Suspensions and polymer solutions

Exercise 3

13 November 2006

1. Consider a parallel stack of infinite membranes in water. The membranes are charged and interact via the DLVO potential between surfaces.

   (a) Derive a necessary condition, involving the membrane charge density σ, the Debye screening length κ^{-1}, the dielectric constant ϵ, and the Hamaker constant H, for the stack not to collapse, i.e., for the membranes to remain separated from one another.

   (b) If we neglect the membrane entropy, we may assume that the equilibrium separation between membranes in the stack is given by the minimum of inter-membrane potential. Calculate this separation for a charge density of 1 e/nm^2, salt concentration of 0.1 M, room temperature, and ϵ and H of water.

2. Derive the Asakura-Oosawa potential of the depletion interaction between two sphere of radius a_l in the presence of smaller spheres of radius a_s.