Answer on Question #41160, Physics, Molecular Physics | Thermodynamics

The pressure inside two soap bubbles is 1.01atm and 1.02atm. The ratio of resp volumes is?

Solution:

The pressure difference between the inside and outside of a bubble depends upon the surface tension and the radius of the bubble. The relationship can be obtained by visualizing the bubble as two hemispheres and noting that the internal pressure which tends to push the hemispheres apart is counteracted by the surface tension acting around the circumference of the circle.

For a bubble with two surfaces providing tension, the pressure relationship is:

$$P_i - P_o = \frac{4T}{R}$$

where T is the surface tension of the soap, and R is the radius of the bubble.

Given:

$P_o = 1$ atm,

$P_{i1} = 1.01$ atm,

$P_{i2} = 1.02$ atm,

V_1 / V_2 = ?

Thus,

$$\frac{4T}{R_1} = P_{i1} - P_o = 1.01 - 1 = 0.01 \text{ atm}$$

$$\frac{4T}{R_2} = P_{i2} - P_o = 1.02 - 1 = 0.02 \text{ atm}$$

$$\frac{R_1}{R_2} = \frac{0.02}{0.01} = 2$$

The volume enclosed by a sphere is given by the formula

$$Volume = \frac{4}{3}\pi R^3$$

Thus,

$$\frac{V_1}{V_2} = \left(\frac{R_1}{R_2}\right)^3 = 2^3 = 8$$

Answer. $\frac{V_1}{V_2} = 8.$