MET330
Group 5

3.6) The value for the absolute pressure will always be greater than that for gage pressure.

TRUE $P_{abs} = P_{gage} + P_{ATM}$

P_{ATM} is always positive

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

FALSE P_{atm} depends on height above sea level. The P_{atm} in Denver, CO is lower than P_{atm} in Norfolk, VA

3.8) The pressure in a certain tank is −55.8 Pa (abs)

FALSE P_{abs} can not be below zero. Zero absolute pressure is a perfect vacuum.

3.9) The pressure in a tank is −4.65 psig.

TRUE $P_{abs} = 14.7\,psia - 4.65\,psig$

$P_{abs} > 0$

3.10) The pressure in a tank is −150 kPa (gage)

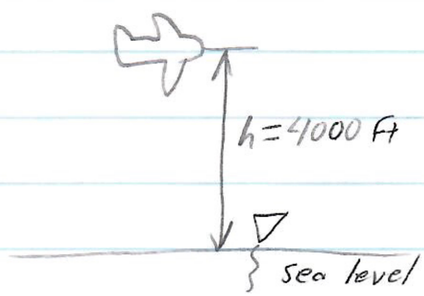
FALSE $P_{abs} = 101.3\,kPa(atm) - 150\,kPa\,(gage)$

$P_{abs} < 0$ which is not possible.

3.11) If you were to ride in an open cockpit airplane at an elevation of 4000 ft above sea level, what would P_{atm} be?

Purpose) Compute the atmospheric pressure at 4000 ft

Drawing)



Data) Fluid = air

h = elevation above sea level = 4000 ft

Procedure) We will solve this problem by referencing the air properties table in the back of the book. Appendix E / Table E.3

@ 4000 ft, $\boxed{P_{atm} = 12.7 \text{ psia}}$

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

At any fluid surface that is open to atmosphere,

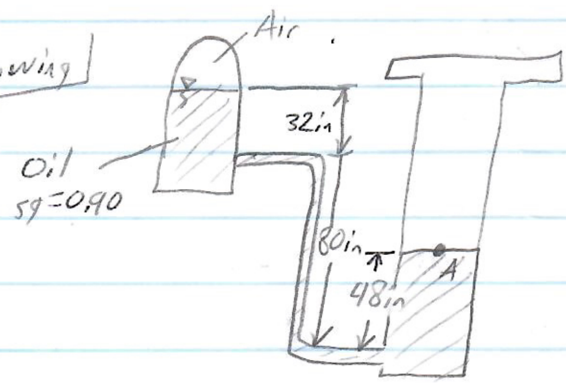
$P_{abs} = P_{atm}$

$P_{gage} = P_{abs} - P_{atm}$ so $\boxed{P_{gage} = 0}$

3.41) The figure shows an elevated tank that is used to pressurize a lift cylinder. Calculate P_{air} to make $P_A = 180_{psig}$.

Purpose | Compute the required air pressure.

Drawing |



Design Considerations | Incompressible fluid
Isothermal process

Data + Variables | $sg(oil) = 0.90$
$P_a = 180\ psig$
$h =$ from drawing

Procedure | Move from P_A to P_{air} with the equation
$\Delta P = \gamma h$.

Calcs | $P_A = \gamma(-4.0ft) + \gamma(6.66ft) + \gamma(2.66ft) + P_{air}$

$\gamma_{oil} = 0.90 \cdot \gamma_{water} = 0.90 \cdot 62.4 \frac{lb}{ft^3} = 56.2\ lb/ft^3$

Plug in values:

$180_{psig} = 56.2\ lb/ft^3(-4.0ft + 6.66ft + 2.66ft) + P_{air}$

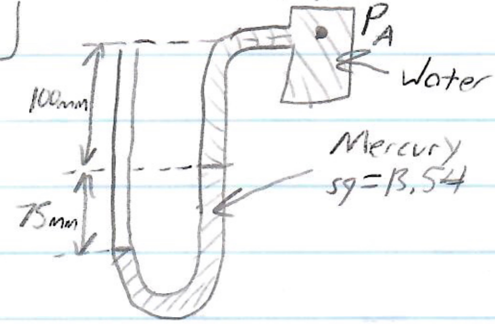
$180_{psig} = 56.2\ lb/ft^3 \cdot 5.33ft + P_{air}$

$180 - 299.5\ lb/ft^2\left(\frac{1ft^2}{144in^2}\right) = \boxed{P_{air} = 177.9\ psig}$

3.62) Water is shown in a pipe, Calculate P_A in kPa(gage)

Purpose) Compute the gage pressure of P_A

Drawing)



Design Considerations) Incompressible and isothermal

Data and variables) sg(Hg) = 13.54

Distances in drawing

Procedure) Trace from P_A to P_{ATM} with $\Delta p = \gamma h$

Calculations)

$$P_A + \gamma_{water}(0.1m) + \gamma_{Hg}(0.075m) = P_{atm} = 0\ kPa(gage)$$

$$P_A + 9.81\frac{kN}{m^3}(0.1m) + (13.5)(9.81\frac{kN}{m^3})(0.075m) = 0$$

$$P_A + 0.981\ kPa + 9.93\ kPa = 0.$$

$$\boxed{P_A = -10.91\ kPa\ (gage)}$$

Summary) The pressure at P_A = -10.91 kPa (gage)

Analysis) The water pressure at P_A is less than Patm.

3.83) A barometer indicates P_{atm} to be equal to 30.65 in of mercury. Calculate the P_{atm} in psia.

Procedure) Use $P_{atm} = \gamma_{hg} h$ to solve

$\gamma_{hg} = 848.7 \, lb/ft^3$

Calcs) $P_{atm} = 848.7 \frac{lb}{ft^3} \cdot 30.65 \, in \cdot \frac{1 ft^3}{1728 in^3}$

$$P_{atm} = 15.05 \, psia$$

3.90) The pressure in a vacuum chamber is -68.2 kPa. Express this in mm Hg.

Procedure) Use $P_{gage} = \gamma_{hg} h$ to solve

$\gamma_{hg} = 133.3 \, kN/m^3$

Calcs) $h = \frac{-68.2 kPa}{133.3 \frac{kN}{m^3}} = 0.511 m$

$h = -0.511 m \left(\frac{1000 mm}{1 m} \right)$

$$h = -511 \, mm$$

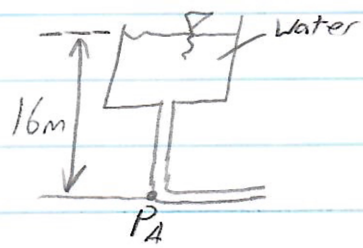
3.94] A solar heater is to be installed on the roof of a building. The tank is open to atmosphere and 16m above ground level. In a static state, what gage pressure must the plumbing at ground level be able to handle?

Purpose] Solve P_{gage} at 0m elevation

Considerations] Incompressible fluid

Procedure] Use $P = \gamma h$ to solve

Drawing]



Calcs] $\Delta P = \gamma h + P_{atm}$

$\Delta P = 9.81 \frac{kN}{m^3} \cdot 16m$

$\Delta P = 157.0$ kPa (gage)

Summary] The pressure at ground level is **157.0kPa (gage)**

Analysis] The pressure at any point in the fluid only depends on the fluid column height and the specific weight of the fluid.