

Fluid Mechanics Hw 1.2 Ben Smithson

3.6 Absolute pressure will always be greater than gage pressure. True because the formula is $Gage = absolute - atmospheric$
 $G = ab - atm$

3.7 As long as you ^{stay} on the surface of Earth, the atmospheric pressure will be 14.7 psia. True because sea level pressure = 14.7 psia.

$$P_{atm} = 14.7 \text{ psia}$$

3.8 The pressure in a certain tank is -53.6 Pa (abs). False because pressure cannot be negative in its value.

$$-53.6$$



$$P_{\text{gage}} = -4.65 \text{ psig}$$

$$P_{\text{atm}} = 14.7 \text{ psia}$$

$$P_{\text{abs}} = P_{\text{gage}} + P_{\text{atm}}$$

$$P_{\text{abs}} = -4.65 \text{ psig} + 14.7 \text{ psia}$$

$$P_{\text{abs}} = 10.05 \text{ psi}$$

*TRUE. The absolute pressure is above 0, therefore the gauge pressure obtainable.

3.10



$$P_{\text{gage}} = -175 \text{ kPa (gage)}$$

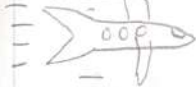
$$P_{\text{atm}} = 101 \text{ kPa}$$

$$P_{\text{abs}} = -175 \text{ kPa} - 101 \text{ kPa}$$

$$P_{\text{abs}} = -74 \text{ kPa}$$

*FALSE! Absolute Pressure cannot be below 0, therefore the gauge pressure cannot be achieved.

3.11



Gage?

$$\Delta P = \gamma_{\text{air}} h$$

$$P_{\text{gage}} = \Delta P - P_{\text{atm}}$$

$$P_{\text{atm}} = 14.7 \text{ psi}$$

$$4,000 \text{ ft} = h \left(\frac{12 \text{ in}}{1 \text{ ft}} \right) = 48,000 \text{ in}$$

$$\gamma_{\text{air}} = \frac{0.0765 \text{ lb}}{\text{ft}^3} \left(\frac{1 \text{ ft}}{12 \text{ in}} \right)^3 = 4.43 \times 10^{-5} \text{ lb/in}^3$$

$$\Delta P = 4.43 \times 10^{-5} \text{ lb/in}^3 (48,000 \text{ in})$$

$$\Delta P = 2.13 \text{ psi}$$

$$P = 14.7 \text{ psi} - 2.13 \text{ psi}$$

$$P = 12.57 \text{ psi}$$

HW 1.2

01/25/2024
Group 6
Angela Sicaja

3-13

What is the pressure at the surface of a glass of milk?



$$P_{\text{absolute}} = P_{\text{gage}} + P_{\text{atm}}$$

$$P_{\text{absolute}} = P_{\text{atm}}$$

$$P_{\text{gage}} = P_{\text{atm}} - P_{\text{atm}} = 0 - 0$$

$$P_{\text{atm}} = 0 \text{ gage}$$

$$P_{\text{gage (milk)}} = 0 \text{ (gage)}$$

3-41

$$h = 12.0 \text{ m}$$

$$T = 25^\circ\text{C}$$

$$P = ?$$

$$\text{sg (Ethylene glycol)} = 1.13$$

$$\rho_{\text{water}} = 1000 \text{ kg/m}^3$$

$$P = \rho_{\text{EG}} g h$$

$$\text{sg} = \frac{\rho_{\text{EG}}}{\rho_{\text{w}}}$$

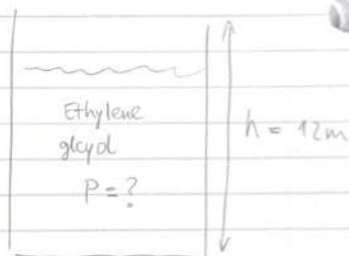
$$\rho_{\text{EG}} = \text{sg} \cdot \rho_{\text{w}}$$

$$\rho_{\text{EG}} = 1.13 \cdot 1000 \text{ kg/m}^3$$

$$\rho_{\text{EG}} = 1130 \text{ kg/m}^3$$

$$P = 1130 \text{ kg/m}^3 \cdot 9.81 \text{ m/s}^2 \cdot 12 \text{ m}$$

$$P = 133024 \text{ Pa} = 133.024 \text{ kPa}$$



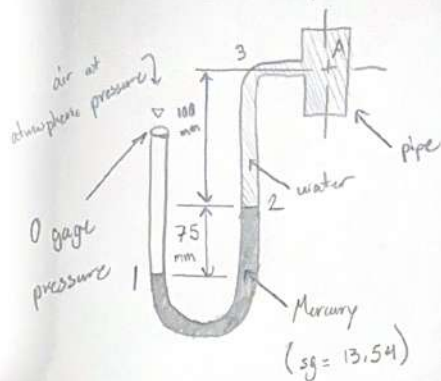
1/24/2024 Pg 1

MET 330

HW 1.2

3.62) Water is in the pipe shown.

