

**Answer on** Question #58497, Physics / Mechanics | Relativity

A nail weighs 0.2254 N in air and 0.1245 N when fully submerged in oil of density 800 kg/m<sup>3</sup>.

What is the density of the nail?

**Find:**  $\rho_{\text{nail}} - ?$

**Given:**

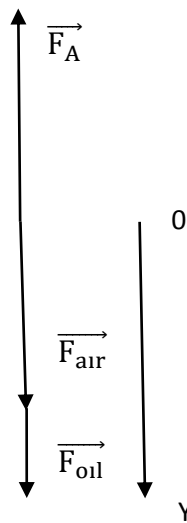
$$F_{\text{air}} = 0,2254 \text{ N}$$

$$F_{\text{nail}} = 0,1254 \text{ N}$$

$$\rho_{\text{oil}} = 800 \text{ kg/m}^3$$

**Solution:**

Consider the forces which acting on a nail.



$$\text{Of the figure} \Rightarrow F_{\text{oil}} = F_{\text{air}} - F_A \quad (1),$$

where  $F_A$  – Archimedes force.

$$\text{Archimedes force: } F_A = \rho_{\text{oil}} V_{\text{nail}} g \quad (2)$$

$$\text{Weight of nail in the air: } F_{\text{nail}} = \rho_{\text{nail}} V_{\text{nail}} g \quad (3)$$

$$\text{Of (3)} \Rightarrow V_{\text{nail}} = \frac{F_{\text{nail}}}{g \rho_{\text{nail}}} \quad (4)$$

$$(4) \text{ in (2): } F_A = \frac{\rho_{\text{oil}}}{\rho_{\text{nail}}} F_{\text{nail}} \quad (5)$$

$$(5) \text{ in (1): } F_{\text{oil}} = F_{\text{air}} - \frac{\rho_{\text{oil}}}{\rho_{\text{nail}}} F_{\text{nail}} \quad (6)$$

$$\text{Of (6)} \Rightarrow \frac{\rho_{\text{oil}}}{\rho_{\text{nail}}} F_{\text{nail}} = F_{\text{air}} - F_{\text{oil}} \quad (7)$$

$$\text{Of (7)} \Rightarrow \rho_{\text{nail}} = \frac{F_{\text{nail}}}{F_{\text{air}} - F_{\text{oil}}} \rho_{\text{oil}} \quad (8)$$

$$\text{Of (8)} \Rightarrow \rho_{\text{nail}} = 1787,12 \text{ kg/m}^3.$$

**Answer:**

$$1787,12 \text{ kg/m}^3$$