[tex79] Classical ideal gas in uniform gravitational field

Consider a column with cross-sectional area A of a classical ideal gas (N atoms of mass m) in a uniform gravitational field of magnitude g. The gas is in thermal equilibrium at temperature T. The Hamiltonian reads:

$$H = \sum_{l=1}^{N} \left(\frac{p_l^2}{2m} + mgz_l \right),$$

where z_l is the height of particle l above sea level.
(a) Find the probability density $\rho_1(z)$ for the vertical positions of individual gas atoms.
(b) Find the pressure distribution $p(z)$.

Solution: