Student's Name: ________________________________ Student's Name: ________________________________

Lab day & time: ____________________ Date: ___________________

Circular Motion (M4) - Data Sheets

(Show all calculations and write all results on the data sheets in ink)

Activity 1: Radial Force vs. Angular Velocity *(2.5 p.)*

Be sure to fill-in the correct units in the space provided: (   )

The radius r, i.e., the distance between the axis of rotation and the center of the brass disk value should remain constant: $r = 0.100$ m. Verify this number! If the radius is not equal to 10.0 cm = 0.100 m, ask your TA for help.

You need to check that the lab equipment is setup for this distance between the moving mass and the axis of rotations. Make sure to zero the force sensor (push the "Tare" button).

The mass of the holding screw also does not change: $m_{screw} = 3.5$ g

If the force number changes to red and there is no data recording, then it is an indication that you forgot to zero the force sensor before starting data acquisition.

a. $m_0 = 20$ g, $\Rightarrow$ $m = m_0 + m_{screw} = 20.0\text{ g} + 3.5\text{ g} = 23.5\text{ g} = 0.0235\text{ kg}$

The theoretical value $mr =$ ______________ (   )

Fit parameter A = ______________ (   )

Percent difference between the theoretical value and the result of force measurements:

$$\frac{mr - A}{mr} \times 100\% = \text{\_\_\_\_\_\_\_\_\_\_\_\_} \; (\%)$$

b. $m_0 = 30$ g, $\Rightarrow$ $m = m_0 + m_{screw} = 30.0\text{ g} + 3.5\text{ g} = 33.5\text{ g} = 0.0335\text{ kg}$

The theoretical value $mr =$ ______________ (   )

Fit parameter A = ______________ (   )

Percent difference between the theoretical value and the result of force measurements:

$$\frac{mr - A}{mr} \times 100\% = \_\_\_\_\_\_\_\_\_\_\_\_ \; (\,\%\,)$$

c. $m_0 = 40$ g, $\Rightarrow$ $m = m_0 + m_{screw} = 40.0\text{ g} + 3.5\text{ g} = 43.5\text{ g} = 0.0435\text{ kg}$

The theoretical value $mr =$ ______________ (   )

Fit parameter A = ______________ (   )

Percent difference between the theoretical value and the result of force measurements:

$$\frac{mr - A}{mr} \times 100\% = \_\_\_\_\_\_\_\_\_\_\_\_ \; (\,\%\,)$$

Print the graph with data and quadratic fit and attached that to your lab report.

Activity 2: Radial Force vs. Mass *(2 p.)*

The radius r value should remain constant (do not change it): $r = 0.100$ m

Make sure to zero the force sensor (push the "Tare" button) each time you change mass.

Mass $m = m_0+m_{screw}$ (kg)	Radial Force F_r ( ) for $\omega = 0$ rad/s	Radial Force F_r ( ) for $\omega = 30$ rad/s	Radial Force F_r ( ) for $\omega = 40$ rad/s	Radial Force F_r ( ) for $\omega = 50$ rad/s
0.0435	"Zero" the force sensor			
0.0335	"Zero" the force sensor			
0.0235	"Zero" the force sensor			

When finished with data recording, prepare and **print** a single graph (or three separate graphs) showing the value of radial force F_r (on vertical axis)$_r$ as a function of mass m (on horizontal axis) for each of the velocity values: ω = 30 rad/s, 40 rad/s and 50 rad/s. You should have three lines with three data points on each line. Note the slope change in these three graphs.

Describe how the radial force is changing with increasing mass.

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The theoretical formula for the radial force F_r vs. mass m is given by Eq. (5):

$$F_r = m\omega^2 r = (mr)\omega^2 \text{ or } y = ax + b, \quad \text{where } a = \omega^2 r \text{ and } b = 0$$

The radial force should be proportional to the mass of the rotation object. For each value of angular velocity ω <u>find the straight line fit</u> for F_r vs. mass m and find the slope a of the straight line.

For each value of angular velocity ω calculate the percent difference between the theoretical value of the slope $\omega^2 r$ and the observed value of the slope a.

ω = 30.0 rad/s $\omega^2 r$ = ____________ (   ) slope a = ____________ (   )

$$\frac{\omega^2 r - a}{\omega^2 r} \times 100\% = \_\_\_\_\_\_\_\_\_\_ \ (\%)$$

ω = 40.0 rad/s $\omega^2 r$ = ____________ (   ) slope a = ____________ (   )

$$\frac{\omega^2 r - a}{\omega^2 r} \times 100\% = \_\_\_\_\_\_\_\_\_\_ \ (\%)$$

ω = 50.0 rad/s $\omega^2 r$ = ____________ (   ) slope a = ____________ (   )

$$\frac{\omega^2 r - a}{\omega^2 r} \times 100\% = \_\_\_\_\_\_\_\_\_\_\_\_ \ (\ \%\ )$$

Quit the program. Do not save any changes. **Logout from your account.**

Return the completed lab report to your lab TA.