Properties Quiz 1 010403

In class we compared the structure of a polymer coil to the path of a Brownian particle.

a) **-Give** a function that describes the distance traveled on average for a Brownian particle.
-Compare this function with the function for the root mean square (RMS) end-to-end distance for a polymer coil.

b) **-What** function describes the probability of a given end-to-end distance (give the function and its name).
-Sketch this function on a probability versus distance plot.
-What is the probability of R = 0, where R is the end-to-end distance?

c) **-Describe** two problems with this description of a polymer coil.

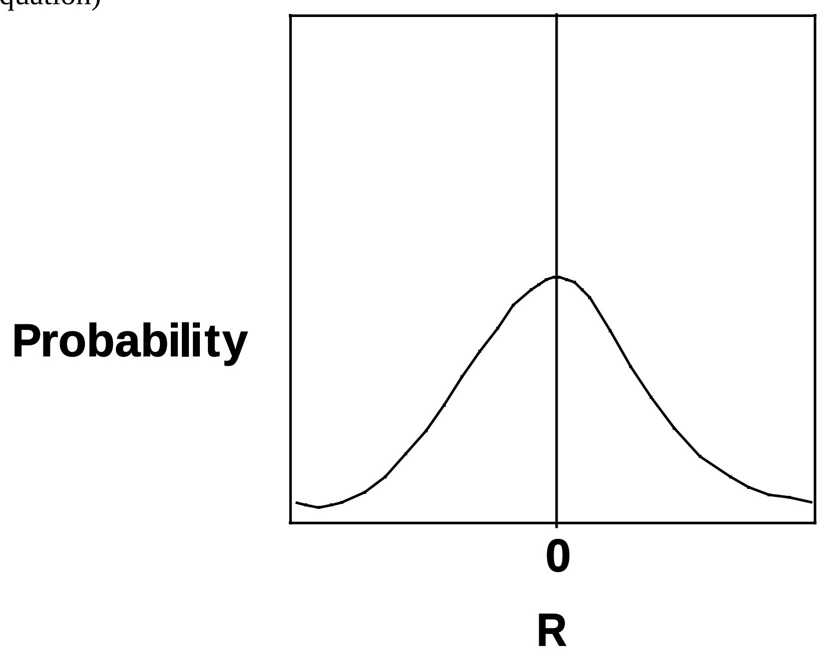
d) **-From** a dimensional perspective how are a plate and a Brownian coil similar?
-From a dimensional perspective how do they differ?

e) **-Explain** how the pair correlation function, g(r) is calculated.
-Give a plot of g(r) for a solid sphere of diameter D.
-Could your sketch correspond to a structure other than a sphere?

Answers: Properties Quiz 1 010403

a) $R = kt^{1/2}$ and $\langle R^2 \rangle^{1/2} = n^{1/2}\, l$
The two are comparable in that the Brownian particle traces out a random walk. If the path of the Brownian particle is decomposed into a series of n steps at constant rate and of step size l then the two equations can be converted to each other.

b) Gaussian Function
(see notes for equation)

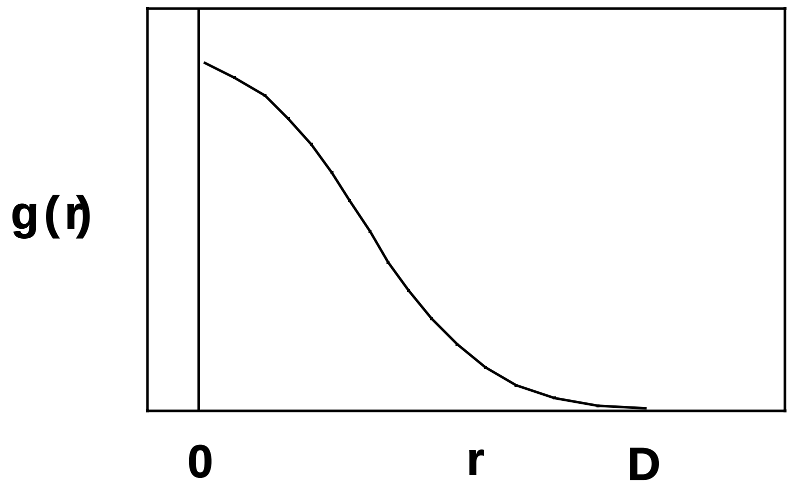


Probability for R=0 is $(2\pi nb^2/3)^{-3/2}$

c) Short range interactions make the chain deviate from freely jointed state.
Long range interactions prevent the chain from crossing itself.

d) Both a plate and a Brownian coil are 2-dimensional objects.
They differ in that the connectivity dimension is 2 for a regular object such as a plate and 1 for a linear structure such as a polymer coil.

e) The pair correlation function is calculated by considering the density of a structure about a point as a function of the distance from a point, r and then averaging this density for all initial points in a structure. For a sphere this is a decay function in r that reaches 0 at the diameter of the sphere.



In calculating the correlation function phase information is lost so there is not a one to one correspondence between the structure, i.e. sphere, and the correlation function. The sphere correlation function could result from a structure other than a sphere.