Robert Slade
Homework 2
MET 330

Problems 6-10

6. The value for the absolute pressure will always be greater than that for the gage pressure.
   - True, because absolute pressure is gage pressure plus Atmospheric pressure.

7. As long as you stay on the surface of Earth, the atmospheric pressure will be 14.7 psia
   - False, The magnitude of the atmospheric pressure Varies with location and with climatic conditions.

8. The pressure in a certain tank is -55.8 Pa(abs)
   - False, A perfect vacuum is the lowest possible pressure. Therefore, an absolute pressure will always be positive.

9. The pressure in a certain tank is -4.65 psig.
   - True, A gage pressure below atmospheric pressure is negative.

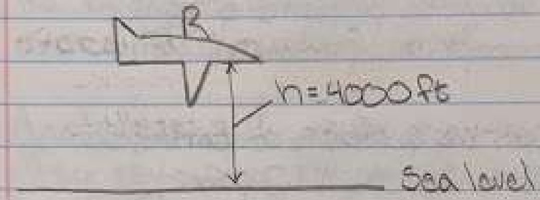
10. The pressure in a certain tank is -150kPa (gage).
   - True, A gage pressure below atmospheric pressure is negative

Problem 11.

Purpose:

What would the atmospheric pressure be if it conforms to the Standard atmosphere

Drawing:



Sources:

Mott, Robert L.; Untener, Joseph A., Applied Fluid mechanics 7th, 2015. Reprinted by permission of Pearson Education, Inc., New York, New York

Design considerations:

The following must be assumed:

1. Incompressible fluid
2. Isothermal process

Data and Variables

$h = 4000 ft$

$P_{atm} = 14.7 psia$

$\gamma = 0.0764\ lb/ft^3$ (table E.2 page 497)

Procedure

Use the Pressure-Elevation Relationship to find the change in pressure.

$\Delta P = \gamma h$

Express the pressure as a gage pressure

$P_{gage} = P_{atm} - P_{abs}(\Delta P)$

Calculations:

$\Delta P = \gamma h = 0.0764 \ lb/ft^3 (4000 ft) = 305.6 \ lb/ft^2$

$\therefore \Delta P = 2.12 \ psia$

$P = P_{atm} - P_{abs} = 14.70 psia - 2.12 psia = \boxed{12.58 psia}$

Summary:

The open-cockpit airplane flying at a height of 4000ft above sea level will have an atmospheric pressure of 12.58psia as it conforms to the standard atmosphere.

Material: Air

Analysis:

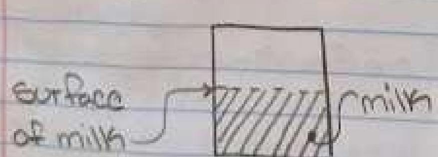
The greater the airplane's elevation as it conforms to the standard atmosphere the atmospheric pressure decreases.

Problem 13

Purpose:

find the pressure at the surface of a glass of milk

Drawing:



Sources:

Mott, Robert L.; Untener, Joseph A., Applied Fluid Mechanics 7th, 2015. Reprinted by permisson of Pearson Education, Inc., New York New York

Design Considerations:
The following must be assumed:
1. Incompressible fluid
2. Isothermal process

Data and Variables
$h = 0$ (at the surface)

Procedure:
Use the pressure-elevation relationship to determine the pressure.
$\Delta P = \gamma h$
Use the definition of Absolute pressure
$P_{abs} = P_{gage} + P_{atm}$ / $P_{gage} = P_{atm} - P_{abs} (\Delta P)$

Calculations:
$\Delta P = \gamma h = \gamma (0) = 0 \text{ Psia}$
$P_{gage} = P_{atm} - 0 = \boxed{0 \text{ Psia}}$

Summary:
The gage pressure at the surface of a glass of milk is zero.

Material:
milk

Analysis:
Without elevation or depth there will be no pressure. A force will need to be applied to have pressure.

