Suspensions and polymer solutions

Exercise 3

23 March 2011

1. Consider a parallel stack of infinite membranes in water. (This models a common material called a lamellar phase.) The membranes are charged and interact via the DLVO potential between surfaces. (This corresponds to the so-called electrostatically stabilized lamellar phase.)

   (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 (numerically) 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.