

Task:

A penguin is held under the surface of seawater by a tension of 0.18 pounds. His density is 1.8 slugs per cubic foot. What is his volume?

Solution:

Assuming Archimedes' principle to be reformulated as follows,

$$F_A = \rho g V,$$

$$1.8 \text{ slugs per cubic foot} = \frac{1.8 \cdot 14.593903 \text{ kg}}{0.3048^3 \text{ m}^3} = 927.682 \frac{\text{kg}}{\text{m}^3}$$

$$0.18 \text{ pounds} = 0.18 \cdot 0.45359237 \text{ kg} = 0.082 \text{ kg}$$

As penguin is held under the surface of seawater $F_A = \text{tension} + \text{penguin's weight}$

$$F_A = 0.082 \text{ kg} \cdot 9.81 \frac{\text{N}}{\text{kg}} + \text{penguin's weight}$$

$$\text{penguin's weight} = 927.682 \frac{\text{kg}}{\text{m}^3} \cdot V$$

$$1030 \frac{\text{kg}}{\text{m}^3} \cdot 9.81 \frac{\text{N}}{\text{kg}} \cdot V = 0.082 \text{ kg} \cdot 9.81 \frac{\text{N}}{\text{kg}} + 927.682 \frac{\text{kg}}{\text{m}^3} \cdot V$$

$$V = 0.0000876597 \text{ m}^3 = 0.00309567 \text{ ft}^3$$

Answer:

$$V = 0.00309567 \text{ ft}^3$$