29. (a) The downward force of gravity mg is balanced by the upward buoyant force of the liquid: $mg = \rho g V_s$. Here m is the mass of the sphere, ρ is the density of the liquid, and V_s is the submerged volume. Thus $m = \rho V_s$. The submerged volume is half the total volume of the sphere, so $V_s = \frac{1}{2}(4\pi/3)r_o^3$, where r_o is the outer radius. Therefore,

$$m = \frac{2\pi}{3}\rho r_o^3 = \left(\frac{2\pi}{3}\right)\left(800\,\text{kg/m}^3\right)(0.090\,\text{m})^3 = 1.22\ \text{kg}\ .$$

(b) The density ρ_m of the material, assumed to be uniform, is given by $\rho_m = m/V$, where m is the mass of the sphere and V is its volume. If r_i is the inner radius, the volume is

$$V = \frac{4\pi}{3}\left(r_o^3 - r_i^3\right) = \frac{4\pi}{3}\left((0.090\,\text{m})^3 - (0.080\,\text{m})^3\right) = 9.09 \times 10^{-4}\ \text{m}^3\ .$$

The density is

$$\rho_m = \frac{1.22\,\text{kg}}{9.09 \times 10^{-4}\,\text{m}^3} = 1.3 \times 10^3\ \text{kg/m}^3\ .$$