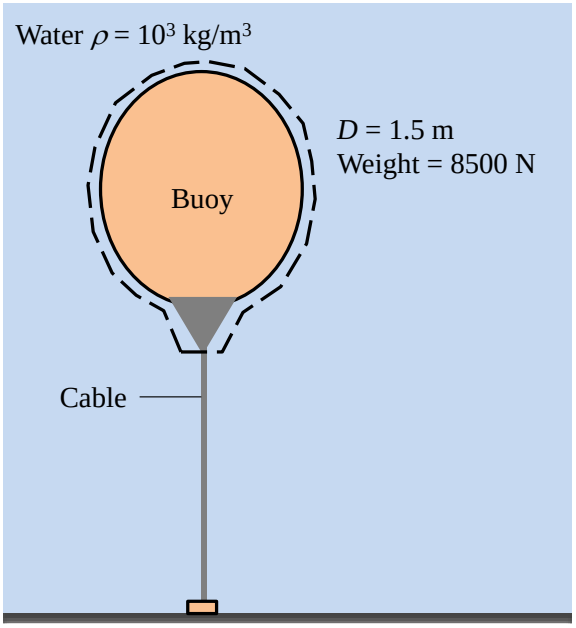
1.39 Figure P1.39 shows a spherical buoy, having a diameter of 1.5 m and weighing 8500 N, anchored to the floor of a lake by a cable. Determine the force exerted by the cable, in N. The density of the lake water is 10^3 kg/m^3 and g = 9.81 m/s^2.

KNOWN: A buoy with known diameter and weight is anchored to the floor of a lake by a cable.

FIND: the force exerted by the cable.

SCHEMATIC AND GIVEN DATA:



ENGINEERING MODEL:
1. The buoy is completely submerged in the water.
2. The acceleration of gravity is 9.81 m/s^2.

ANALYSIS: The resultant pressure force acting on the system denoted by the dashed line is the buoyant force, F_B, acting vertically upward with a magnitude equal to the weight of the displaced water. See Sec. 1.6.2 for discussion. Also acting on the system, vertically downward, are the weight of the system and the force exerted by the cable. In sum,

$$F_B = \text{Weight} + F_{cable}$$

$$F_{cable} = F_B - \text{Weight} = (\rho V)g - \text{Weight}$$

with $V = \pi D^3/6$ for a sphere,

$$F_{cable} = \rho\left(\frac{\pi D^3}{6}\right)g - \text{Weight}$$

Calculating,

$$F_{\text{cable}} = \left(10^3 \frac{\text{kg}}{\text{m}^3}\right)\left(\frac{\pi(1.5\,\text{m})^3}{6}\right)\left(9.81\frac{\text{m}}{\text{s}^2}\right)\left|\frac{1\,\text{N}}{1\frac{\text{kg}\cdot\text{m}}{\text{s}^2}}\right| - 8500\ \text{N} = \mathbf{\underline{8836\ N}}$$