

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:

$$W_{fl} = \rho_{fl} g V = \rho_{fl} g l^3, \quad (1)$$

where l is the linear dimension of the block.

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

$$W_b = 0.9 \rho_{fl} g V = 0.9 \rho_{fl} g l^3 \quad (2)$$

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

$$W_s = W_{fl} - W_b = \rho_{fl} g l^3 - 0.9 \rho_{fl} g l^3 = 0.1 \rho_{fl} g l^3 \quad (3)$$

Considering the fluid to be water, thus its density is 1 g/cm³.

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

Answer: 7.84 kg