Homework 5 - Aidan Sharpe

1

If the specific weight, γ, of a substance is 8.2[kN/m^3], what is its mass density, ρ, in kg/m^3?

On Earth, 9810[kg] weighs 1[kN], so an object that weighs 8.2[kN] will have a mass of 80442[kg]. Therefore, $\rho = 80442$[kg/m^3].

2

A fluid flowing between two parallel plates has a viscosity, $\mu = 0.62$[Ns/m^2], and density, $\rho = 1250$[kg/m^3]. Calculate the intensity of shear stress, τ, in pascals at $y = 3$[cm], assuming a straight-line viscosity distribution, given that the top plate has a velocity of 100[cm/s] and the fluid is 6[cm] thick.

Velocity at $y = 3$[cm]:

$$\tau = \mu \frac{du}{dy} = 0.62 \left(0.03 \times \frac{1}{0.06} \right) = 0.31[\text{Pa}]$$

3

A cube with side length 10[cm] is placed into two different liquids. In the first liquid, the top of the cube is $h_1 = 1$[cm] above the surface. In the second liquid, the top of the cube is h_2 above the surface. If the densities of the liquids are known to be $\rho_1 = 1000$[kg/m^3], and $\rho_2 = 1300$[kg/m^3] respectively, find h_2.

Displaced mass for liquid 1, same as mass of cube:

$$0.1 \times 0.1 \times (0.1 - 0.01) \times 1000 = 0.9[\text{kg}]$$

Displaced mass for liquid 2:

$$0.1 \times 0.1 \times (0.1 - h_2) \times 1300 = 0.9$$

$$\therefore h_2 = 0.031[\text{m}] = 3.1[\text{cm}]$$