9. **REASONING** The total mass of the solution is the sum of the masses of its constituents. Therefore,

\[ \rho_s V_s = \rho_w V_w + \rho_g V_g \]  

(1)

where the subscripts s, w, and g refer to the solution, the water, and the ethylene glycol, respectively. The volume of the water can be written as \( V_w = V_s - V_g \). Making this substitution for \( V_w \), Equation (1) above can be rearranged to give

\[ \frac{V_g}{V_s} = \frac{\rho_s - \rho_w}{\rho_g - \rho_w} \]  

(2)

Equation (2) can be used to calculate the relative volume of ethylene glycol in the solution.

**SOLUTION** The density of ethylene glycol is given in the problem. The density of water is given in Table 11.1 as \( 1.000 \times 10^3 \) kg/m\(^3\). The specific gravity of the solution is given as 1.0730. Therefore, the density of the solution is

\[ \rho_s = (\text{specific gravity of solution}) \times \rho_w \]

\[ = (1.0730)(1.000 \times 10^3 \text{ kg/m}^3) = 1.0730 \times 10^3 \text{ kg/m}^3 \]

Substituting the values for the densities into Equation (2), we obtain

\[ \frac{V_g}{V_s} = \frac{\rho_s - \rho_w}{\rho_g - \rho_w} = \frac{1.0730 \times 10^3 \text{ kg/m}^3 - 1.000 \times 10^3 \text{ kg/m}^3}{1116 \text{ kg/m}^3 - 1.000 \times 10^3 \text{ kg/m}^3} = 0.63 \]

Therefore, the volume percentage of ethylene glycol is \( 63\% \).

27. **REASONING** According to Equation 11.4, the pressure \( P_{\text{mercury}} \) at a point 7.10 cm below the ethyl alcohol-mercury interface is

\[ P_{\text{mercury}} = P_{\text{interface}} + \rho_{\text{mercury}} gh_{\text{mercury}} \]  

(1)
where \( P_{\text{interface}} \) is the pressure at the alcohol-mercury interface, and \( h_{\text{mercury}} = 0.0710 \text{ m} \).

The pressure at the interface is

\[
P_{\text{interface}} = P_{\text{atm}} + \rho_{\text{ethyl}} gh_{\text{ethyl}}
\]

Equation (2) can be used to find the pressure at the interface. This value can then be used in Equation (1) to determine the pressure 7.10 cm below the interface.

**SOLUTION** Direct substitution of the numerical data into Equation (2) yields

\[
P_{\text{interface}} = 1.01 \times 10^5 \text{ Pa} + (806 \text{ kg/m}^3)(9.80 \text{ m/s}^2)(1.10 \text{ m}) = 1.10 \times 10^5 \text{ Pa}
\]

Therefore, the pressure 7.10 cm below the ethyl alcohol-mercury interface is

\[
P_{\text{mercury}} = 1.10 \times 10^5 \text{ Pa} + (13600 \text{ kg/m}^3)(9.80 \text{ m/s}^2)(0.0710 \text{ m}) = 1.19 \times 10^5 \text{ Pa}
\]

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43. **REASONING AND SOLUTION** Under water, the weight of the person with empty lungs is \( W_{\text{empty}} = W - \rho_{\text{water}} g V_{\text{empty}} \), where \( W \) is the weight of the person in air and \( V_{\text{empty}} \) is the volume of the empty lungs. Similarly, when the person's lungs are partially full under water, the weight of the person is \( W_{\text{full}} = W - \rho_{\text{water}} g V_{\text{full}} \). Subtracting the second equation from the first equation and rearranging gives

\[
V_{\text{full}} - V_{\text{empty}} = \frac{W_{\text{empty}} - W_{\text{full}}}{\rho_{\text{water}} g} = \frac{40.0 \text{ N} - 20.0 \text{ N}}{(1.00 \times 10^3 \text{ kg/m}^3)(9.80 \text{ m/s}^2)} = 2.04 \times 10^{-3} \text{ m}^3
\]

71. **REASONING AND SOLUTION**

a. If the water behaves as an ideal fluid, and since the pipe is horizontal and has the same radius throughout, the speed and pressure of the water are the same at all points in the pipe. Since the right end of the pipe is open to the atmosphere, the pressure at the right end is atmospheric pressure; therefore, the pressure at the left end is also atmospheric pressure, or \( 1.01 \times 10^5 \text{ Pa} \).

b. If the water is treated as a viscous fluid, the volume flow rate \( Q \) is described by Poiseuille's law (Equation 11.14):

\[
Q = \frac{\pi R^4 (P_2 - P_1)}{8 \eta L}
\]
Let $P_1$ represent the pressure at the right end of the pipe, and let $P_2$ represent the pressure at the left end of the pipe. Solving for $P_2$ (with $P_1$ equal to atmospheric pressure), we obtain

$$P_2 = \frac{8 \eta LQ}{\pi R^4} + P_1$$

Therefore,

$$P_2 = \frac{8(1.00 \times 10^{-3} \text{ Pa} \cdot \text{s})(1.3 \text{ m})(9.0 \times 10^{-3} \text{ m}^3 / \text{s})}{\pi (6.4 \times 10^{-3} \text{ m})^4} + 1.013 \times 10^5 \text{ Pa} = 1.19 \times 10^5 \text{ Pa}$$