

A sample of an unknown material weighs 300.0 N in air and 200.0 N when submerged in an alcohol solution with a density of 70.0 kg/m³. What is the density of the unknown solution?

Body's weight in air:

$$P_1 = mg \rightarrow m = \frac{P_1}{g}$$

Using Archimedes' principle to find body's weight in an alcohol solution:

$$P_2 = \rho_{sol}gV_{mat}$$

We can find the volume of the unknown material:

$$V_{mat} = \frac{m}{\rho_{mat}}$$

Thus:

$$P_2 = \frac{\rho_{sol}}{\rho_{mat}} gm$$

Using first equation:

$$P_2 = P_1 \frac{\rho_{sol}}{\rho_{mat}} \rightarrow \rho_{mat} = \rho_{sol} \frac{P_1}{P_2}$$
$$\rho_{mat} = 70 \text{ kg/m}^3 \frac{300 \text{ N}}{200 \text{ N}} = 105 \text{ kg/m}^3$$

Answer: $\rho_{mat} = 105 \text{ kg/m}^3$