Lab Quiz for PHY324

Q1: What experiment are you doing?

Air gyroscope

Q2: Summarize the physics elements in this experiment.

Earth gravity gives a torque L, which cause a pure precession of the sphere around vertical axis w/ angular velocity $\Omega = \frac{L}{Iw}$. L, I are functions of radius R, density ρ, and ϵ.

Q3: Describe one major goal of the lab.

Measure "g"

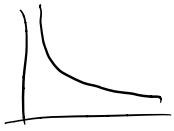
Q4: What do you measure directly in pursuit of the major goal described above?

nominal diameter $2R$, truncated diameter $R+\epsilon$,
and we are going to measure angular velocity Ω and w in horizontal and vertical axis.

Q5: Outline how you get the answer to Q3 from the data collected as described in Q4. If you will graph data to achieve the goal in Q3 then explain what you will graph, what the trend-line will look like, and how it achieves the goal in Q3. Include any equations you will use to turn the data described in Q4 into the answer described in Q3.

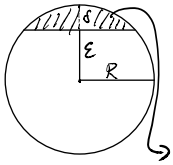
by formula $\Omega = \frac{L}{Iw}$, and $\epsilon = 1 - \frac{\epsilon}{R}$,

we can have g with the formula $\frac{L}{I} = \underbrace{g \frac{5}{2R} \frac{\epsilon^2}{(2-\epsilon)(\epsilon^2+\epsilon+\frac{2}{3})}}_{\text{constant}} = \Omega w$ → we are going to measure

$\Rightarrow \Omega \propto \frac{1}{w}$ so the graph looks like 

Q6: Your TA asked you a/some question(s) about the equipment. Write the question(s) and answer(s) here.

1. What is the density of the sphere?



$R = 25.57\,mm$
$\epsilon = 48.71 - 25.57 = 23.14\,mm$
$\delta = 25.57 - 23.14 = 2.43\,mm$
$V_1 = \pi\delta^2(R - \frac{\delta}{3}) = 459.32\,mm$
$V_{ball} = \frac{4}{3}\pi R^3 = 70029.4626\,mm^3$

$\therefore V = V_{ball} - V_1 = 69570.1426\,mm^3$

2. How to use the harmonics to determine the freq.

Draw a dot on the side of flat surface of the ball, when the ball rotates, we can see the dot is also rotating. Set the strobe to 120 Hz, which is twice of the angular velocity registered. Then the strobe will light up twice when the ball rotates for one cycle. Therefore we shall see a two stationary dots when the ball is rotating at 60 Hz.