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

Homework #7 **4-9-02**

Due: 4-18-02, beginning of class.

1. Calculate the stability ratio for a monodisperse population of particles (R=100 nm) in water (T =298K) whose pair interaction potential in water is given by:

$$\frac{V(r)}{kT} = B\exp[-k(r-2R^*)]$$

where k=0.18 nm^{-1}, r is the center-to-center distance between particles, k is the Boltzmann constant, T is the absolute temperature, B is a constant that depends on the particle's charge (B=40), and R* is some characteristic length that can be approximated by the particle radius. *You will need to use numerical integration for this.*

2. Problem 8.4, Evans.

3. If coagulation involves two spheres of different radius R_i and R_j, show that the expression for the flocculation rate constant *(k_r)*:

$$k_r = \frac{2kT}{3m}(R_i + R_j)\left(\frac{1}{R_i} + \frac{1}{R_j}\right)$$

can be reduced to :

$$k_r = \frac{2kT}{3m}\left[4 + \left(\sqrt{\frac{R_i}{R_j}} - \sqrt{\frac{R_j}{R_i}}\right)^2\right]$$

Ottewill and Wilkins (*Trans. Faraday Soc.* 58:608, 1962) observed a k_r of 2.9 x 10^{-11} cm^3/s. What ratio of two radii would account for this rate constant (use 0.01 g/cm-s for the viscosity of water, T=298 K)?

4. The critical coagulation concentration (CCC) was measured for a $Fe(OH)_3$ sol in water (T=298 K) using a series of electrolytes. The results were:

Electrolyte	CCC (mM)
NaCl	9.25
KBr	12.2
$BaCl_2$	4.8
K_2SO_4	0.20
$MgSO_4$	0.22

a) Is the sol positively or negatively charged?

b) Is the surface charge density relatively high or low?

c) Estimate the surface potential.