

Suspensions and polymer solutions

Exercise 1

9 March 2011

1. Derive the expression for the Debye screening length in a general electrolyte, containing any number of different ions, each having valence z_i and bulk concentration c_i .
2. (a) Calculate the free energy of interaction of two oppositely charged plates (surface charge densities $\pm\sigma$) in a salt solution, within the Debye-Hückel approximation, as a function of the inter-plate separation d .
(b) Compare the result to the one we derived for similarly charged plates. Where are the spatial decays of the interactions in the two cases similar, and where do they dramatically differ? Examine specifically the limit $d \rightarrow 0$.
(c) Try to give an intuitive explanation for the difference between the two cases.
3. (a) Generalize the Derjaguin approximation to the case of two spherical particles of unequal radii, a and b .
(b) Use the result to derive the expression for the force between a sphere and a planar surface.