Calculate the pressure at point A in kPa (gage)



$$100 \text{ mm} = 0.1 \text{ m}$$

$$75 \text{ mm} = 0.075 \text{ m}$$

$$\Delta p = \gamma h$$

$$P_1 - \gamma_{\text{mercury}}(0.075 \text{ m}) - \gamma_{\text{water}}(0.175 \text{ m}) = P_A$$

$$P_A = P_1 - \gamma_{\text{mercury}}(0.075 \text{ m}) - \gamma_{\text{water}}(0.175 \text{ m})$$

$$P_1 = P_{\text{atm}} = 0 \text{ Pa (gage)}$$

$$\begin{aligned} \gamma_{\text{mercury}} &= (sg_{\text{mercury}})(9.81 \text{ kN/m}^3) \\ &= (13.54)(9.81 \text{ kN/m}^3) \\ &= 132.8 \text{ kN/m}^3 \end{aligned}$$

$$\gamma_{\text{water}} = 9.81 \text{ kN/m}^3$$

$$\text{kN/m}^2 = \text{kPa}_{\text{gage}}$$

$$P_A = (0 \text{ Pa}_{\text{gage}}) - (132.8 \text{ kN/m}^3)(0.075 \text{ m}) - (9.81 \text{ kN/m}^3)(0.175 \text{ m})$$

$$P_A = (0 \text{ Pa}_{\text{gage}}) - (9.96 \text{ kN/m}^2) - (1.72 \text{ kN/m}^2)$$

$$P_A = -11.68 \text{ kN/m}^2$$

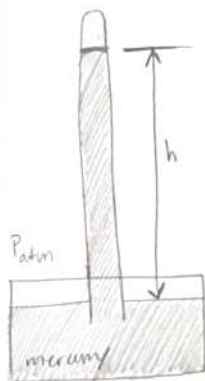
$$P_A = -11.68 \text{ kPa}_{\text{gage}}$$

1/24/2024 Pg 2

MET 330

HW 1.2

3.83) What would be the reading of a barometer in inches of mercury corresponding to an atmospheric pressure of 14.2 psia?



$$0 + \gamma_m h = P_{atm}$$

$$P_{atm} = \gamma_m h$$

$$h = \frac{P_{atm}}{\gamma_m}$$

$$h = \frac{14.2 \text{ lb/in}^2}{\left(\frac{848.7 \text{ lb}}{1728 \text{ in}^3} \right)}$$

$$\text{psia} = \frac{\text{lb}}{\text{in}^2}$$

$$P_{atm} = 14.2 \text{ psia}$$

$$\gamma_m = 848.7 \frac{\text{lb}}{\text{ft}^3}$$

$$\left(\frac{848.7 \text{ lb}}{\text{ft}^3} \right) \left(\frac{\text{ft}^3}{1728 \text{ in}^3} \right)$$

↓

$$\gamma_m = \frac{848.7 \text{ lb}}{1728 \text{ in}^3}$$

$$= \left(14.2 \frac{\text{lb}}{\text{in}^2} \right) \left(\frac{1728 \text{ in}^3}{848.7 \text{ lb}} \right)$$

$$= 14.2 \left(\frac{1728 \text{ in}}{848.7} \right)$$

$$h = 28.91 \text{ in}$$

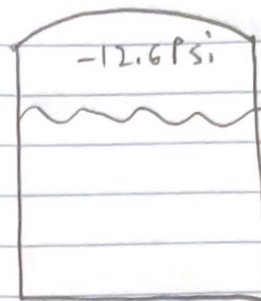
3.90)

$$P = -12.6 \text{ PSI}$$

From textbook

$$1.0 \text{ inHg} = 0.491 \text{ PSI}$$

$$-12.6 \text{ PSI} \left(\frac{1 \text{ inHg}}{0.491 \text{ PSI}} \right) = -25.67 \text{ inHg}$$



3.94) $P = 160 \text{ kPa}$

From table
 $\gamma_w = 9.81 \frac{\text{KN}}{\text{m}^3}$

$$\Delta P = \gamma h$$

$$P = \gamma_{\text{water}} h$$

$$h = \frac{P}{\gamma_{\text{water}} @ 4^\circ \text{C}}$$

$$h = \frac{160 \text{ kPa}}{9.81 \frac{\text{KN}}{\text{m}^3}} = \frac{160 \frac{\text{KN}}{\text{m}^2}}{9.81 \frac{\text{KN}}{\text{m}^3}} \rightarrow h = 16.3 \text{ M}$$

