Answer on Question #41470 – Physics – Other

Question.

If you dive underwater, you notice an uncomfortable pressure on your eardrum due to the increased pressure. The human endrum has a pressure of 70mm2 (7.10^-5 m2) and it can sustain a force of 7N without rupturing. if your body had no means of balancing the extra pressure, what would be the maximum depth you could dive without rupturing the eardrum?

$S = 70 \, mm^2 = 7 \cdot 10^{-5} \, m^2$

$F = 7 \, N$

$\rho = 1000 \, \frac{kg}{m^3}$ // it's the density of water

$g = 9.8 \, \frac{N}{kg}$

$h = ?$

Solution.

Find the maximum pressure that a person can stand under water:

$$P_{critical} = \frac{F}{S} = \frac{7}{7 \cdot 10^{-5}} = 10^5 \, Pa$$

Pressure of water column on a person in a depth h is:

$$P_{water} = \rho g h$$

Pressure at maximum depth h corresponds to the maximum allowable pressure P_{crit}:

$$P_{critical} = P_{water}$$

$$\frac{F}{S} = \rho g h$$

So,

$$h = \frac{F}{\rho g S}$$

$$h = \frac{7}{7 \cdot 10^{-5} \cdot 9.8 \cdot 1000} = 10.2 \, m$$

Answer.

$$h = \frac{F}{\rho g S} = 10.2 \, m$$