Physics 22 Problem Set 3

Harry Nelson

due Monday, April 23, In Class

Course Info: This week we investigate the most famous case of a rotation axis that is not fixed in direction - the case of precession. Chapter 7 of K&K has a lot of information in it, but we will focus only on Sections 7.3 and 7.4, pp. 295-304 (stop at Example 7.12). Then, we will skip Chapter 8, and start in on Chapter 9, sections 9.1-9.5, which are pp. 378-390.

The instructor is Harry Nelson, the TA is Joel Varley. A web page for the course is set up at http://hep.ucsb.edu/courses/ph22.

We meet MWF 1:00-1:50pm in 1640 Broida. There are **two sections**, attendance at **both** is mandatory. Joel Varley's section will take place Friday 11:00-11:50pm in 1802 Psychology, and Harry Nelson's will take place Friday 2:00-2:50pm in 2129 Girvetz. Harry Nelson's office hours will follow section until 5:00pm on Friday, either in 2129 Girvetz (if possible) or in the PSC. Joel Varley's office hours will will take place in the Physics Study Room (1019 Broida) on Monday from 2:00pm to 3:00pm, Thursday from 3:30pm to 4:30pm, and Friday noon-1:00pm.

Please make your work neat, clear, and easy to follow. It is hard to grade sloppy work accurately. Generally, make a clear diagram, and label quantities. Derive symbolic answers, and then plug in numbers after a symbolic answer is available.

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1. (a) Qualitatively explain why the precession frequency Ω is *inversely* proportional to the frequency ω_s of a spinning gyroscope.
   (b) When ω_s in a gyroscope is reversed, say, from counterclockwise to clockwise, does Ω reverse too, and why or why not?
   (c) Imagine a bicycle wheel with mass $m = 1\,\mathrm{kg}$, radius $R = 50\,\mathrm{cm}$ (treat it as a ring), which is made into a gyroscope with an $\ell = 1$ meter massless rod connecting the wheel to the pivot, which is on Earth. Evaluate Ω numerically.
2. K&K 7.6. This is a problem where you can take a coin and to it yourself... that is, you can investigate the relationships between $\tan\phi$, v, and R. Note that the point of contact between the ground and the coin is momentarily at rest, and so you should evaluate the moment of inertial of the coin about that point when computing the spin angular momentum $I\omega_s$.
3. K&K Problem 9.2
4. K&K Problem 9.6
