**Answer on Question #69121 Physics / Other**

2. A small sculpture made of brass ($\rho_{\text{brass}} = 8470$ kg/m^3) is believed to have a secret central cavity. The weight of the sculpture in air is 15.76 N. When it is submerged in water, the weight is 13.86N. What is the volume of the secret cavity?

**Solution:**

2. The weight of the sculpture in air is

$$mg = 15.76 \text{ N}$$

The weight of the sculpture in water is

$$mg - g\rho_{\text{water}}V = 13.86 \text{ N}$$

So $15.76 \text{ N} - g\rho_{\text{water}}V = 13.86 \text{ N}$

The volume of the sculpture

$$V = \frac{15.76 - 13.86}{g\rho_{\text{water}}} = \frac{1.90}{9.8\times1000} \text{ m}^3$$

The volume of the brass

$$V_{\text{brass}} = \frac{15.76}{g\rho_{\text{brass}}} = \frac{15.76}{9.8\times8470} \text{ m}^3$$

So, the volume of the secret cavity

$$V - V_{\text{brass}} = \frac{1.90}{9.8\times1000} - \frac{15.76}{9.8\times8470} = 4\times10^{-6} \text{ m}^3 = 4 \text{ cm}^3$$

**Answer:** 4 $\text{cm}^3$.

3. In a classroom demonstration, a 73.5-kg physics professor lies on a "bed of nails." The bed consists of a large number of evenly spaced, relatively sharp nails mounted in a board so that the points extend vertically outward from the board. While the professor is lying down, approximately 1900 nails make contact with his body.
a. What is the average force exerted by each nail on the professor's body?
b. If the area of contact at the head of each nail is $1.26 \times 10^{-6}$ m^2, what is the average pressure at each contact?
**Solution**

a) Average force

$$F = \frac{mg}{1900} = \frac{73.5\times9.8}{1900} = 0.379 \text{ N}.$$

b) Average pressure

$$p = \frac{F}{A} = \frac{0.379}{1.26\times10^{-6}} = 0.3\times10^6 \text{ Pa} = 3 \text{ atm}.$$

**Answer:** 0.379 N, 3 atm.