Show that the single-particle partition function for a dilute gas of monatomic indistinguishable particles is given by

$$Z_{sp} = V \left(\frac{2\pi \, mkT}{h^2} \right)^{3/2}$$

Show that in an adiabatic change

$$p \text{ is proportional to } V^{-5/3}$$

((p is pressure, V is volume, k is Boltzmann constant))