Example: Ball underwater anchored to rope.

Calculate the tension in the rope (in pounds (lbs)) anchoring a 12” diameter ball which is underwater. The unit weight of water = 62.4 pcf and the volume of a sphere = \( \frac{4}{3} \pi r^3 \). Ignore the weight of the ball and rope.

Solution

Setup:

\[
\begin{align*}
\text{Forces} & \quad \text{Downward forces} \quad \text{Upward forces} \\
B & = T
\end{align*}
\]

\[
\begin{align*}
B & = \gamma V \\
\gamma & = 62.4 \ \frac{lb}{ft^3} \\
V & = \frac{4}{3} \pi r^3 = \frac{4}{3} \pi \left( \frac{12}{2} \right)^3
\end{align*}
\]

Solve for T (being careful with units).

Soln:

\[
\begin{align*}
V & = 905 \ \text{in}^3 \\
B & = (62.4 \ \frac{lb}{ft^3})(905 \ \text{in}^3)(\frac{1 \ \text{ft}}{12 \ \text{in}})^3 = 32.7 \ \text{lb} \\
T & = 32.7 \ \text{lb}
\end{align*}
\]