3. Let T_L be the temperature and p_L be the pressure in the left-hand thermometer. Similarly, let T_R be the temperature and p_R be the pressure in the right-hand thermometer. According to the problem statement, the pressure is the same in the two thermometers when they are both at the triple point of water. We take this pressure to be p_3. Writing Eq. 19-5 for each thermometer,

$$T_L = (273.16\,\mathrm{K})\left(\frac{p_L}{p_3}\right) \qquad \text{and} \quad T_R = (273.16\,\mathrm{K})\left(\frac{p_R}{p_3}\right) \ ,$$

we subtract the second equation from the first to obtain

$$T_L - T_R = (273.16\,\mathrm{K})\left(\frac{p_L - p_R}{p_3}\right) \ .$$

First, we take $T_L = 373.125\,\mathrm{K}$ (the boiling point of water) and $T_R = 273.16\,\mathrm{K}$ (the triple point of water). Then, $p_L - p_R = 120\,\mathrm{torr}$. We solve

$$373.125\,\mathrm{K} - 273.16\,\mathrm{K} = (273.16\,\mathrm{K})\left(\frac{120\,\mathrm{torr}}{p_3}\right)$$

for p_3. The result is $p_3 = 328\,\mathrm{torr}$. Now, we let $T_L = 273.16\,\mathrm{K}$ (the triple point of water) and T_R be the unknown temperature. The pressure difference is $p_L - p_R = 90.0\,\mathrm{torr}$. Solving

$$273.16\,\mathrm{K} - T_R = (273.16\,\mathrm{K})\left(\frac{90.0\,\mathrm{torr}}{328\,\mathrm{torr}}\right)$$

for the unknown temperature, we obtain $T_R = 348\,\mathrm{K}$.