design for the volumetric limit. They must determine the maximum potential hydrostatic pressure at the base to specify the correct wall thickness and plate welding strengths needed to prevent structural rupture.