# Classical Mechanics (PHYS 350): Week 1

Fall 2013 v3.1

We begin our study of mechanics with Chapter 3 (really 2 as well since Morin does statics first), reviewing **one-particle Newtonian dynamics**. There is the expected thorough discussion of Newton's "Laws" as well as a set of examples illustrating useful methods, solving diff eq'ns, and motion described with planar polar coordinates. Let me know if you wish to discuss any of these topics, or the ones in Chapters 1 and 2 in more detail. We can set aside some time in the next Friday class.

**Reading:**

This week we will discuss the whole of Chapter 3. Please read Chapters 1 and 2 as well. We will come back to them again and again. If the method for solving problems discussed in Chapter 1 is not you mantra then make it so!

**Problems:**

All problems are from Morin unless noted otherwise. Answers to problems ("P") are in the book. Answers to exercises ("E") are not in the book. Once you have gotten started on the problems and exercises please do not hesitate to ask questions. Your solutions are due in the target time of Tuesday morning through Wednesday. Caveat: I will normally not hold office hours on Tuesday.

(1) 1.3 P Ah, the 195 memories...

(2) 1.17 E BUT derive the equation of motion and solve this anyway you wish, no need to write code unless you wish to.

(3) 2.5 P

(4) 2.17 P or 2.18 P

(5) 2.20 E

(6) "Groping about the masonry just below the margin, I succeeded in dislodging a small fragment, and let it fall into the abyss. For many seconds I hearkened to its reverberations as it dashed against the sides of the chasm in its descent ; at length there was a sullen plunge into water, succeeded by loud echoes."

- Edgar Allan Poe

You drop a coin into a dry canyon and hear the dull slap as it hits the sand at the bottom. The time elapsed between releasing the coin at rest and the reception of the sound is 2.06 s. What is the depth of the canyon? Note any assumptions you make.

(7) A uniform ladder of mass 25.0 kg and length $L$ leans against a smooth wall so that it makes an angle of $51^\circ$ with respect to the ground. A person of mass 80.0 kg climbs up the ladder to a point two-thirds of the way to the top. If the ladder is not to slip then how large must the coefficient of static friction between the floor and the ladder?

(8) 3.8 P

(9) The pair of parametric equations

$$x = \theta - a\cos(\theta),\ y = a\sin(\theta) \tag{1}$$

define a family of curves similar to cycloids, the parametric equations for the curve that a point on the rim of a wheel of radius $a$ cycloid inscribes as the wheel rolls in a straight line,

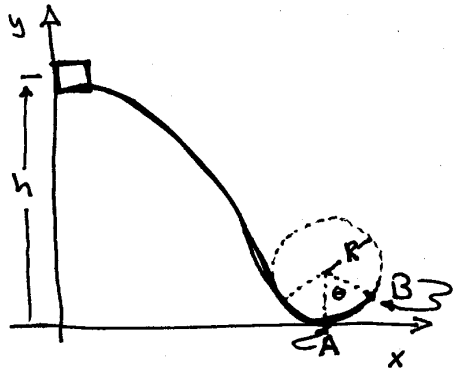
$$x = \theta - a\cos(\theta),\ y = a\sin(\theta).$$

Use Maple, Mathematica or Wolfram Alpha to explore the shapes of the curves (1) for different values of the parameter $a$ in the range 0.5 – 2. The relevance of these curves will become apparent next week.

(10) 3.50 Do this first on a *level* plane.

(11) A (point-like) block of mass $m$ slides down a frictionless incline as shown. The block is released a height $h$ above the bottom of the loop. The angle $\theta = 45^o$.

(a) What is the force of the track on the block at point $A$?
(b) What is the force of the track on the block at point $B$?
(c) At what speed does the block leave the track?
(d) Assuming a level surface how far away does the block land?
(e) Sketch the potential energy $U(x)$ and the total energy on a plot.




**Seminar: Friday 6 September**
Maple workshop. Bring your laptops.