Chem Engr. 06-607 Physical Chemistry of Colloids and Surfaces

Homework #1 **1-22-02**

Due: 1-31-02, beginning of class.

1. A preparation of viral protein particles in water reached sedimentation equilibrium at 25 C after 4 hr. of centrifugation at 12,590 revolutions per minute (rpm). The following data show the reading from a fluorescence recorder, which is proportional to concentration:

c (arb. units)	2.29	2.51	2.79	3.09	3.51	3.89	4.47	5.01	5.89	6.61	7.41	8.51
r(cm)	6.55	6.58	6.60	6.65	6.67	6.69	6.71	6.74	6.76	6.79	6.81	6.84

a) Use these results to evaluate the mass of particles present (density, dry protein = 1.370 g/cm^3) and estimate the unsolvated radius and f_0 for the particles. Is the sample monodisperse? Explain.
b) The sedimentation coefficient is 2.7 S for this preparation. Evaluate f and f/f_o.
c) What can be said about the possible axial ratio-hydration combination of this protein?

2. Southern bean mosaic virus particles are centrifuged at 12,590 rpm and the absorbance at 260 nm is measured along the settling direction as a function of time. The center of the absorption band varies with distance from the center of the rotor as follows:

t (min.)	16	32	48	64	80	96	112	128	144
r(cm)	6.22	6.32	6.42	6.52	6.62	6.72	6.82	6.92	7.02

Find the sedimentation coefficient.

3. Lipid micelles in a suspension have a molecular weight of 97,000 g/mole. Assuming the density of dry lipid applies to micelles (1.018 g/cm^3), calculate the radius and D_{AB} for these particles at 20 C. In a separate measurement, the D_{AB} for the micelles was found to be 6.547 x 10^{-7} cm^2/s under these same conditions. What is the extent of hydration for the micelle?

4. The molecular weights and sedimentation coefficients of human plasminogen and plasmin (density = 1.40 g/cm^3) are as follows:

	Plasminogen	Plasmin
M (g/mole)	81,000	75,400
S, 20 C (S)	4.2	3.9

a) Find D_{AB} for each.
b) Plot how an initially thin band widens with time for three different times.

5. The following data give the number of gold particles *(n)* vs. depth for an aqueous dispersion allowed to reach sedimentation equilibrium under the influence of gravity:

Depth(mm)	4.44	5.06	5.67	6.30	6.90	7.53	8.15	8.65
log *n*	10.36	10.51	10.63	10.75	10.89	11.05	11.22	11.39

Find the radius of the gold particles (density = 19.3 g/cm^3), assuming a spherical geometry.