Answer to Question #80985, Physics / Mechanics | Relativity

Question:

The surface pressure on Venus is 92.00 atm, and the acceleration due to gravity there is 0.894 g. In a future exploratory mission, an upright cylindrical tank of benzene is sealed at the top but still pressurized at 92.00 atm just above the benzene. The tank has a diameter of 1.90 m , and the benzene column is 12.80 m tall. Ignore any effects due to the very high temperature on Venus.

a) What force does the Venusian atmosphere exert on the outside surface of the bottom of the tank?

b) What total inward force does the atmosphere exert on the vertical walls of the tank?

Solution:

a) The force applied on the outside surface of the bottom of the cylinder can be calculated as $F = P*\mathrm{S}$ where P is a pressure of the gas at the surface of the planet and S is the area of the bottom of the cylinder. Considering that one atm I equal to 101325 Pa we can calculate the force as

$$F = PS = \frac{P*\pi d^2}{4} = \frac{101325*3.14*1.9^2}{4} = 287139.9 \text{ N}$$

b) The fact that the cylinder is pressurized at 92 atm above the benzene hints us that the pressure of the Venusian atmosphere can be considered constant with respect to the height of the cylinder. In this case the total inward force on the vertical walls of the cylinder can be calculated as $F = P*\mathrm{S}$ where P is a pressure of the gas at the surface of the planet and $S = \pi*d*h$ is the area of the side walls of the cylinder. Now

$$F = PS = P*\pi dh = 101325*3.14*1.9*12.8 = 7737663.4 \text{ N}$$