Quiz 4 Polymer Properties 080206

 The radius of gyration for an object made of discrete steps, such as a freely jointed chain, can be obtained with summation. For continuous objects, such as disks and rods, an integration over all points must be made to determine R_g.

a) Obtain the radius of gyration for a rod, R_g^2 , by performing a normalized double integral over length and radius using a coordinate system with an origin at the center of mass for the rod. You need to use cylindrical coordinates so the integral for a function R_g^R .

$$f(r,y)$$
 is $\int_{r=0y=-H} \int 2\pi r f(r,y) dr dy$. (Remember to normalize by an integral with $f(r,y) = 1$.)

b) Consider a plus sign made of spheres with 3.5 spheres per arm. Calculate the R_g^2 for this object by defining the center of mass, performing a summation and normalizing the result. Does this answer change for a rod of 7.5 spheres per arm (yes or no)? Does it change for a "jack" (6 arm star) (yes or no)?

c) Compare your answer for a plus sign with the radius of gyration for a sphere of diameter 7. (This can be calculated by a normalized spherical integral about the center of mass $\int_{r=0}^{R} r^2 (r^2 dr) / \int_{r=0}^{R} (r^2 dr)$ or you can just use the answer and compare if you remember

- 2) Scattering from a disordered structure such as a polymer coil is often plotted on a log-log scale.
 - a) Why is a log-log plot used?
 - b) What equation is used to determine the radius of gyration and sketch the appearance of this function on a log-log plot.
 - c) In what way is this equation a Gaussian function and why might this be true?
- 3) Explain how the moiré fringe pattern shown in class relates to scattering by:
 - a) Explain the conditions for a fringe to occur.

b) Explain the relationship between the fringes and the angle of scattering in terms of spacing.

c) Explain the relationship between the fringes and the angle of scattering in terms of orientation of the fringes (i.e. what angle do the fringes fall on compared to the scattering angle, θ ?).

D $\int_{r=0}^{k} \int_{-K}^{K} 2\pi r (r^{2} + h^{2}) dr dy = 2\pi \int_{-K} \int_{-K} \left[\frac{r}{4} + \frac{r}{2} y \right]^{R} dy$ I) a) the mass or degree of polymeriz $\sqrt{p}\left(\frac{x}{2}^{2}+\frac{R^{2}}{2}+\frac{R^{2}}{2}\right)$ is Councillage and size Marie the scaling exponent $\sqrt{p}\left(\frac{R^{2}}{2}+\frac{R^{2}}{2}\right)$ is Course in $\sqrt{p}\left(\frac{R^{2}}{2}+\frac{R^{2}}{2}\right)$ $= T \left[\frac{R^4 \gamma}{2} + \frac{R^2 \gamma^3}{2} \right]^{-1}$ $\frac{1}{1} = \frac{1}{12} \left[R^4 H + \frac{2R^2 H^3}{12} \right]$ St=0-4 2TT r dudy = 2TT R² H $R_{j}^{2} = \frac{\int (y^{2}+y^{2}) dv dy}{\int v dv dy} = \frac{R^{2}}{2} + \frac{1}{2}$ b b) What is the connectivity dimension for crumpled aluminum foil c) The tensile modulus for a crur/ple $\sum_{i=1}^{2} 2\left(2 \leq i^{2}\right) = \frac{4}{4} \cdot (1+4)$ a) Describe [le difference between short We interactions (SRI) and long range interactions (LRI). For the balled sheets of question 2, consider that balls of paper spring interactions (LRI). For the balled sheets of deciding contracts on the springiness open when pressure is released while $b(\frac{4}{4}) \cdot m \cdot \mu$ um foil do not. Is this springiness associated with short range $b(\frac{6}{4}) \cdot m \cdot \mu$ in paper. b) Describe the differences be with n) statistic ξ_1 egment length, ii) chemical unit length, iii) for the length of the springing in the springing of the sp sheet in figure 1 above. (see for example (80.51) 10^{-1} 10^{-1} 35 3056-3071 (1987)) For 7 spheres $R_1^2 = \frac{2(2\overline{2}, 2)}{N}$

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(2) For Jack $n_{1}^{2} = \frac{3(2\xi_{1}^{2})}{\sum_{i=1}^{3}} = \frac{6\cdot(14)}{19} = 4.42$ H 6(3) = 2.10 Close to the same. 2) a) log-log plotrace med to high light power law functions I(j)~ g de bueraple b) Guinice's Law 2(5)= 6 eg(5-1) lgI lagg c) Guinier's law is a gaussian dustribution about g=0 G 2(5) The Fourier Transform of a saussian is another gaussian so the Carelation function is a Gaussian 920

The Gaussian conclation function is related to the Wilson Gost particle. For any structure verden depict the public lity of 2 points squale by a distance 'n heing in the particle by rotating the particle about any part in the particle so that a probability density cloud is curdied whose density distribution function is a Gaussian by any dispert. 3) a) Fringer occar when incident & scattered wavegave highere? bed Fingos arour along aline at 9/2 ayle if the scattered angle is O. The Finger ancient of paring with smaller angle & have no upper limit but have a lower limitof 1/2.