Prob-1

Consider 100 mL of a dilute solution of a protein contained in a beaker.

Conditions of equilibrium are maintained. The temperature and pressure are constant at 37 deg C, and 1 atm, respectively.

i)   When can it be assumed that the speeds of individual particles follow the Maxwell-Boltzmann velocity distribution?

ii)   Write down the expressions for a) velocity component (say u_y), and
        b) velocity magnitude (u) distributions.

iii) Show all steps to find the *means*, ie. $< u_y >$ and $< u >$

iv) Show all steps to find the *root mean square* values, ie. $< u_y^2 >$ and $< u^2 >$

v) Find the variance and standard deviations of u_y and u.

Prob-2

Consider that the protein under consideration in the last problem is an enzyme.
The *activity* (units: micromoles second^{-1}) of this enzyme scales as the square root of its kinetic energy, with a pre-factor 'B'.

i)   What are the units of 'B'?

ii)   Estimate the mean activity.