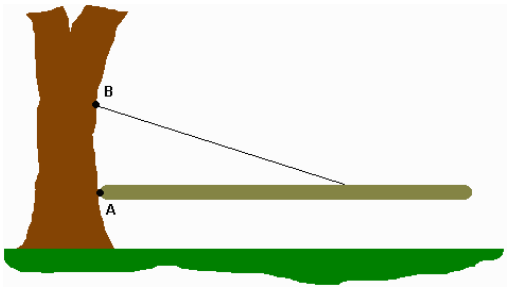
DAY 20

Homework Assignment (see syllabus for homework collection information)

ALL PROBLEMS PHY 231 ONLY

1. A hunter decides to build a cheap gate for his hunting ground by cutting down a small oak tree, trimming off the branches, and attaching it to another tree as shown.

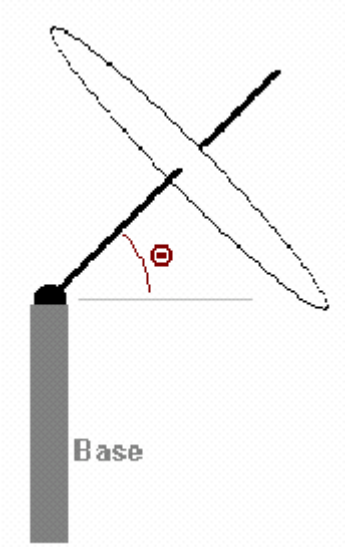


   The horizontal oak log is 12 ft long and 6 inches in diameter. The cable is 9 ft long. The point where the cable is attached to the tree (B) is 4 ft above the point where the log joins the tree (A).

   What is the optimal B–A height for which the tension in the cable is a minimum?

2. Determine the rate of precession for a gyroscope that consists of a rotating wheel spinning at 500 RPM. The wheel is a solid disk of diameter 3 inches that weighs ½ lb. The wheel precesses on an arm 2.5 inches in length.

3. Calculate an equation for Ω for a gyroscope that is not horizontal but rather that is tilted at an angle Θ above the horizontal. How does tilting the gyroscope change its rate of precession (Ω) (Does it make it precess faster? Make it precess slower? Have no effect?)



4. The position vector for an object orbiting in the gravitational field of a planet is given by the equation below, where ε is known as the *eccentricity* of the orbit and 2α is the *latus rectum* of the orbit. Show that an orbit with zero eccentricity is a circle with a diameter equal to the latus rectum.

$$\mathbf{r} = \frac{\alpha\cos(\theta)}{1+\varepsilon\cos(\theta)}\hat{\mathbf{i}} + \frac{\alpha\sin(\theta)}{1+\varepsilon\sin(\theta)}\hat{\mathbf{j}}$$

5. Using EXCEL or other methods, plot out orbits for α = 10 and
   ε = 0
   ε = 0.1
   ε = 0.5
   ε = 0.95
   ε = 1.0
   ε = 1.5
   Put all orbits on the same plot.

6. a) Plot the path of the object whose position vector is given below. Calculate the acceleration of this object.

$$\boldsymbol{r} = 10\cos(2t)\,\boldsymbol{i} + 20\sin(2t)\,\boldsymbol{j}$$

   b) Plot the path of the object whose position vector is given below. Calculate the acceleration of this object.

$$\boldsymbol{r} = 10\cos(2t)\,\boldsymbol{i} + 20\cos(2t)\,\boldsymbol{j}$$

7. In the above problem, derive an equation for the angular velocity about the origin ω for each object.