Zachary Ahmad
PSE 380
Due: 02/03/2021

1.9. Can you carry 1 m^3 of liquid water?

Given 1 m^3, we should convert to kilograms to see if carrying is possible.

$$\rho = 997 \text{ kg/m}^3 \quad \text{(table A.4)}$$

Eq for mass of water:

$$m = \rho \cdot V = 997 \cdot 1 = 997 \text{ kg}$$

For clarity, 997 kg $\approx$ 2198 lbs.

This is extremely heavy, so, **NO** unless lifting with capable machinery.

- I understand how to solve this problem.

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Due: 2/3/2021

1.19: A thermometer that indicates the temperature with a liquid column has a bulb with a larger volume of liquid. Why?

This is to account for liquid volume expansion due to heat. With more volume in the bulb, we can allow for liquid expansion up the thin column for an accurate reading. A small resevoir would not allow for delocalization of the liquid.

- I understand how to solve this problem.

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Due: 2/3/2021

1.28: When you move up from the surface of the earth, the gravitation is reduced as $g = 9.807 - 3.32 \times 10^{-6} z$, with z being the elevation in meters. By what percentage is the weight of an airplane reduced when it cruises at 11000 m?

Given: $g_z = 9.807 - 3.32 \times 10^{-6} \times z$

so @ 11000 m, $g_z = 9.807 - 3.32 \times 10^{-6} \times 11000 = 9.7705 \text{ ms}^{-2}$

ms^{-2}

$W_0 = m g_0$; $W_H = m g_H$

$$W_H / W_0 = g_H / g_0 = \frac{9.7705}{9.807} = 0.9963$$

So the reduction is $1 - 0.9963 = 0.0037$

(Because percent) so $\boxed{0.37\ \%}$

- I understand how to solve this problem

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1.33: The elevator in a hotel has a mass of 750 kg, and it carries six people with a total mass of 450 kg. How much force should the cable pull up with to have an acceleration of 1 m/s^2 in the upward direction?

If the elevator needs to go up, then:

$F = m_{total} a + m_{total} g$

$a = 1\ m/s^2$

so $F = m_{total}(a+g)$

$g = 9.806\ m/s^2$ (table A.1)

$m_{total} = 750 + 450$

$m_{total} = 1200\ kg$

$F = 1200\ kg\ (1\ m/s^2 + 9.806\ m/s^2) = 12967\ N$

$\approx \boxed{12.97\ kN}$

- I understand how to solve this problem.

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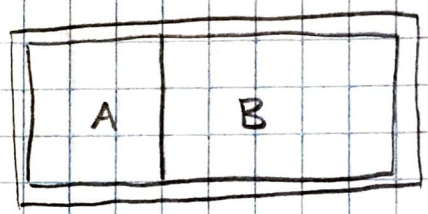
PSE 380
Due: 3/2/2021

1.41: A tank has two rooms separated by a membrane. Room A has 1 kg of air and a volume of 0.5 m^3; room B has 0.75 m^3 of air with density 0.8 kg/m^3. The membrane is broken, and the air comes to a uniform state. Find the final density of the air.



Mass per unit volume

$$m = m_A + m_B = m_A + \rho_B V_B$$

$$= 1 + 0.8 \cdot 0.75 = 1.6 \text{ kg}$$

(m_A: mass$_A$; ρ_B: density$_B$; V_B: volume$_B$)

$$V = V_A + V_B = 0.5\ m^3 + 0.75\ m^3 = 1.25\ m^3$$

$$\rho = \frac{m}{V} = \frac{1.6\ kg}{1.25\ m^3} = \boxed{1.28\ kg/m^3}$$

- I understand how to solve this problem.

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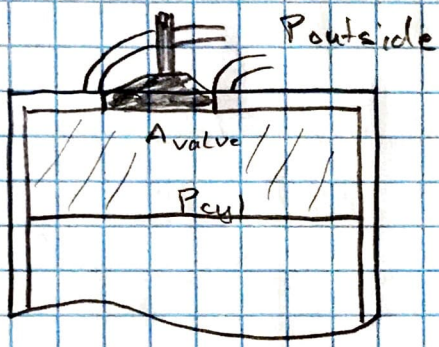
PSE 380
Due 2/3/2021

1.44: A valve in the cylinder shown has a cross-sectional area of $11 cm^2$ with a pressure of 735 kPa inside the cylinder and 99 kPa outside. How large a force is needed to open the valve?



$$F_{net} = P_{in}A - P_{out}A$$

$$= (735\ kPa - 99\ kPa) \cdot 11\ cm^2$$

$$= 6996\ kPa\ cm^2 \cdot \frac{kN}{m^2} \cdot 10^{-4}\ m^2$$

$$= 700\ N \qquad \text{(conversion from A.1)}$$

- I understand how to solve this problem.

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Due 2/3/2021

1.49: A 75 kg human total footprint is $0.05 m^2$ when the human is wearing boots. Suppose you want to walk on snow that can at most support an extra 3 kPa; what should the total snowshoe area be?

Pressure eq. → $P = F/A$

so we have $A = \frac{mg}{P}$

$$A = \frac{75\,kg\,(9.81)}{3 \times 10^3\,Pa} \quad \text{(table A.1)}$$

$$= \frac{735.75}{3000} = \boxed{0.245\ m^2}$$

- I understand how to solve this problem.

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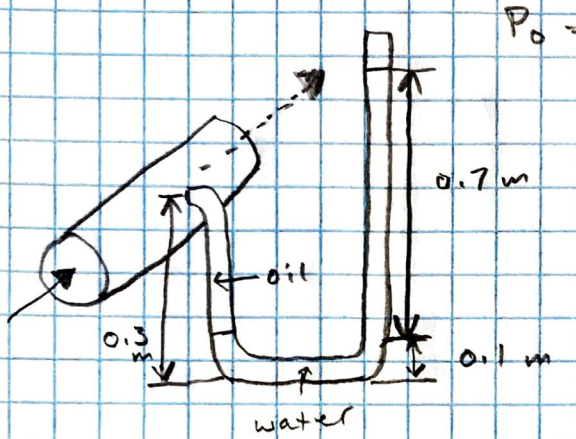
Due: 2/3/2021

1.78: A pipe flowing light oil has a manometer attached, as shown below. What is the absolute pressure in the pipe flow?



(table A.3)

$\rho_{oil} = 910\ kg/m^3$ $\rho_{water} = 997\ kg/m^3$

$$P = P_o + \rho_{water} g H_{total} = P_o + 997 \times 9.807 \times 0.8$$
$$= P_o + 7822\ Pa$$

$$P_{pipe} = P - \rho_{water} g H_1 - \rho_{oil} g H_2$$
$$P - 997 \times 9.807 \times 0.1 - 910 \times 9.807 \times 0.2$$
$$P - 997.7\ Pa - 1784.9\ Pa$$

$$P_{pipe} = P_o + (7822 - 977.7 - 1784.9)\ Pa$$
$$= P_o + 5059.4\ Pa = 101.325 + 5.06 = \boxed{106.4\ kPa}$$

- I do not fully understand how to solve this problem.