

[tex135] Gas pressure and density inside centrifuge

Consider a hollow disk of width L and radius R filled with N particles of a dilute gas at temperature T . The disk is in a state of rotation with angular velocity ω about its axis.

(a) Find the probability density $\rho_1(r)$ for the radial position of a gas particle and find the particle density $n(r)$. Note that the unit of $\rho_1(r)$ is $[\text{m}^{-2}]$ and the unit of $n(r)$ is $[\text{m}^{-3}]$.

(b) Find the pressure $p(r)$.

(c) In an experiment that measures $p(0)$ and $p(R)$ at various values of ω and fixed T , which two quantities must be plotted against each other such that the data points are predicted to fall onto a straight line with slope equal to the mass of the gas particles?

Solution: