Homework 7
CM4650 Spring 2016

Due: *Wednesday 25 April 2018, in class*

Please do not write on the back side of the pages you submit. Please write legibly and large. Thank you. Note that there is a typo in the note at the bottom of Table 9.3. See the link and the reverse of this page: http://www.chem.mtu.edu/~fmorriso/cm4650/URerrata.html

1. (10 points) If you had the SAOS data for a polymer $G'(\omega), G''(\omega)),$, $10^{-2} \leq \omega, \frac{rad}{s} \leq 10^{2}$, how would you calculate the shear start-up response $\eta^{+}(t, \dot{\gamma}_0)$? Over what range of $\dot{\gamma}_0$ would you be able to predict the function $\eta^{+}(t)$?

2. (10 points) We showed that we can "fix" constitutive equations by using the Finger tensor as the strain measure or by using the Cauchy tensor as the strain measure. What is wrong with constitutive equations that we need to *fix* them in this manner? Please use your own words (do not directly quote the book or others).

3. (20 points) In Table 9.3, the quantity "γ" appears in the expressions in the shear column. What is γ for the following cases (show your work):
    a. Startup of steady shear
    b. Cessation of steady shear

4. (30 points) Text 9.16 Calculate the start-up of steady shear material functions $\eta^{+}(t)$, $\Psi_1^{+}(t)$, and $\Psi_2^{+}(t)$ for the Lodge model. Plot your results.

5. (20 points) Text 10.18 (How to respond to low torques.)

6. (10 points) What shear geometries would we use to experimentally determine the following material functions. Why would we favor these geometries? That is, why are some geometries suitable for some measurements and less suitable for others?
    a. Steady shear flow at low shear rates
    b. Steady shear flow at high shear rates
    c. Start up of steady shearing
    d. Step shear strain

Chapter 10 *errata of Understanding Rheology*
http://pages.mtu.edu/~fmorriso/cm4650/URerrata.html#ch10

p.391 - Equation 10.44 should be labeled "Wall shear rate in capillary flow of any homogeneous fluid".
p. 393, line 10 from bottom. Change "Q" to "Q/R^3".
p. 435 - The problem should read: "For the data in Figure 10.8, calculate the true pressure drop as a function of L/R."
p.436 - In problem 10.19 parts b) and c) the shear rate listed should be 10 s^{-1} (the "s" is missing in both cases)