9.4
From Eq. (9.1) we find the mean density of the Earth to be

$$\rho_\oplus = \frac{M_\oplus}{V_\oplus} = \frac{M_\oplus}{\frac{4\pi}{3}R_\oplus^3} = \frac{3(5.975 \times 10^{24}\,\text{kg})}{4\pi(1.274\,246 \times 10^7\,\text{m}/2)^3} = 5.515 \times 10^3\,\text{kg/m}^3 .$$

Now change $\rho_\oplus$ to ρ_N, the density of nuclear matter, and solve for the corresponding new radius $R'_\oplus$ from the equation above:

$$R'_\oplus = \left(\frac{3M_\oplus}{4\pi\rho_N}\right)^{1/3} = \left[\frac{3(5.975 \times 10^{24}\,\text{kg})}{4\pi(2 \times 10^{17}\,\text{kg/m}^3)}\right]^{1/3} = 2 \times 10^2\,\text{m},$$

which is only about one-eighth of a mile.

9.8
The molar mass of water is 18 g/mol. Thus the number of water molecules contained in 1.00 g of water is $[1.00\,\text{g}/(18\,\text{g/mol})]\,(6.02 \times 10^{23}/\text{mol}) = 3.34 \times 10^{22}$. Since each H_2O molecule contains 3 atoms, the number of atoms in 1.00 g of H_2O is $3(3.34 \times 10^{22}) = 1.00 \times 10^{23}$, regardless of whether it is in liquid or solid state.

2
e mass of a water molecule is 18.0 u, of which 2.0 u, or 2.0 u/18.0 u = 1/9, is hydrogen. Thus weight of hydrogen in 62.4 lb of water is (1/9)(62.4 lb) = 6.93 lb, which corresponds to a of (6.93 lb)(0.453 6 kg/lb) = 3.14 kg.

9.24
On the one hand, when the fluid level is at height h above the bottom of the tank, the fluid surface assumes a circular area of radius $r = \frac{1}{2}h$. The volume of the water in the tank at that moment is $V = \frac{1}{3}\pi r^2 h = \frac{1}{12}\pi h^3$. The time rate of change of V is then

$$\frac{dV}{dt} = \frac{d}{dt}\left(\frac{1}{12}\pi h^3\right) = \frac{1}{4}\pi h^2\left(\frac{dh}{dt}\right).$$

On the other hand, we know that the volume of the water changes because water is being poured into the tank at the rate of $dm/dt = \mu$, in kg per sec. Since $V = m/\rho$, we may divide μ by ρ, the density of water, to obtain the rate at which the volume of the water changes due to the addition of the water:

$$\frac{dV}{dt} = \frac{d(m/\rho)}{dt} = \frac{1}{\rho}\frac{dm}{dt} = \frac{\mu}{\rho}.$$

Equate the two expressions above for dV/dt to obtain $\frac{1}{4}\pi h^2(dh/dt) = \mu/\rho$, or

$$\frac{dh}{dt} = \frac{4\mu}{\pi h^2 \rho}.$$

9.26
Use Eq. (9.4): $P_1 = \rho g h$. Here $P_1 = 400\,\text{kPa}$ and $\rho = 1.000 \times 10^3\,\text{kg/m}^3$, so the height of the water column is

$$h = \frac{P_1}{\rho g} = \frac{400 \times 10^3\,\text{N/m}^2}{(1.000 \times 10^3\,\text{kg/m}^3)(9.81\,\text{m/s}^2)} = 40.8\,\text{m}.$$