

## Gyroscope Investigation

1. You will need a gyroscope, a gear puller, a gyroscope stand, and a love for rotational mechanics.
2. Get the gyroscope spinning by using the gear puller. Hold the gyroscope firmly, and pull the handle - being careful not to strip the little teeth. Play with it over a table. If it drops on the floor it will break. Come up with a stupid gyroscope trick.
3. Get the gyroscope spinning anti-clockwise as seen from above (This way the L vector is pointing up), put the bottom of the gyro into stand. Note carefully which way the gyroscope precesses.
4. **Draw careful diagrams** that a) show the direction of the torque on the gyroscope (Due to gravity) the axis about which this torque acts is the stand  $\Gamma = r \times F$ , so r is away from the stand, F is straight down, b) show the direction of the angular momentum vector, c) show that the direction of precession has the tip of the L vector going in the direction of the torque.
5. Answer these questions:
  - A. Measure the mass of the rotor by weighing the gyroscope, and subtracting the 23.5 grams that is the cage. Measure the radius of the rotor, and use a formula like  $I = mr^2$  (or is it  $.9mr^2$ ? - feel free to make your own formula) to **find the moment of inertia of the rotor in  $\text{kgm}^2$** .
  - B. The axle has a diameter of 3.9 mm (0.0039 m). Supposing the puller was moving about 1.5 m/s at the end of your pull,
    1. **calculate the angular velocity of the gyro**, (use  $v = \omega r$ ) and
    2. **calculate the angular momentum of the gyro**. ( $L = I\omega$ )
  - C. Calculate the **angular momentum of the earth** ( $L = I\omega$ ). (use the interwebs to find the mass, radius, and period of rotation. Assume the earth is a sphere ( $\frac{2}{5}mr^2$ ).  $\omega = 2\pi/T$ . You can also just go to wolfram alpha and type "angular velocity of the earth") Show that it is about  $7 \times 10^{33}$   $\text{kgm}^2/\text{s}$  (be a bit more exact)
6. Leave your gyroscope exactly the way you found it.

Here's what you turn in:

1. The diagram as explained in part 4.
2. The answers for part 5.