

SAMPLE PROBLEM A

Buoyant Force

PROBLEM

A bargain hunter purchases a “gold” crown at a flea market. After she gets home, she hangs the crown from a scale and finds its weight to be 7.84 N. She then weighs the crown while it is immersed in water, and the scale reads 6.86 N. Is the crown made of pure gold? Explain.



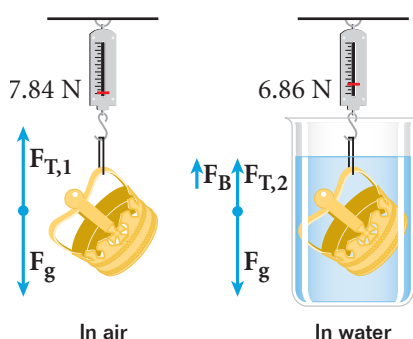
SOLUTION

1. DEFINE

Given: $F_g = 7.84 \text{ N}$ apparent weight = 6.86 N
 $\rho_f = \rho_{\text{water}} = 1.00 \times 10^3 \text{ kg/m}^3$

Unknown: $\rho_o = ?$

Diagram:



TIP

The use of a diagram can help clarify a problem and the variables involved. In this diagram, $F_{T,1}$ equals the actual weight of the crown, and $F_{T,2}$ is the apparent weight of the crown when immersed in water.

2. PLAN

Choose an equation or situation:

Because the object is completely submerged, consider the ratio of the weight to the buoyant force.

$$F_g - F_B = \text{apparent weight}$$

$$\frac{F_g}{F_B} = \frac{\rho_o}{\rho_f}$$

Rearrange the equation to isolate the unknown:

$$F_B = F_g - (\text{apparent weight})$$

$$\rho_o = \frac{F_g}{F_B} \rho_f$$

3. CALCULATE

Substitute the values into the equation and solve:

$$F_B = 7.84 \text{ N} - 6.86 \text{ N} = 0.98 \text{ N}$$

$$\rho_o = \frac{F_g}{F_B} \rho_f = \frac{7.84 \text{ N}}{0.98 \text{ N}} (1.00 \times 10^3 \text{ kg/m}^3)$$

$$\rho_o = 8.0 \times 10^3 \text{ kg/m}^3$$

4. EVALUATE

From **Table 1**, the density of gold is $19.3 \times 10^3 \text{ kg/m}^3$. Because $8.0 \times 10^3 \text{ kg/m}^3 < 19.3 \times 10^3 \text{ kg/m}^3$, the crown cannot be pure gold.