Centripetal Force – *the Virtual Experiment* Name _____

Objective: Students will experimentally investigate circular motion and apply graphical analysis to verify the equation: Fc=mv2r **using the Physics Aviary lab:** https://thephysicsaviary.com/Physics/Programs/Labs/ClassicCircularForceLab/

Procedure: You must complete five different experiments using different washer numbers, different radii, and different moving masses.

1. **Record the washers' total mass in grams.**
2. **Convert the washers' total mass to kilograms.**
3. **Find the experimental force using F=mg.**
4. **Record the radius in meters.**
5. **Hit begin and time thirty revolutions.**
6. **Divide the number of revolutions by thirty to find the time for one revolution.**
7. **Calculate the speed of the moving mass in meters per second.**
8. **Square the speed of the moving mass.**
9. **Record the mass of the moving mass in kilograms.**
10. **Calculate the force using the formula for F_{calc}.**

Data: (1 point per box)

Mass of washers (g)	Mass of washers (kg) (← g/1000)	Force (Experimental) (N) (←9.8 $\frac{m}{s^2}$×kg)	Radius in m (cm/100)	Time (T) of 30 Revolutions (sec)	Time (t) of 1 Revolution (sec)	Speed (v) (m/s)	Speed^2 (v^2) (m^2/s^2)	Moving Mass (m) in kg (g/1000)	Force (Calculated) (N)

Equations: $F_{exp} = mass \times 9.8 \frac{m}{s^2}$ $\quad F_{calc} = \frac{mass_{moving} v^2}{r_{circle}}$ $\quad t_{1\,rev} = \frac{T}{30}$

$$\%Error = \frac{|F_{exp} - F_{calc}|}{F} \times 100 \qquad v = \frac{2\pi r_{circle}}{t}$$

Calculations: (1 point per box)

1. **From the data above, use m, v^2, and r in the Centripetal Force equation to obtain a calculated value of F_c. Compare this with the experimental value of column three of the table. Do this for each trial; then calculate the % error for each trial.**

Trial #	F_{exp}	F_{calc}	% Error

2. **Plot graphs of F_{exp} vs. *Speed* and F_{exp} vs. $Speed^2$, with F_{exp} on the y-axis and *Speed* or $Speed^2$ on the x-axis using GoogleSheets using a smooth line curve. The origin must have coordinates of (0, 0)! Find a smooth *line* or *curve of best fit* with appropriate equations and R^2 value. (10 points each)**

Conclusion Questions: Answer numbers 1 – 5 on your lab report. (3 points each)

1. **What shape do your graphs take? What do these shapes indicate, Direct Proportionality or Indirect Proportionality? Why?**
2. **In comparing your % error between F_{exp} and F_{calc}, do you believe that the equation for centripetal force is supported? Why or why not?**
3. **List all possible sources of error.**