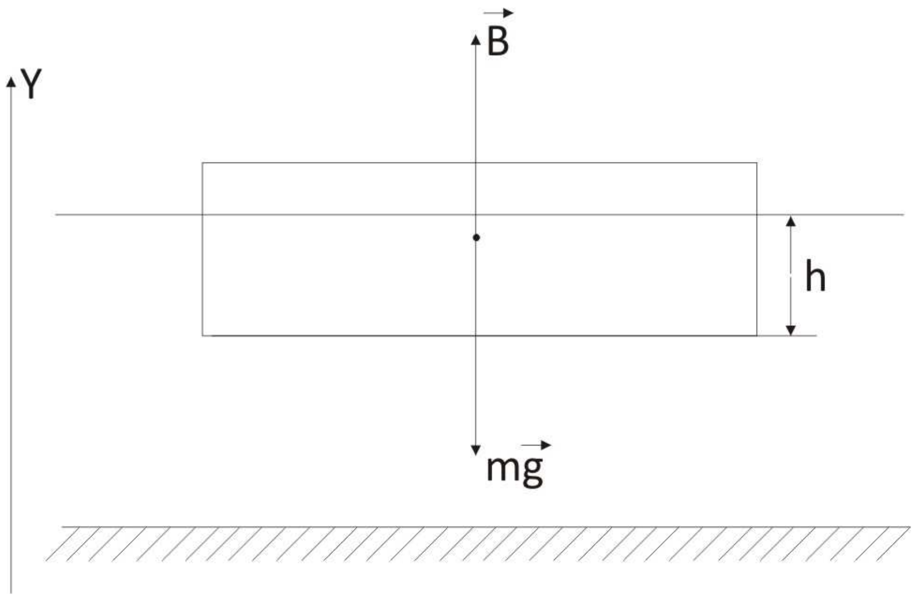
A raft is constructed of wood having a density of $452.0\frac{kg}{m^3}$. The surface area of the bottom of the raft is $5.4m^2$, and the volume of the raft is $0.51m^3$. When the raft is placed in fresh water having density $1.0 \cdot 10^3 \frac{kg}{m^3}$, how deep is the bottom of the raft below water level?

Solution.

$$\rho_w = 1.0 \cdot 10^3 \frac{kg}{m^3}, \rho_r = 452.0\frac{kg}{m^3}, S = 5.4m^2, V_r = 0.51m^3;$$

$$h-?$$



Newton's second law in vector form:

$$m\vec{a} = \vec{B} + m\vec{g}.$$

A raft is at rest, then:

$$\vec{a} = 0.$$

$$0 = \vec{B} + m\vec{g}.$$

Projection on Y:

$$0 = B - mg;$$

$$B = mg.$$

B – a buoyancy force.

m - a mass of a raft.

$$m = \rho_r V_r;$$

ρ_r – the density of a raft.

V_r – a volume of a raft.

$$B = \rho_w V g;$$

ρ_w – the density of a water;

V – a part of volume of a raft below water level.

$$V = Sh;$$

h - a high of the bottom of the raft below water level.

$$\rho_w V g = mg;$$

$$\rho_w V = m;$$

$$\rho_w S h = \rho_r V_r;$$

$$h = \frac{\rho_r V_r}{\rho_w S}.$$

$$h = \frac{452.0 \cdot 0.51}{1.0 \cdot 10^3 \cdot 5.4} = 0.043(m).$$

Answer: $h = 0.043m$.