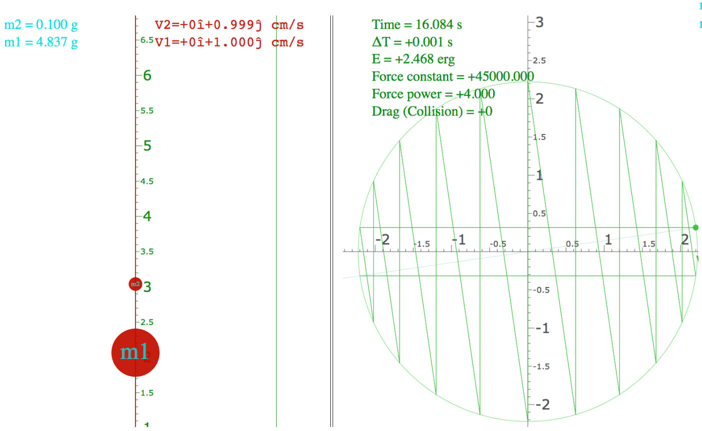
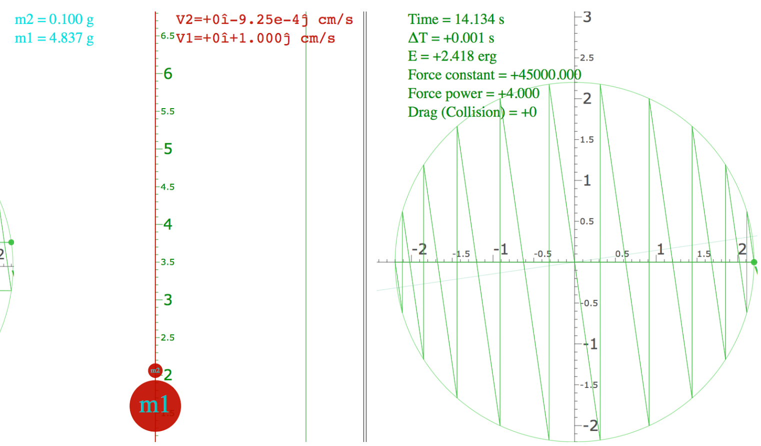
9/5 Assignment Set 3 - Read Unit 1 Ch. 3 thru Ch.7 Due Wed. *9/18/19* Name______________

Pseudo-Rotations for Independent Bounce Model

Exercise 1 Estrangian plot in Fig. 5.2 (Details on p.51-59 of Lecture 3) has mass ratio $M_1/m_2 = 49/1$ and has nearly periodic path plot. (Experiment using BounceIt link in Lect.3 p.74-77. https://modphys.hosted.uark.edu/markup/BounceItWeb.php?scenario=1014)
(Let small-mass be m_2=1 here.) Changing to M_1= 48.3.. 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= 48.3...(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. Plot an Estrangian velocity path on the protractor graph-paper attached assuming initial velocity $V_1=1$ and $V_2=0$.

(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. (Many have chaotic behavior.)

KE becomes PE

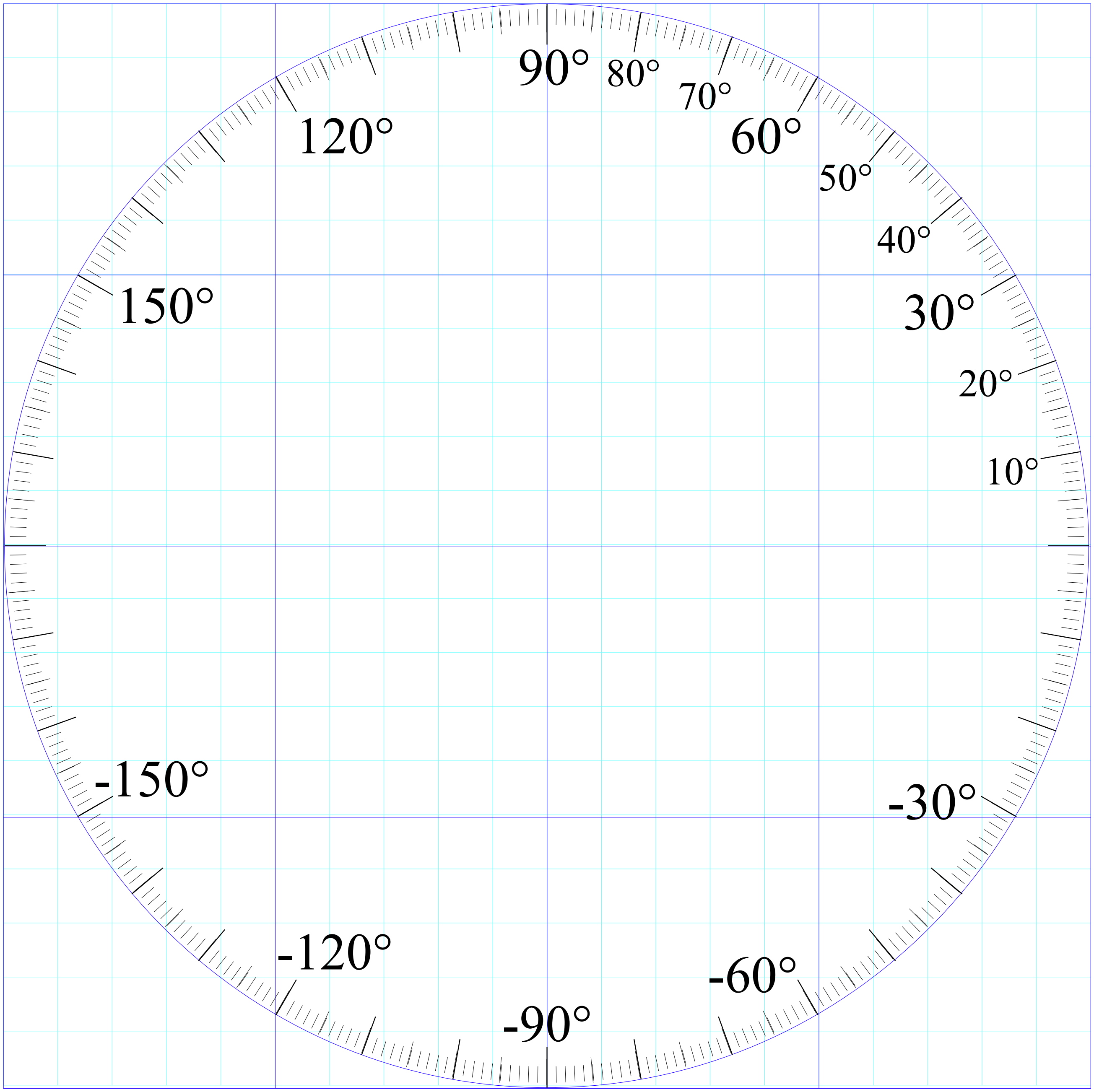
Exercise 2 A mass $m_1=1kg$ ball is trapped (like Fig. 6.3) between two smaller mass $m_2=1gm$ balls of high speed ($v_2(0)=1000m/s$ for $x=0$). Suppose this affects m_1 with an effective force law $F(x)$ of isothermal approximation (6.11). Assume m_1 motion is small and slow around $x=0$. ("Balls" idealize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


90°
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