

Question #56920, Physics / Molecular Physics | Thermodynamics

A wooden block (20 cm x 20 cm x 20 cm) has a relative density of 0.9. What weight (in air)  $W$  of a sinker will cause it to be fully submerged?

**Solution:**

According to Archimedes' principle, the block is buoyed up by the fluid, with the force which is equal to the weight of the fluid displaced by the block. When the block is fully submerged, the weight of displaced fluid is:

$$W_f = \rho_f gV = \rho_f gl^3, \quad (1)$$

where  $l$  is the linear dimension of the block.

At the same time, the weight of the block is:

$$W_b = 0.9\rho_f gV = 0.9\rho_f gl^3 \quad (2)$$

The required weight of sinker is equal to the difference between (1) and (2):

$$W_s = W_f - W_b = \rho_f gl^3 - 0.9\rho_f gl^3 = 0.1\rho_f gl^3 \quad (3)$$

Considering the fluid to be water, thus its density is  $1 \text{ g/cm}^3$ .

$$W_s = 0.1 \times 1 \times 9.8 \times 20^3 = 7840 \text{ g} = 7.84 \text{ kg}$$

**Answer:** 7.84 kg