Fluid Mechanics HW #2

Ch3

(6.) The value for the absolute pressure will always be greater than that for the gage pressure. TRUE

(7) As long as you stay on the surface of Earth, the atmospheric pressure will be 14.7 psia. False

→ The pressure will be different when you travel from a coastal city (14.7 psi) to a mountain town (10 psi).

(8)/(9.) The pressure in a certain tank is −55.8 Pa (abs).
False → An absolute pressure will always be positive because a perfect vacuum is the lowest possible pressure.

(10.) The pressure in a certain tank is −150 kPa (gage).
False → the lowest possible pressure is −101 kPa (gage).

(11.) If you were to ride in an open-cockpit airplane to an elevation of 4000 ft above sea level, what would the atmospheric pressure be if it conforms to the standard atmosphere?

$\Delta p = \gamma h$ $\quad h = 4000\,ft$, $\gamma = 12.01\ N/m^3$ [Appendix E]

$\Delta p = 12.01 \frac{N}{m^3} (1219.1405\,m)$ $\quad 3.281\,ft = 1\,m$ [Appendix K]

$\Delta p = 14641.8774\ N/m^2$ $\quad 4000\,ft \cdot \frac{1\,m}{3.281\,ft} \approx 1219.1405\,m$

$p_{atm} = 14.7\,psia$, 101 kPa (absolute)

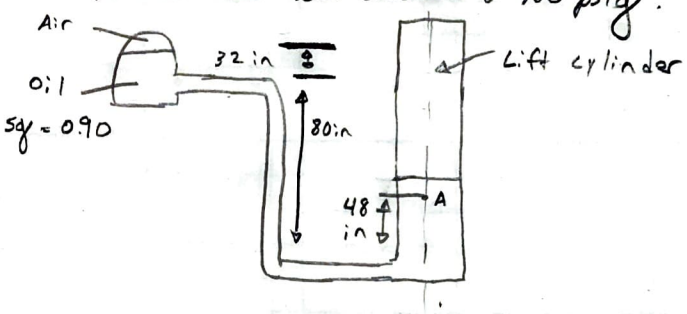
$\Delta p = 101{,}000\,Pa - 14641.8774\,Pa = 86{,}358.1226\,Pa$

86.36 kPa (absolute)

(13.) Expressed as a gage pressure, what is the pressure at the surface of a glass of milk?

0 Pa (gage)

(41.) The figure shows a diagram of the hydraulic system for a vehicle lift. An air compressor maintains pressure above the oil in the reservoir. What must the air pressure be if the pressure at point A must be at least 180 psig?



$\Delta p = \gamma h$

$\Delta p = 8.829\ kN/m^3\ (1.6256 m)$

$\Delta p = 14.3524\ kN/m^2$

$h = 80 in - 48 in + 32 in$

$= 64 in = 1.6256 m$

$Sg = \frac{\gamma oil}{\gamma water\ @\ 4°C}$ (Appendix A)

$\gamma oil = Sg\ (\gamma water\ @\ 4°C)$

$= 0.90\ (9.81 kN/m^3)$

$= 8.829\ kN/m^3$

$P_A = 180 psig$

$= 1241.0563 kPa (gage)$

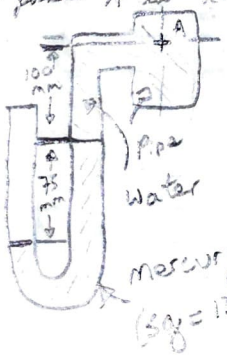
$P_A - \Delta p = P_{Air}$

$1241.0563 kPa - 14.3524 kPa$

$P_{Air} = 1226.7039 kPa (gage)$

1226.70 kPa (gage)

(62) Water is in the pipe shown. Calculate the pressure at point A in kPa (gage).



$\Delta p = \gamma h$

$\Delta p = 132.8274 \frac{kN}{m^2} (0.075 m)$

$= 9.9621 kN/m^2$

$\Delta p = 7.81 \frac{kN}{m^2} (0.1 m)$

$= 0.981 kN/m^2$

$Sg = \frac{\gamma mercury}{\gamma water\ @\ 4°C}$ (Appendix A)

$\gamma mercury = 13.54 (9.81 \frac{kN}{m^3})$

$\gamma mercury = 132.8274 \frac{kN}{m^3}$

$(-9.9621 kPa) + (-0.981 kPa)$

$= -10.9431 kPa$ (gage)

(83.) A barometer indicates the atmospheric pressure to be 30.65 in of mercury. Calculate the atmospheric pressure in psia.

$p_{atm} = \gamma_m h$

$\gamma_{mercury} = 848.7\ \#/ft^3$

$p_{atm} = 848.7\frac{\#}{ft^3}(2.5542\ ft)$ $\quad h = 30.65\ in\left(\frac{1\ ft}{12\ in}\right)$

$p_{atm} = 2167.7495\ \#/ft^2 \approx 2.5542\ ft$

$= 2167.75\ \#/ft^2$

$= \boxed{15.0538\ psia}$

(90.) The pressure in a vacuum chamber is -68.2 kPa. Express the pressure in mm Hg.

$p = \gamma h$ $\quad \gamma_{mercury} = 133.3\ kN/m^3$

$-68.2\ kPa = 133.3\frac{kPa}{m}\ h$

$\frac{-68.2\ kPa}{133.3\ kPa/m} = h$

$h = -0.5116\ m = \boxed{-511.63\ mm\ Hg}$

(94.) A passive solar water heater is to be installed on the roof of a multi-story building. The heater tank is open to atmospheric pressure and is mounted 16 m above the ground level. If in the [illegible] (gas-flowing [illegible]), what gage pressure, in kPa, must the plumbing line be designed to withstand if it is connected all the way down to ground level?

$\Delta p = \gamma h$ $\quad \gamma = 9.81\ kN/m^3$ [Appendix A]

$\Delta p = 9.81\ kN/m^3(16\ m)$ $\quad h = 16\ m$

$\Delta p = \boxed{156.96\ kPa\ (gage)}$