Question #85047 — Physics — Molecular Physics | Thermodynamics

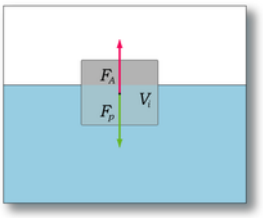
When a polar bear jumps on an iceberg, he notices that his 420 lb weight is just sufficient to sink the iceberg. What is the weight of the iceberg? Density of salt water is 64 lb/ft³ and that of iceberg is 57.2 lb/ft³.

Solution

Let us introduce next notations

V_i -volume of the iceberg, ρ_i -density of the iceberg, ρ_w -density of the water,

m_b - mass of the bear, g- is the acceleration due to gravity, Archimedes force: F_A and force of gravity F_g, where $\rho_i V_i$ -is the mass of iceberg.



In our system we have only two forces F_A and F_g witch joined by condition of equilibrium

$$F_A = F_g, \qquad (1)$$

From the Archimedes law we obtain $F_A = \rho_W g V_i$, and the resulting force of gravity for bear and iceberg: $F_g = (\rho_i V_i + m_b)g$.

Now from (1)

$$\rho_W g V_i = (\rho_i V_i + m_b)g \Rightarrow V_i = \frac{m_b}{\rho_w - \rho_i}$$

So the mass of iceberg

$$m_i = V_i = \rho_i \frac{m_b}{\rho_w - \rho_i} = 57.2[\text{lb/ft}^3]\frac{420[\text{lb}]}{64[\text{lb/ft}^3] - 57.2[\text{lb/ft}^3]} = 3532.94[\text{lb}]$$

Answer: weight of the iceberg 3532.94 lb