

ENGINEERING FLUID MECHANICS

EXTRAORDINARY FINAL EXAM

June 25, 2019

SURNAME:

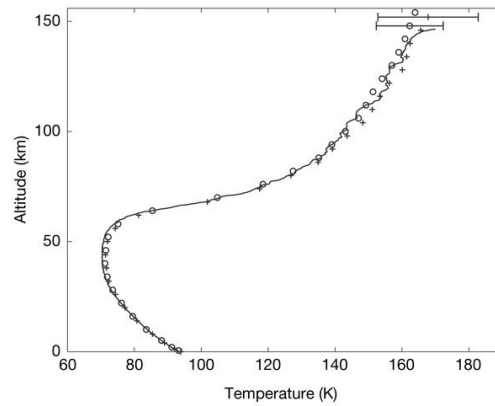
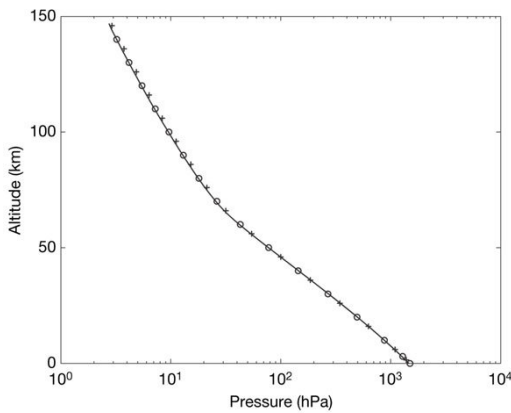
NAME:

GROUP:

Quiz A (3 points)

Correct answer = +0.6 pts.; wrong answer = -0.2 pts.; no answer = 0 pt.

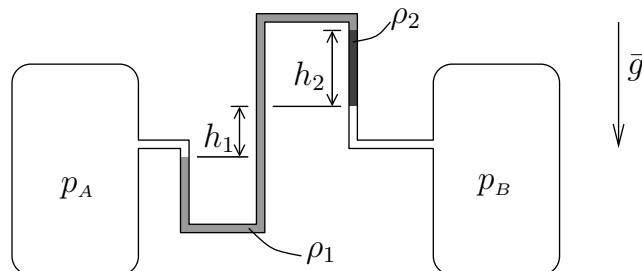
1. Using the temperature and pressure profiles in Titan's atmosphere, measured by the Cassini-Huygens mission, determine the value of the mean intermolecular distance d at an altitude of $h = 50$ km. Recall that: $1 \text{ hPa} = 100 \text{ Pa}$, the value of the universal gas constant is $R^\circ = 8.31 \text{ J/mol/K}$ and Avogadro's number is $\mathcal{N}_A = 6.02 \times 10^{23} \text{ mol}^{-1}$



- $d \approx 5.0 \times 10^{-9} \text{ m} \checkmark$
- $d \approx 1.3 \times 10^{-8} \text{ m}$
- $d \approx 5.0 \times 10^{-7} \text{ m}$
- $d \approx 1.3 \times 10^{-6} \text{ m}$

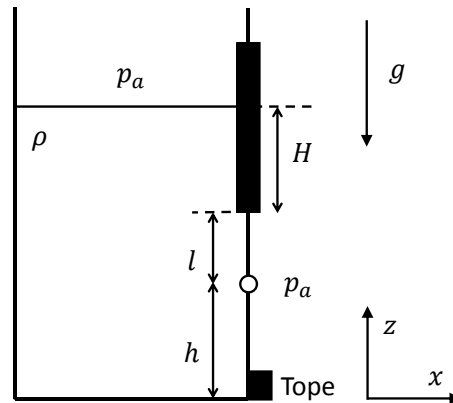
2. Determine the relation between pressures p_A and p_B of the air in the two tanks shown in the figure.

- $p_A - p_B = \rho_2 g h_2 - \rho_1 g h_1$
- $p_A - p_B = \rho_1 g (h_2 - h_1) + \rho_2 g h_2$
- $p_A - p_B = \rho_1 g h_1 + \rho_2 g h_2$
- None of the above \checkmark



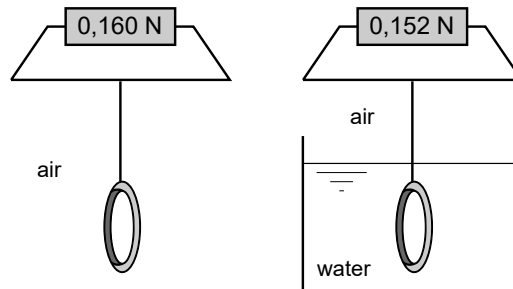
3. Determine the water height $H \geq 0$ that will cause the hinged gate shown in the figure to open. The hinge is positioned at $l = 1$ m below the upper wall and $h = 1.5$ m above the floor. Note that there is a stopping square (“tope”) that does not allow counterclockwise rotation of the gate.

- $H = 1.5$ m
 $H = 3.0$ m
 The gate will not open ✓
 None of the above



4. Your friend is concerned about a gold ring he bought recently, and he would like to know whether it is really made of gold or of something else. You decide to help him, using your knowledge of physics. You weigh the ring and find that it has a weight of 0.160 N. Using a string, you suspend the ring from the scale and, with the ring submerged in water, weigh it again to find a new reading of 0.152 N. What is the relative density of the ring $\rho_{\text{ring}}/\rho_{\text{water}}$?

- $\rho_{\text{ring}}/\rho_{\text{water}} = 10$
 $\rho_{\text{ring}}/\rho_{\text{water}} = 20$ ✓
 $\rho_{\text{ring}}/\rho_{\text{water}} = 30$
 $\rho_{\text{ring}}/\rho_{\text{water}} = 40$



5. Consider the flow between two flat and horizontal plates, separated by a distance H . The flow that takes place when the upper plate moves parallel to itself with a velocity U is defined by a velocity field $\vec{v} = \frac{U}{H} y \vec{e}_x$. Determine the mathematical expression for the streamlines of this flow. In the answers, C represents a constant value.

- $xy = C$
 $x = C$
 $y/x = C$
 $y = C$ ✓

