Omar Ebrahim 1100765 75 Assignment 2

1) Given: SG = 3 $\rho_w = 998\ kg/m^3$

Rts: gage Pressures at A, B, C, D P_A, P_B, P_C, P_D

$P_A = \rho_w g h_A = 998(9.81)(1+1+2+1) = 48951.9\ Pa$

$P_B = \rho_w g h_B = 998(9.81)(1+1+2) = 39161.52\ Pa$

$P_C = P_B - \rho_{air} g h_c \simeq 39161.52\ Pa$ (negligible)

$P_D = P_C + \rho_l g h_D = 39161.52 + (3 \times 998)(9.81)(2)$

$= 97903.8\ Pa$

∴ The Pressure at A is 48951.9 Pa

∴ The Pressure at B is 39161.52 Pa

∴ The Pressure at C is 39161.52 Pa

∴ The Pressure at D is 97903.8 Pa

2) Given: $\rho_w = 998\ kg/m^3$ $\rho_{Hg} = 13550\ kg/m^3$

Rtf: Pressure difference $P_A - P_B$

$\gamma_{oil} = (0.8)(9790) = 7832\ N/m^3$

$\gamma_m = 133100\ N/m^3$

$\gamma_w = 9790\ N/m^3$

$P_B + \gamma_w h_1 + \gamma_m h_2 - \gamma_{oil} h_3 = P_A$

$P_A - P_B = (9790)(0.18) + (133100)(0.22-0.08)$
$- (0.8 \times 9790)(0.16) = 19143.08\ Pa$

∴ The pressure difference is 19143.08Pa

3) Given: $g = 3.71\ m/s^2$ $R_{CO_2} = 189\ \frac{J}{kg\,K}$

$P = 700\ Pa$ $T = T_0 e^{-Cz}$ $C = 1.3 \times 10^{-5}\ m^{-1}$ $T_0 = 250\ K$

a) $$\int_1^2 \frac{dP}{P} = \ln\frac{P_2}{P_1} = -\frac{g}{R}\int_1^2 \frac{dz}{T} = -\frac{g}{R}\int_0^z \frac{dz}{T_0 e^{-Cz}}$$

$$= -\frac{g}{RT_0C}(e^{Cz} - 1) = P_0 e^{-\frac{g}{RT_0C}(e^{Cz}-1)}$$

b) Rtf: altitude where Pressure is 1 Pa z

$$P = P_0 e^{-\frac{g}{RT_0C}(e^{Cz}-1)}$$

$$1 = (700)\, e^{-\frac{3.71}{(189)(250)(1.3\times10^{-5})}\left(e^{(1.3\times10^{-5})z} - 1\right)}$$

$$\ln\frac{1}{700} = -6.55 = -6.04\left[e^{(1.3\times10^{-5})z} - 1\right]$$

$$z = \frac{\ln\left(\frac{-6.55}{-6.04} + 1\right)}{1.3\times10^{-5}} = \underline{56500\ m}$$

∴ The altitude is 56500m

4) Given: $\rho_w = 998\ kg/m^3$ $\rho_{Hg} = 13550\ kg/m^3$

$\rho_{air} = 1.2\ kg/m^3$ Req: Gage Pressure at A P_A

$\gamma_w = 9790\ N/m^3$ $\gamma_{Hg} = 133100\ N/m^3$ $\gamma_{air} = 12\ N/m^3$

$P_{atm} \quad \gamma_{oil} h_1 - \gamma_{Hg} h_2 - \gamma_{air} h_3 + \gamma_w h_4 = P_A$

$P_A = P_{atm} + (0.85)(9790)(0.4)$

$- (133100)(0.15) - (12)(0.3)$

$+ (9790)(0.45) = -12200\ Pa + P_{atm}$ (vacuum)

$\because -12200 < P_{atm}$ $\therefore$ It is a Vacuum Pressure

$\therefore$ The Pressure at A is -12200 pa and The pressure is lower than P_{atm}