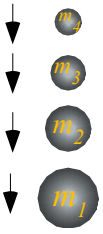
Assignment 3 Read Unit 1 Chapters 1 thru 8. *Ex. 1.7.2 and 1.8.1-3 are due Thursday Sept. 14, 2016*

The following is to acquaint you with of some lesser known properties of all-important parabolic PE functions

1.7.2 A most important mechanics problems is that of atomic oscillators affected by electric fields since it is basic to all spectroscopy. A useful approximate model is potential $V^{atom}(x)=k\,x^2/2$ function of center x of charge Q where k is a spring constant of atomic polarizability. A uniform electric field E is assumed to apply a force $F=Q\cdot E$ to the charge by adding a potential $V^{E}(x)$ to $V^{atom}(x)$. (Give $V^{E}(x)=$_____ and $F^{E}(x)=$_____)

Consider the resulting potential $V^{total}(x)$ for an atom for unit constants $k=1$ and $Q=1$. Derive and plot the new values for equilibrium position $x^{equil}(E)$, energy $V^{equil}(E)$, dipole moment $p^{equil}(E)=Q\cdot x^{equil}$. Plot $V^{total}(x)$ for field values of $E=-3,-2,-1, 0, 1, 2,$ *and* 3. Does oscillation frequency $\omega^{equil}(E)$ vary with field E? If so, how?

Superball tower IBM model constructions (Independent Bang Model with initial $V_k=-1$)



The 100% energy transfer limit

1.8.1 Suppose each m_k has just the right mass ratio m_k/m_{k+1} with the m_{k+1} above it to pass on all its energy to m_{k+1} so the top ball-N, a *1gm* pellet, goes off with the total energy. Construct velocity-velocity diagrams, indicate velocity at each stage, and derive the required intermediate mass values for (a) $N=2$, (b) $N=3$, (c) $N=4$.

(d) Give algebraic formula for this *Maximum Amplified Velocity* factor in terms of N *(MAV(N)=*_____*?)*.

(e) Give algebraic formula neighbor-mass ratios $R=M_{N-1}/M_N$ in terms of N *(R(N)=*_____*?)*.

The towering limit

1.8.2 Suppose each m_k is very much larger than m_{k+1} above it so that final v_{k+1} approaches its upper limit. Then top m_N goes off with nearly the highest velocity v_N attainable. Construct the velocity-velocity diagrams. Indicate each intermediate velocity limit value at each stage and the limiting top value for (a) $N=2$, (b) $N=3$, (c) $N=4$.

(d) Give algebraic formula for *Absolute Maximum Amplified Velocity* factor in terms of N *(AMAV(N)=*____*?)*.

The optimal idler (An algebra/calculus problem with a geometric result)

1.8.3 To get highest final v_3 of mass m_3 find optimum mass m_2 in terms of masses m_1 and m_3 that will do that.