LECTURE 2-PROPERTIES OF FLUID

SELF EVALUATION QUESTIONS AND ANSWERS

1.A tank trunk contains 125000 liters of hydraulic fluid having a specific gravity of 0.9. Determine the fluid's specific weight, density and weight.

2. At a depth of 8 km in the ocean the pressure is 81.8 MPa. Assuming that the specific weight of seawater at the surface is 10.05 $\mathrm{kN/m^3}$and that the average volume modulus is $2.34\times10^9\mathrm{N/m^2}$for that pressure range.(a) What will be the change in specific volume between that the surface and at that depth? (b) What will be the specific volume at that depth? (c) What will be the specific weight at that depth?

3 A vessel contains 85L of water at 10℃ and atmospheric pressure. If water is heated to 70℃, what will be the percentage change in its volume? What weight of water must be removed to maintain the volume at its original value?

Take $\gamma_{10} = 9.804kN/m^3 \gamma_{70} = 9.589\,kN/m^3$

QUESTION 1 - Solution

$$volume(V) = 12500L = 125m^3$$

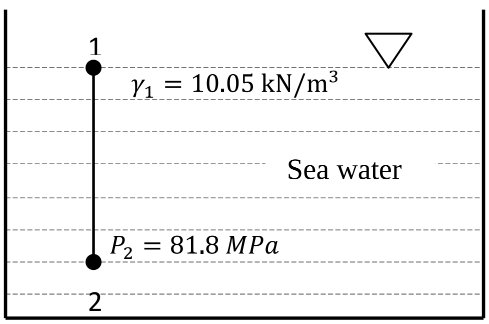
$$Sp.gravity = \frac{\rho_{hydraulic\ fluid}}{\rho_{water\ at\ standard\ temperature}} = 0.9$$

$$Mass\ Density\ of\ fluid\ (\rho_{hydraulic\ fluid}) = 900kg/m^3$$

$$Sp.weight(\gamma) = \rho_{hydraulic\ fluid} * g = 8829N/m^3$$

$$Weight(w) = \gamma * V = 8829x125 = 1103625\ N = 1103.6\ \text{kN}$$

QUESTION 2- Solution



Q2

$$a) \quad v_1 = \frac{1}{\rho_1} = \frac{g}{\gamma 1}$$

$$= \frac{9.81}{10050} = 0.000976\text{m}^3/\text{kg}$$

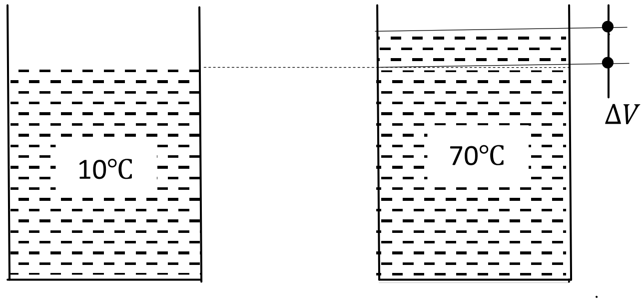
$$\Delta v = -0.000976(81.8\text{x}106 - 0)/(2.34\text{x}109)$$

$$= -34.1 \times 10 - 6m^3/kg$$

$$b) \quad v_2 = v_1 + \Delta v = 0.000942\ m^3/kg$$

$$c) \quad \gamma_2 = g/v_2 = 9.81/0.000942 = 10410\ N/m^3$$

QUESTION3- Solution



$\boldsymbol{V_{10}} = \mathbf{85}\boldsymbol{L}$ $\boldsymbol{V_{70}}$ =?

Q3

Volume, $V_{10} = 85L = 0.085\text{m}^3$

$\gamma_{10} = 9.804kN\ /m^3\gamma_{70} = 9.589\ kN\ /m^3$

$Weight\ of\ water, W\ = \gamma V\tilde{V} = \gamma_{10}\, V_{10}\tilde{V} = \gamma_{70}\tilde{V}V_{70}\tilde{V}$

$9.804(0.085) = 9.589\ \tilde{V}V_{70}$

$V_{70}\tilde{V} = 0.08691\ \text{m}^3$

$\Delta\tilde{V}V\ = V_{70}\tilde{V} - V_{10} = 0.08691 - 0.08500 = 0.001906m^3\ at\ \gamma_{70}$

$$\frac{\Delta\tilde{V}V\ \tilde{V}}{V_{10}} = \frac{0.001906}{0.085} = 2.24\%\ \text{increase}$$

Must remove (at γ_{70}):

$$\left(\text{W}\frac{\Delta\tilde{V}V\ \tilde{V}}{V_{10}}\right) = \gamma_{70}\Delta\tilde{V}V = (9589N/m3)(0.001906\ m3)$$

$= 18.27\ N$