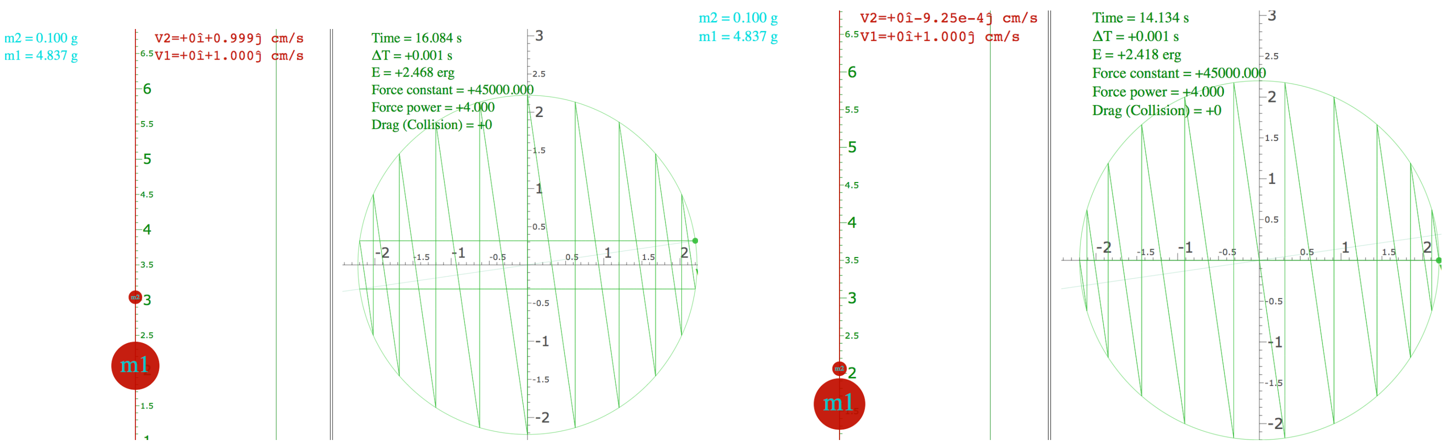
Assignment Set 3 - Read Unit 1 Ch. 3 thru Ch.7 Due *9/12/17* Name______________

Pseudo-Rotations for Independent Bounce Model

Exercise 1 Estrangian plot in Fig. 5.2 (Details on p.30-33 of Lecture 3) has mass ratio $M_1/m_2 = 49/1$ and has nearly periodic path plot. (Experiment using BounceIt on web. http://www.uark.edu/ua/modphys/testing/markup/BounceItWeb.html)
(Let the pen-mass be m_2=1 here.) Changing to M_1= 48.37 gives more nearly periodic symmetry paths seen below.



(a) What order N=___ of C_N or D_N polygonal symmetry is appearing here?

(b) Give a closed formula for value of M_1= 48.37...(to 7 figures) that approaches *exactly* periodic behavior. Simplest formula should relate the tangent of a desired Estrangian rotation half-angle $\theta/2$ to mass M_1.

(c) Ceiling height (It is $y_{\max} = 7.0$ for cases above) may eventually affect or destroy periodicity. Use BounceIt to show cases that are affected and discuss. (Many have chaotic behavior.)

KE becomes PE

Exercise 2 A mass m_1=*1kg* ball is trapped (like Fig. 6.3) between two smaller mass m_2=*1gm* balls of high speed ($v_2(0)$=*1000m/s* for x=*0*). Suppose this affects m_1 with an effective force law $F(x)$ of isothermal approximation (6.11). Assume m_1 motion is small and slow around x=*0*. ("Balls" idealize as point masses here.)

(a) A further approximation is the one-Dimensional Harmonic Oscillator (1D-HO) force and PE in (6.12). If each mass m_2 start in an interval Y_0=*1m*, derive approximate 1D-HO frequency and period for mass m_1.

(b) What if the adiabatic approximation is used instead? Does the frequency decrease, increase, or just become anharmonic? Compare isothermal and adiabatic quantitative results for m_1=*1kg* ball being hit by two m_2=*1gm* balls each having speed of $v_2(0)$=*1000m/s* as each starts bouncing in a space of Y_0=*1m* on either side of the equilibrium point x=*0* for the *1kg* ball.

(c) How does the frequency decrease or increase in isothermal case *versus* the adiabatic case if we shorten the run interval Y_0=*1m* to one-quarter meter?...What if we reduce the mass ratio m_1/m_2 by one-quarter?

(d) Derive the adiabatic frequency and period for the case M=*50kg* in adiabatic force of two m=*0.1kg* masses of initial speed v_0=*20m/s* and range Y_0=*3m*. Compare with Fig. 1.6.3c.