

We are well into rigid body rotational dynamics with Euler's equations.

Please have a look at the possible projects so you can choose one after the Thanksgiving holidays. Toy projects are on the website.

Reading:

T & M Chapter 11

Problems: Due Wednesday November 16 at 5 PM.

- (1) Choose **one**: 11-5 or 11-15
- (2) 11-13 Three masses - what is I_{ij} ?
- (3) Find the moments and products of inertia for a cube rotating around one edge.
- (4) A thin uniform rectangular plate (lamina) is of mass m and dimensions $2a$ by a . Choose a coordinate system such that the plate lies in the xy plane and has the origin at a corner. Find:
 - (a) the moments and products of inertia
 - (b) the moment of inertia about the diagonal through the origin
 - (c) the angular momentum about the origin when the lamina is spinning with angular velocity ω around the diagonal, and
 - (d) the kinetic energy for this case.
- (5) 11-11 How long does a cube balanced on edge take to fall on a side? Use energy and the moments computed above.
- (6) 11-20 a falling rod. Find the velocity of the end of the rod when it hits the ground. Compare this to the final velocity of a mass dropped from a height equal to the length of the rod.
- (7) As you slog your way back to your room you slip on the snowy path. Your large self-portrait goes flying as you fall. In a moment of exceptional observational clarity, you notice as you fall that when the portrait initially rotates around one particular axis the rotation is unstable. Why does the portrait do this? You may answer this in the following way:
 - (a) How are the moments of inertia I_1, I_2 and I_3 related?
 - (b) Which is the axis referred to above?
 - (c) Use the Euler equations to investigate the stability of rotation around the other two axes.
 - (d) Summarize your results and use them to explain the portrait's behavior.
- (8) A toy gyroscope is made of a uniform disk and a light spindle. The disk has mass 0.1 kg and radius $a = 2$ cm. The pivot is 3 cm from the center of the disk. If the gyro is set spinning with 20 revolutions per second, find the period for steady horizontal precession.

Notes on text:

- pages 411-415 Review of rotational motion as we have encountered it before.
- pages 416-440 The first bit of key technology - the inertia tensor. Pay very close attention to its definition and role in kinetic energy and angular momentum. Note that many of its properties detailed in later sections are those that follow from its form as a real, symmetric matrix.
- pages 440-447 The second bit of key technology- the Euler angles. The eom 11.114 are an essential tool for exploring rotational motion.
- pages 448 -462 Two important applications of the new technology - a symmetric top and a symmetric top with a fixed point.

Friday Class: Stay tuned...