Problem 41

Purpose:

Find the required air pressure in the reservoir for the lift cylinder to maintain 180 psig

Drawings:

See text book figure 3.19

Sources:

Mott, Robert L.; Untener, Joseph A. Applied Fluid mechanics 7th, -2015. Reprinted by permission of Pearson Education Inc. New York New York

Design considerations:

The following must be Assumed:

1. Incompressible fluid
2. Isothermal process

Data and Variables:

$P_{bottom} = 180$ psig

$Sg = 0.90$

Procedures

Use Pressure-elevation Relationship

$\Delta P = \gamma h$

express the pressure as a gage pressure

$P_{air} = P_{atm} - P_{abs}(\Delta P)$

← Point A

Calculations

$h = 32in + 32in = 64in$

$Sg = \dfrac{\gamma}{62.4\ lb/ft^3 \text{ (Page 11)}} = \gamma = (0.90)(62.4\ lb/ft^3) = 56.16\ lb/ft^3$

$\gamma = 0.0325\ lb/in^3$

$\Delta P = \gamma h = 0.0325 \, lb/in^3 (64 in) = 2.08 \, Psig$

Point A

$P_{air} = P_{atm} - \Delta P = 180 \, Psig - 2.08 \, Psig = \boxed{177.92 \, Psig}$

Summery:

The air pressure in the reservoir is 177.92Psi to maintain 180psi at point A in the lift cylinder.

Material: Air, Oil

Analysis:

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

Problem 62

Purpose:

Compute the pressure at point A of the manometer.

Drawing:

See textbook figure 3.26

Sources:

Mott, Robert L, Untener, Joseph A., Applied fluid mechanics 7th, -2015. Reprinted by Permission of pearson Education Inc, New York New York

Design Considerations

The following must be assumed

1. Incompressible fluid
2. Isothermal process

Data and Variables:

Sg(mercury) = 13.54

All distances in the drawing

Procedure:

Use pressure-elevation relationship

$\Delta P = \gamma h$

express the pressure as a gage pressure.

$P_{point A} = P_{atm} - \Delta P$

Calculations:

~~$-\gamma_m \times 75mm - \gamma_w \times 100mm = P_a$~~

~~$= -13.54 \times 0.075m - 9.81 kN/m^3 \times 0.1m = P_a$~~

~~$= -1.0155m -$~~

Start over

$\gamma_m = Sg_m \times \gamma_w = 13.54(9.81 kN/m^3) = 132.8 kN/m^3$

$-\gamma_m(0.075m) - \gamma_w \times 0.1m = P_a$

$-132.8 kN/m^3(0.075m) - 9.81 kN/m^3(0.1m) = P_a$

$-9.96 kN/m^2 - 0.981 kN/m^2 = P_a$

$-10.941 kN/m^2 = P_a$

$\therefore \boxed{P_a = -10.941 kPa}$

Summary:

The pressure at point A in the manometer is -10.943 kPa.

Material:

water, mercury

Analysis

The pressure on a certain point depends directly on the fluid column height and on the specific weight of the fluid.

Problem 83

Purpose:

Calculate the atmospheric pressure (Psia) of the barometer.

Drawing:

Sources:

Mott, Robert L, Untener, Joseph A. Applied fluid mechanics 7th - 2015 Reprinted by permission of Pearson Education Inc, New York New York

Design Considerations

The following must be assumed.

1. Incompressible fluid
2. Isothermal process

Data and Variables

30.65in of mercury

Procedure:

Convert from inches to Psia

1.0in of mercury = 0.491 psi

Calculations

$P_{atm} = 30.65in \times \frac{0.491 psi}{1.0 in} = \boxed{15.049 \text{ psia}}$

Summary:
The atmospheric pressure is 15.049 Psia

Material
Mercury

Analysis
Conversion factors can be used to measure high pressures with a mercury manometer.