Solution

The water added to the vessel evaporates. Assume that the whole portion of water evaporated. Then the density of water vapor in 100°C should be 0.300 g/l. It is less than the density of saturated vapor at 100°C equal to 0.597 g/l. (The students were allowed to use physical tables.) So, at 100°C the vessel contains air and unsaturated water vapor only (without any liquid phase).

Now we assume that both air and unsaturated water vapor behave as ideal gases. In view of Dalton law, the total pressure p in the vessel at 100°C is equal to the sum of partial pressures of the air p_a and unsaturated water vapor p_v:

$$p = p_a + p_v .$$

As the volume of the vessel is constant, we may apply the Gay-Lussac law to the air. We obtain:

$$p_a = p_0 \left(\frac{273+t}{273} \right).$$

The pressure of the water vapor may be found from the equation of state of the ideal gas:

$$\frac{p_v V_0}{273+t} = \frac{m}{\mu} R ,$$

where m denotes the mass of the vapor, μ - the molecular mass of the water and R – the universal gas constant. Thus,

$$p_v = \frac{m}{\mu} R \frac{273+t}{V_0}$$

and finally

$$p = p_0 \frac{273+t}{273} + \frac{m}{\mu} R \frac{273+t}{V_0} .$$

Numerically:

$$p = (1.366 + 0.516)\ \text{atm} \approx 1.88\ \text{atm}.$$