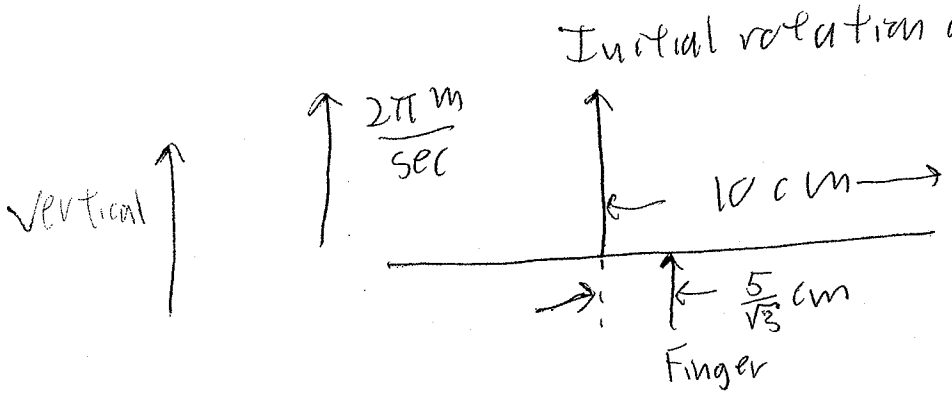
Physics 612/613, PS #1; Due: In class, Tuesday, Jan 26

1) An infinitely thin circular disk of radius $r = 10\,cm$ is initially rotating about a vertical axis with a rotational period of $\frac{1}{10}$ sec. At time $t = 0$ it is struck from below by a finger, giving its center an upwards speed of $2\pi \frac{meters}{sec}$. This impact, whose duration is $\ll \frac{1}{10}$ sec, occurs $\frac{5}{\sqrt{3}}$ cm to the right of the center, as shown:



The impact is frictionless.

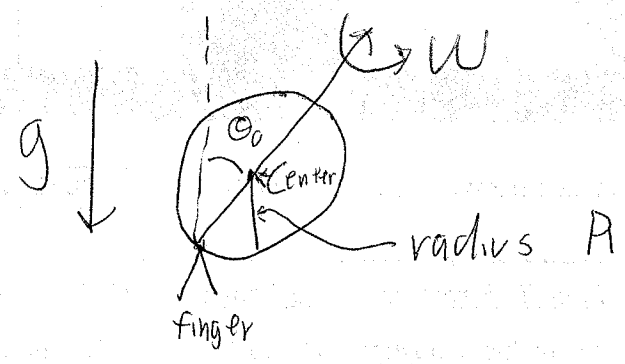
1a) Find the maximum subsequent angle between the normal to the disk and the vertical.

1b) At what time t does this maximum first occur?

2) I spin a basketball on my finger such that initially the center is stationary, the line from my finger (which is also stationary) to the center of the ball makes an angle $\theta_0 < 1$ with the vertical, and the ball is spinning about the line from my finger to the center of the ball at an angular speed ω.

~~Model as a~~

See this figure:



Model the ball as a thin, hollow shell of radius R.

2) (cont) What is the minimum initial angular speed ω required to keep the ball on my finger, assuming it will fall off if the line from my finger (which does not move) to the center makes an angle of more than 60° to the vertical?

Express your answer in terms of g and R. Evaluate your answer for a real basketball, of diameter 1 foot.

$\left(g = 32 \frac{ft}{sec^2}\right)$