Quiz 12 Polymer Properties November 15, 2013

1). Farnoux (Farnoux B, Boue F, Cotton JP, Daoud M, Jannink G, Nierlich M, de Gennes PG, J. de Phy. **39** 77 (1978)) shows the following graph of I^{-1} versus $q^{5/3}$ to support the concept of a concentration blob (a modified Ornstein-Zernike or Zimm plot).

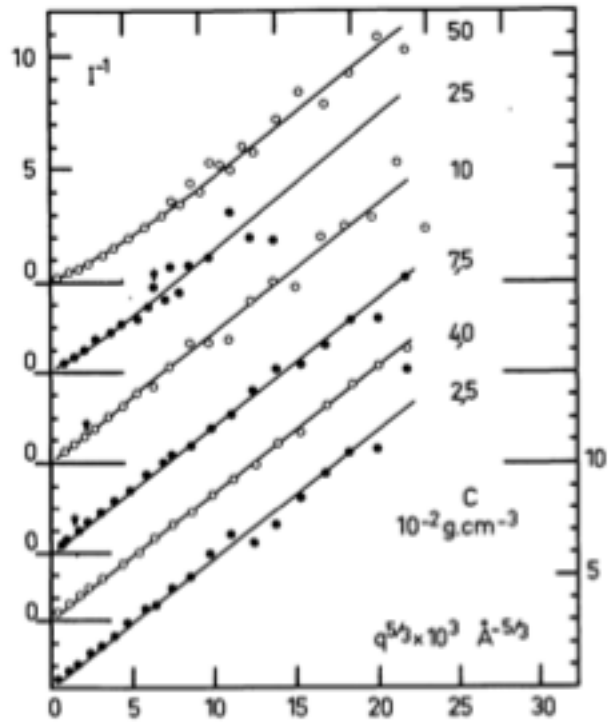

FIG. 2. — Plot of the inverse scattered intensity *versus* the scattering vector raised to the power 5/3 for samples E to J (see table II). The total concentration *C* is indicated on the right. Each solution contains a concentration of 0.005 g cm^{-3} of PSD chains. Open and closed points are experimental data. Solid lines are the result of calculation using formula (3.8). Vertical arrows show the theoretical cross-over point.

a) Digitize the plot for the 50, 25 and 4.0 x 10^{-2} g/cm^3 samples using a shareware program like PlotDigitizer (PC) or GraphClick (Mac), convert 1/I to I/c (c = concentration) and $q^{5/3}$ to q then replot on a log log plot I/c versus q to show the effect of concentration on the scattering profile. (Note that the y-axis is offset for the progressive samples by differing amounts, 50:0, 25:4, 4.0:15).
b) The tailover point in Farnoux's plot is found from the deviation of the linear region, in your log-log plot how does this transition appear?
c) Explain how these graphs support or do not support the concentration blob model. Describe the model and explain how the graph scaling regimes supports the model.
d) Derive the expected dependence of blob size on concentration and compare the blob size you obtain from your plot or that obtained by Farnoux with this predicted dependence by plotting ξ versus c^P. Can you obtain c* from this plot?
e) Explain what are c* and c** in terms of ξ, R_g and l_p.

2). Farnoux (Farnoux B, Boue F, Cotton JP, Daoud M, Jannink G, Nierlich M, de Gennes PG, J. de Phy. **39** 77 (1978)) shows the following graph of I^{-1} versus q^2 to support the concept of a thermic blob (a modified Ornstein-Zernike or Zimm plot).

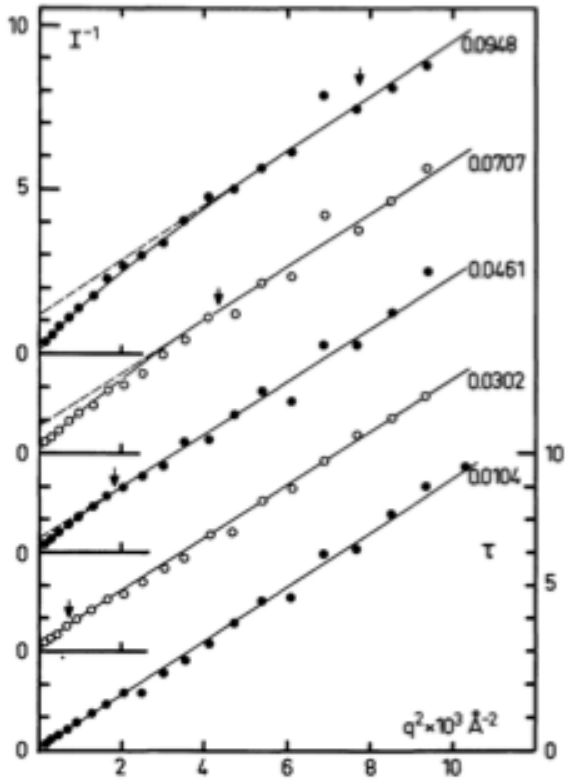

FIG. 7. — Inverse of the scattered intensity *versus* the square of the scattering vector. Points are experimental data recorded at different reduced temperatures τ as indicated on the right. The solid curves are the results of calculation using the formula (3.16). Vertical arrows show the theoretical cross-over point.

a) Why does the x-axis differ from that in question "1"?
b) Digitize the plot for the $\tau = 0.0948$, 0.0461 and 0.0104 samples using a shareware program like PlotDigitizer (PC) or GraphClick (Mac), convert 1/I to I and q^2 to q then replot on a log log plot I versus q to show the effect of temperature on the scattering profile. (Note that the y-axis is offset for the progressive samples by differing amounts, 0.0948:0, 0.0461:6 and 0.0104:12). Draw lines of slope -2 and slope -5/3 on this plot to show the scaling regimes for these three temperatures.
c) The tailover point in Farnoux's plot at low-q is found from the deviation of the linear region, in your log-log plot how does this transition appear?
d) Explain how these graphs support or do not support the thermic blob model. Describe the model and explain how the graph scaling regimes supports the model.
e) In class the thermic blob size is related to temperature through the interaction parameter. Give this expression and obtain an expression for the thermic blob size as a function of $\tau = (T-\theta)/\theta$. How does the blob size from your plot or from Farnoux's plot compare with this expected behavior from the thermic blob model?