Quiz 4 4/24/01 Polymer Properties

a) For a polymer chain with N_p = 300 and l_p = 6Å calculate:

R_F for a very good solvent

R_F for a theta solvent

R_F for a good solvent with , ξ_t = 30Å

R_F for a very good solvent in the semi-dilute regime with ξ_p = 30Å

b) Sketch the log I versus log q scattering curves for the above 4 cases. Make sure to indicate any changes in the radius of gyration.

c) How does the overlap concentration, c*, depend on molecular weight, N?

d) Calculate the dependence of the concentration blob size ξ_p on concentration, c, given that:

$$\xi_p = R_{F0}\,(c/c^*)^P$$

where P is a power you need to determine, and R_{F0} is the coil size in the dilute regime for a very good solvent. (Hint: You need to know the N dependence of ξ_p to do this calculation.)

e) **Write** an expression for the themal (thermic) blob size, ξ_t, as a function of the persistence length, l_p and the interaction parameter χ_{12}.

-Give and explain the three regimes defined by this expression.

Answers: Quiz 4 4/24/01 Polymer Properties

a) Very Good Solvent $R_F = N^{3/5}\, l_p = 300^{3/5}\, 6 = 184$ Å

Theta Solvent $R_F = N^{1/2}\, l_p = 300^{1/2}\, 6 = 104$ Å

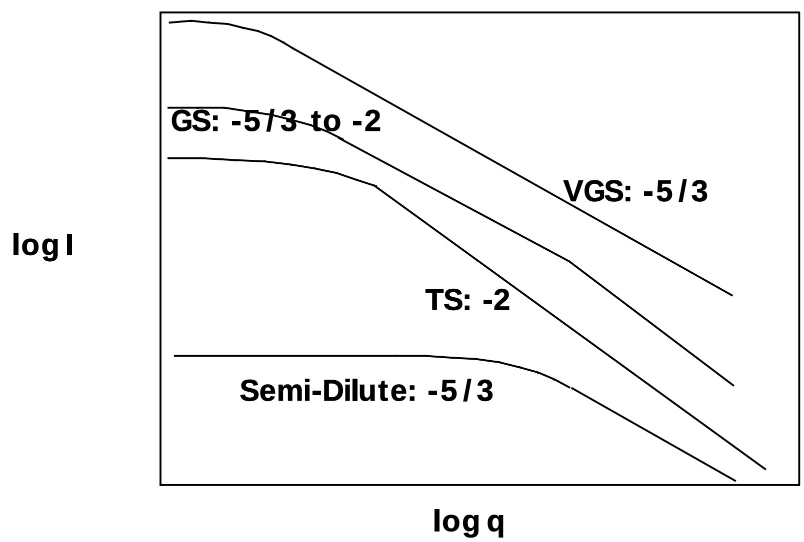
Good Solvent $\xi_t = 30\text{Å} = n_t^{1/2}\, l_p$, $n_t = 25$ so $N_t = (300/25) = 12$

$R_F = N_t^{3/5}\, \xi_t = 133\text{Å}$

Semi-Dilute $\xi_p = 30\text{Å} = n_t^{3/5}\, l_p$, $n_t = 14.6$ so $N_t = (300/14.6) = 20.5$

$R_F = N_p^{1/2}\, \xi_p = 136\text{Å}$

b)



c) $c^* = N/R_F^3 = N^{1-3/df} = N^{-4/5}$

d) ξ_p doesn't depend on molecular weight, while c* has the dependence in c) and R_{F0} goes as $N^{3/5}$. $N^0 = N^{3/5}(N^{4/5})^P$, so P must equal -3/4.

e) $\xi_t = l_p/(1-2\chi_{12})$

This equation defines three regimes:

$\chi_{12}<0$ where ξ_t doesn't exist

$\chi_{12}=0$ where ξ_t just equals l_p

and the thermic blob regime, $\chi_{12}>0$ where $\xi_t>l_p$. The thermic blob exists as a compromise between entropically driven miscibility at large scales and enthalpically driven phase separation at small scales.