7. Fire (6 points)

There is wet wood burning in a fireplace on the ground. Seven meters above ground, the smoke is at a temperature of $t_7 = 40\,^\circ\mathrm{C}$. Disregard the exchange of heat with the surrounding air and assume that the atmospheric pressure at the ground is constant in time and equal to $p_0 = 1000\,\mathrm{hPa}$; the air temperature $t_0 = 20\,^\circ\mathrm{C}$ is independent of height[1]. Assume that the smoke represents an ideal gas of a molar mass $\mu = 29\,\mathrm{g/mol}$ (i.e. equal to the molar mass of the air), and of a molar specific heat at constant volume $C_V = 2.5R$; universal gas constant $R = 8.31\,\mathrm{J/kg \cdot K}$. How high will the smoke column rise?

[1] Actually, during day time, this is not the case: air temperature decreases with height. However, during evening and night, due to heat radiation, the lower layers of air cool more rapidly than upper layers, and it may easily happen that the temperature is roughly independent of height.