Energy Conservation

If all forces are conservative (no friction, engine etc), Total Mechanical Energy (Kinetic + Potential) is conserved:

$$E = K + U = const$$

Here K is Kinetic energy:

$$K = \frac{mv^2}{2}$$

U is Potential energy, which is the work done against the conservative force, when object is moved from point A to point B. Two important cases are gravity and spring force:

Type of force	F	U
Gravity (on Earth surface)	*mg*	*mgh*
Hooke's Law (spring force)	*kx*	$\frac{kx^2}{2}$

Here x is extension of the spring, h is coordinate directed upward for gravity.

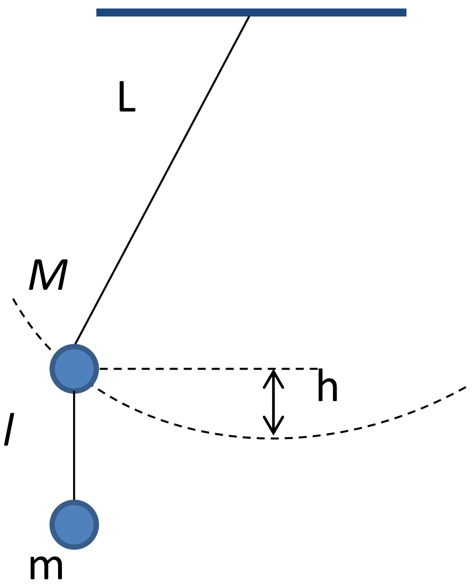
Homework

Problem 1

A tennis ball falls from height h=1 m, with no initial velocity. When it collides with the ground, it bounces back, but looses 1/3 of its speed. What will be the maximum height that it will reach after that? Neglect air resistance.

Problem 2

A double pendulum is made of two masses, *M* and *m*, and two weightless rods of lengths *L* and *l*, respectively. At moment t=0 the pendulum is moved out of equilibrium, as shown in the Figure, so that both masses are lifted by height *h.* Your goal is to achieve chaotic motion. This occurs when one of the masses can "flip over". What is the minimal value of h for which this is possible?
(Once it is allowed by conservation laws, it will happen).



Homework

Problem 1

English Longbow was an extremely powerful weapon that gave England big advantage in the Middle Ages. Consider it to be just a simple Hooke's spring with spring constant *k=1000N/m (Newtons per meter)*. When shooting, an archer had to pull the string back by approximately x=70 cm.

a) What was the force that an archer had to apply?
b) How much energy was carried by a single shut?
c) What was the initial speed of the arrow of mass m=60g?
d) If the arrow were shut vertically upward, what would be the maximum height it could reach?

Problem 2

A tennis ball falls from height h, with no initial velocity. When it collides with the ground it bounces back, but looses 1/3 of its speed. What will be the maximum height that it will reach after that? Neglect air resistance.