Answer on Question #74100, Physics / Mechanics | Relativity

The volume of an air bubble become three times as it rises from the bottom of a lake to its surface. Assuming atmospheric pressure to be 75 cm of Hg and density of water to be 1/10 of the density of mercury, the depth of the lake.

Solution:

Pressure at the bottom of lake,

$$P_1 = Atmospheric\ pressure + pressure\ due\ to\ water\ column\ in\ the\ lake$$

$$P_1 = 75 \times \rho_{Hg} \times g + h \times \rho_w \times g$$

Volume of bubble at the bottom, $V_1 = V$

Volume of bubble at the surface, $V_2 = 2V$

Pressure at the surface

$$P_2 = Atmospheric\ pressure$$

$$P_2 = 75 \times \rho_{Hg} \times g$$

From Boyle's law,

$$P_1V_1 = P_2V_2$$

$$(75 \times \rho_{Hg} \times g + h \times \rho_w \times g) \times V = 75 \times \rho_{Hg} \times g \times 2V$$

$$h = 75 \times (\rho_{Hg} / \rho_w)$$

$$h = 75\ cm \times \left(\frac{13.56\ g/cm^3}{13.56\ g/cm^3 \times 1/10}\right)$$

$$h = 75\ cm \times 10 = 750\ cm = 7.5\ m$$

Answer: 7.5 m