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

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

where \(\kappa=0.18 \text{ nm}^{-1}\), \(r\) 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 \((k_r)\):

\[
k_r = \frac{2kT}{3\mu} \left( R_i + R_j \left( \frac{1}{R_i} + \frac{1}{R_j} \right) \right)
\]

can be reduced to:

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

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

<table>
<thead>
<tr>
<th>Electrolyte</th>
<th>CCC (mM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaCl</td>
<td>9.25</td>
</tr>
<tr>
<td>KBr</td>
<td>12.2</td>
</tr>
<tr>
<td>BaCl$_2$</td>
<td>4.8</td>
</tr>
<tr>
<td>K$_2$SO$_4$</td>
<td>0.20</td>
</tr>
<tr>
<td>MgSO$_4$</td>
<td>0.22</td>
</tr>
</tbody>
</table>

a) Is the sol positively or negatively charged?

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

c) Estimate the surface potential.