Due Tuesday Sept. 15: Assignment 3- Read Unit 1 Chapters 6 thru 9.

KE becomes PE

Exercise 1.6.1 Suppose Fig. 6.3 shows a mass $m_1=1kg$ ball trapped between two smaller mass $m_2=1gm$ balls of high speed ($v_2(0)=1000m/s$ for $x=0$) that provide m_1 with an effective force law $F(x)$ based on isothermal approximation (6.11) while assuming m_1 moves only moderately far or fast from equilibrium at $x=0$.
(We idealize "balls" as point masses here and in many other CM problems.)

(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 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.

Action at the Monster Mash

Exercise 1.6.2 The moving ball-wall-trapped-ball constructions in Fig. 6.4 involves a plot of a "ball-wall" coming in with unit slope (velocity). (Again, we idealize "balls" as point masses.)
(a) Consider a construction where it has a velocity of $1/2$ and intercepts a trapped ball of velocity -1 at space-time point $(x=-2, t=4)$ that is 2 units from the fixed wall. Construct six or more back-and-forth collisions and comment on what, if any, differences exist with Fig. 6.4. Also, construct one or two *prior* collisions (before $t=4$).
(b) Evaluate approximate-average action values as described in class or after Fig. 6.4 in Unit 1.

Ford circles and Farey sums

Exercise 1.6.3 Complete the fraction-geometry construction started in class up to denominator 10.