A metal block of weight 8.7-N is suspended under water from a string. The tension on the string is determined to be 8.25-N. Identify the metal.

Given:

Weight of the block: $W = 8.7$ N

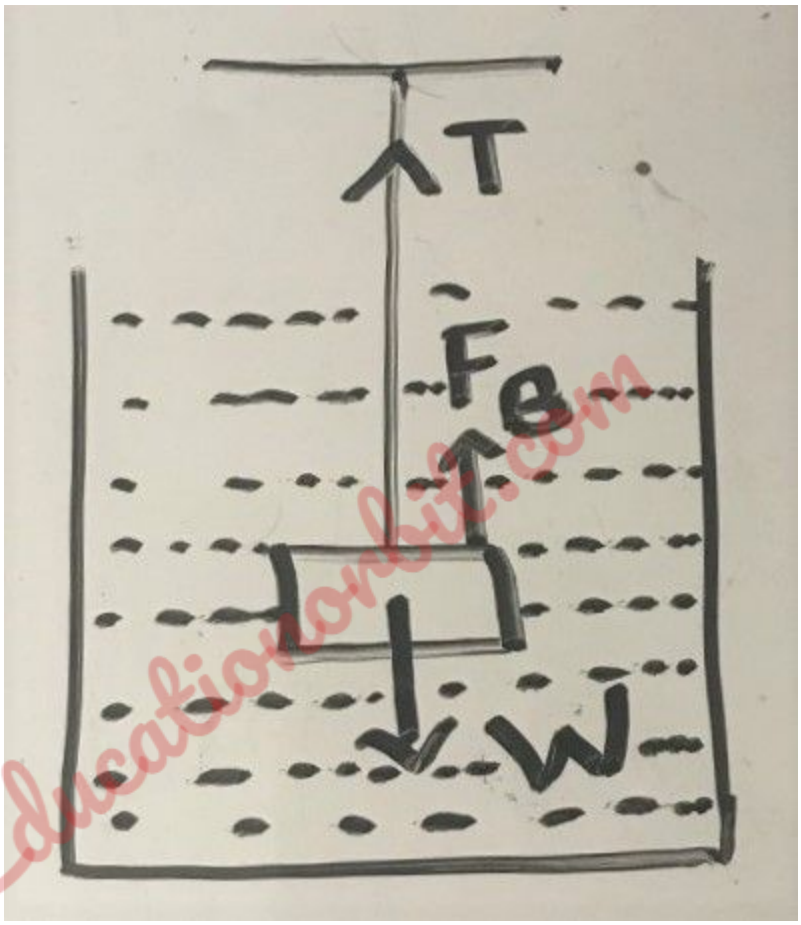
Tension on the suspending string: $T = 8.25$ N

Known:

Acceleration due to gravity: $g = -9.8\ m/s^2$

Density of water: $\rho_w = 1000\ kg / m^3$

Determine: Identity of the metal



To identify the metal, we have to determine the density of the metal: ρ_M

Since the metal block is suspended underwater , the sum of the tension on the suspending string and upward buoyant force is equal to the downward force which is the weight of the metal block.

Use formula:

$$T + F_B = W \text{ ----------(1)}$$

Rearranging (1) & substituting for T and W in (1):

$$F_B = 8.7 - 8.25 = 0.45 \text{ N}$$

Buoyant force is calculated as follows:

$$F_B = V_w \rho_w g \text{----------(2)}$$

V_W is the volume of water displaced by the metal block. It is equal to the volume of the metal block itself since the block is completely submerged in the water.

Rearranging (2) & substituting for F_B , ρ_w , and g in (2):

$$V_w = F_B / \rho_w g = 0.45 / (1000 \times | - 9.8 |) = 0.00004592 \text{ m}^3$$

Since $V_S = V_w$, $V_S = 0.00004592 \text{ m}^3$

Also, mass of the metal block is:

$$M = W / g = 8.7 / | -9.8 | = 0.888 \text{ kg}$$

Density of the metal:

$$\rho_M = M / V_S = 0.888 / 0.00004592 = 19338 \text{ kg / m}^3$$

Density of gold is 19,300 kg / m3. ρ_M is very close to the density of gold. Identity of the metal in this problem is therefore gold.