9. Stratostat ***(5 points)***

i) Show that the pressure of an isothermal gas of molar mass μ follows the law $p = p_0 e^{-\alpha z}$, where p_0 is the pressure at the origin, and z is the height. Find the constant α. The temperature is T, the free fall acceleration is g.

ii) Consider a stratostat, the envelope of which (a freely deformable non-elastic sack) is filled at the Earth's surface by helium to the volume fraction of $\beta = 10\,\%$. At which height h does the helium expand so that it fills the entire volume of the stratostat? The molar masses of the air and helium are $\mu_a = 29\,\mathrm{g/mol}$ and $\mu_{\mathrm{He}} = 4\,\mathrm{g/mol}$, respectively. You may neglect the temperature variations of the atmosphere, and use the value $T = 250\,\mathrm{K}$.