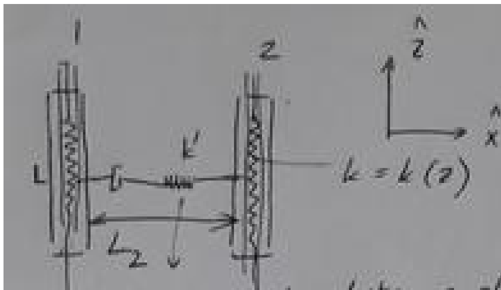
$$E_I = E_0 + \frac{Nkz^2}{2} - \frac{Nkz^3}{3L} - \frac{Nkd^3}{L}\tan^{-1}\left(\frac{z}{d}\right) - Nkd^2(\sec(\tan^{-1}(z/d)) - 1) + \frac{c}{d^6} + \frac{(pNkd^2)}{2}\frac{L-z}{L}, \quad (1)$$

See the sketch below. Each vertical, uncoupled, oscillator has potential energies corresponding to these eqns.

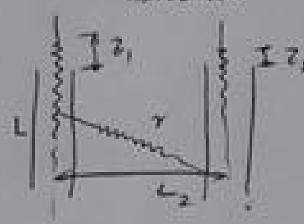
$$E_{II} = E_0' - \frac{Nkz^3}{3L} + \frac{c}{d^6} + \frac{(pNkd^2)}{2}\frac{L-z}{L}, \quad (2)$$

Eqn.(1) holds for z< L_m, eqn.(2) holds for z >L_m. Take L_m= 1.5 Angstroms. Take L as 6 angstroms. k has a value of 0.3-0.4 N/m. In the eqns N is an integer that is between 6 to 12, and p scales as p ~ N^(-0.32). d=3.4 angstroms. L_2 in the sketch below can be taken as 3 to 6 Angstroms (you can play around with this). Decide what you want to take for the value of the damping coefficient.



L_2 = separation between the two vertical non linear oscillators

horizontal elastic coupling



z_1, z_2 — extended lengths / displacements of the two vertical springs.

New length of the "horizontal spring" is r, $r^2 = (z_2 - z_1)^2 + L_2^2$

So the extension, Δl for the horizontal spring is $\Delta l = r - L_2$.

Take the magnitude of k' to be of the same or lesser order as that of k.

Additional term to include in the potential energy eqns. (1) & (2) is that due to the coupling. $k(\Delta l)^2/2$

Include dissipation due to the viscous damping. i.e., when you write the eqns of motion, use

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_i}\right) - \frac{\partial L}{\partial q_i} + \frac{1}{2}\frac{\partial D}{\partial \dot{q}_i} = 0$$

, D corresponding to the dissipation.

Here $D = \frac{1}{2}\eta \dot{x}^2$, η being some damping factor.