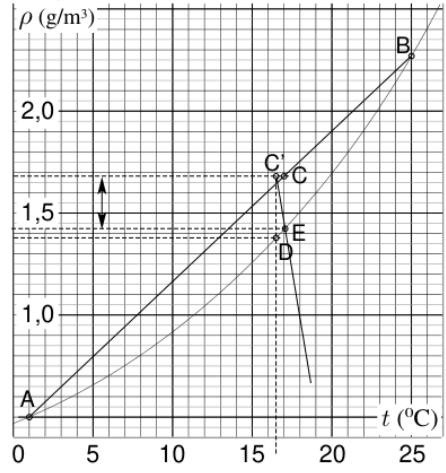
1. Drying

1) Let the number of moles of cold and warm air be ν_1 and ν_2; letC_V designate the molar heat capacitance at a fixed volume. Then the total change of internal energy is $\Delta U = C_V[\nu_1(T - T_1) + \nu_2(T - T_2) = (C_V p_0/R)(V - V_1 - V_2)$ (using the ideal gas law). Internal energy change must be equal to the work of the external pressure: $(C_V p_0/R)(V - V_1 - V_2) = p_0(V - V_1 - V_2)$, hence $V - V_1 - V_2$ (since $C_V/R \neq 1$).

2) The molar amount of gas $(p_0/R)(V_1/T_1 + V_2/T_2) = (p_0/R)(V_1 + V_2)/T_*$, hence $T_* = (V_1 + V_2)/(V_1 T_1^{-1} + V_2 T_2^{-1})$, i.e. $t_* \approx 16{,}5\,^\circ\mathrm{C}$.

3) The vapor mass $m_a = \rho_a(t_1)V_1 + \rho_a(t_2)V_2$, the mass of saturating vapor at the given temperature $m_{ak} = \rho_a(t_*)(V_1 + V_2)$. Relative humidity $r = m_a/m_{ak}$, because at the fixed temperature, the pressure is proportional to the density. So, $r = \tilde{\rho}_a/\rho_a(t_*)$, where the weighted average of the vapor $\tilde{\rho}_a = [\rho_a(t_1)V_1 + \rho_a(t_2)]/(V_1 + V_2)$ — this value can be found from the graph as the coordinate of the point C: we draw the line $at + b$, connecting points A and B, and take the reading for the point C lying on the line $at_{**} + b \approx 1{,}68\,\mathrm{g/m^3}$ at $t_{**} = 17\,^\circ\mathrm{C}$ (this value divides the interval $[t_2; t_1]$ in the proportions $V_1 : V_2$). The saturating vapor pressure at the given temperature is found as the coordinate of the point D: $p_a(t_*) \approx 1{,}38\,\mathrm{g/m^3}$. Finally we obtain $r \approx 1{,}22 = 122\%$.



4) In order to find the condensating mass, we write down heat balance: $c_p\rho_0\Delta t = q[\tilde{\rho}_a - \rho_a(t_* + \Delta t)]$, where Δt is the temperature change due to the condensation. By designating $t_* + \Delta t = \tau$ we can rewrite the balance as $\rho_a(\tau) = \tilde{\rho}_a - c_p\rho_0(\tau - t_*)/q$. So, we need to find the intersection point E of the curve $\rho_a(\tau)$ with the line $\tilde{\rho}_a - c_p\rho_0(\tau - t_*)/q = \tilde{\rho}_a - 0{,}478\,\mathrm{g\cdot m^{-3}K^{-1}}\cdot(\tau - t_*)$ (line $C'E$ in Fig.). Using the graph we find $\Delta\rho \approx 0{,}25\,\mathrm{g/m^3}$ — this is the length of the line with arrows. So, the condensating mass $\Delta m = \Delta\rho(V_1 + V_2) \approx 7{,}5\,\mathrm{g}$.

Thus, when meteorologists tell us that at the meeting point of cold and hot air, there are heavy rains, the phenomenon can be explained by this problem.