Answer on Question #72396-Physics-Mechanics-Relativity

A cubical block of wood 10 cm on a side & rho wood= 0.5 g/cm^3 floats in a jar of water. Oil of density 0.8 g/cm^3 is poured into the water until the top of the oil layer is 4 cm below the top of the block. How deep is the oil?

Solution

Side of cubical block is

$$L = 0.1\ m$$

Density of wood is

$$d_1 = 500\frac{kg}{m^3}$$

Density of oil is

$$d_2 = 800\frac{kg}{m^3}$$

The top of the oil layer is 0.04 m below the top of the block.

Area of face of wooden block is

$$A = 0.01\ m^2$$

Volume of wooden block is

$$V = 0.001\ m^3.$$

Weight of wooden block is

$$W_b = 0.1A \cdot 500g = 50Ag.$$

Suppose depth of oil layer is x.

Volume of oil displaced is

$$V_o = xA$$

Weight of oil displaced is

$$W_o = 800\ xAg$$

Volume of water displaced is

$$V_w = (0.1 - 0.04 - x)A = (0.06 - x)A$$

Weight of water displaced is

$$W_w = 1000(0.06 - x)\ Ag$$

From law of floatation:

$$W_o + W_w = W_b$$

$$800\,xAg + 1000(0.06 - x)Ag = 50Ag$$

$$800x + 1000(0.06 - x) = 50$$

$$x = 0.05\,m = 5\,cm.$$

Answer: 5 cm.