Homework # 2. Due Friday 5/20 at 11:59pm. Send to yenglong@phys.sinica.edu.tw

Stress response function

1. Consider a viscoelastic fluid with a stress relaxation with a stress relaxation modulus

$$G(t) = G \; \frac{\exp(-t/\tau_s)}{1 + \left(\frac{t}{\tau_F}\right)^{\frac{1}{2}}}$$

Where G0 is the t=0 modulus. The two relaxation times characterize two very different molecular dynamic processes, one fast and one slow. They obey the strong inequality : $\tau_S >>> \tau_F$.

a) Sketch (not mathematically or numerically compute) the storage and loss modulu, $G'(\omega)$ and $G''(\omega)$, in a log-log format. Clearly show the different power law regimes, their slope, & crossover frequencies.

b) Estimate (not compute) the shear viscosity

Scaling arguments

2) (a) Show that for a dilute real (self-avoiding) polymer adsorbed on a two-dimensional surface, the radius of gyration $R_g \sim \sigma N^{3/4}$, where N is number of blobs and σ is the blob size.

(b) The characteristic diffusion time for a polymer adsorbed on a two-dimensional surface is

$$t = \frac{R_g^2}{D} \quad \text{, where} \quad D = \frac{kT}{\zeta} = \frac{kT}{N\zeta_0} \text{ (Rouse) and } \quad D = \frac{kT}{\zeta} \sim \frac{kT}{R_g} \text{ (Zimm)}$$

It has been observed that the Zimm model applies for an unconfined polymer in free solution, and the Rouse model applies for a polymer adsorbed on a surface.

Derive the dependence of t on the confinement height h, as a free solution is confined in a slit of height h.