Date of Lab 9/24/19 Date of Submission 10/3/19

Laboratory Report Cover for #12 Lab

Title Circular Motion and Centripetal Force

Homeroom	Section	Name	
12-I			Moe Oshima

Lab Partners Ayano Chiba

Summary

We did 2 experiments by spinning the rubber on the string to understand the relationships between centripetal fore & angular velocity and Inverse of radius & angular velocity. We measured the time the rubber took to spin and figured out the period and did this with different lengths of string. From the results, we calculated the Inverse of radius and angula velocity. When we drew a graph, the line almost went through origin, which showed that they are proportional. This result confirmed the equation $F = mr\omega^2$, which gave me a better understanding by visually recognizing the relation ship. In the 2nd experiment, percent error was huge and could not really prove the equation $F = Mg\sin\theta$. I believe percentage of error was big because M (mass of washers) was not accurate, We compared each result with different M, so we should have been more careful about the measurement.

- Meet a deadline
- Write logically
- Write clearly
- Write with your own words

* Use this form as a cover sheet.
* Submit your reports by the seventh day after your lab.

PhysicsLab-012	Circular Motion and Centripetal Force

Tables

Mass of rubber m:	10.0 g
$\theta=\cos^{-1}(m/M)$	67.42°

Mass of washers M:	6.51g (x4)
F'=Mgsinθ:	235.6 N

Table #1

No		1	2	3	4	5	6
L	x 10^{-2} m	20	30	40	50	60	
r = Lsinθ	x 10^{-2} m	18.47	27.70	36.93	46.17	55.40	
1/r		0.0541	0.0361	0.0271	0.0217	0.0181	
(L-r)/L x 100	%	7.65	7.67	7.68	7.66	7.66	
20T	s	10.38	13.46	14.72	17.28	18.63	
T	s	0.519	0.673	0.736	0.864	0.932	
ω^2	s^{-2}	146.6	87.16	72.88	52.88	45.45	

Mass of rubber m:	10.0g
$\theta=\cos^{-1}(m/M)$	

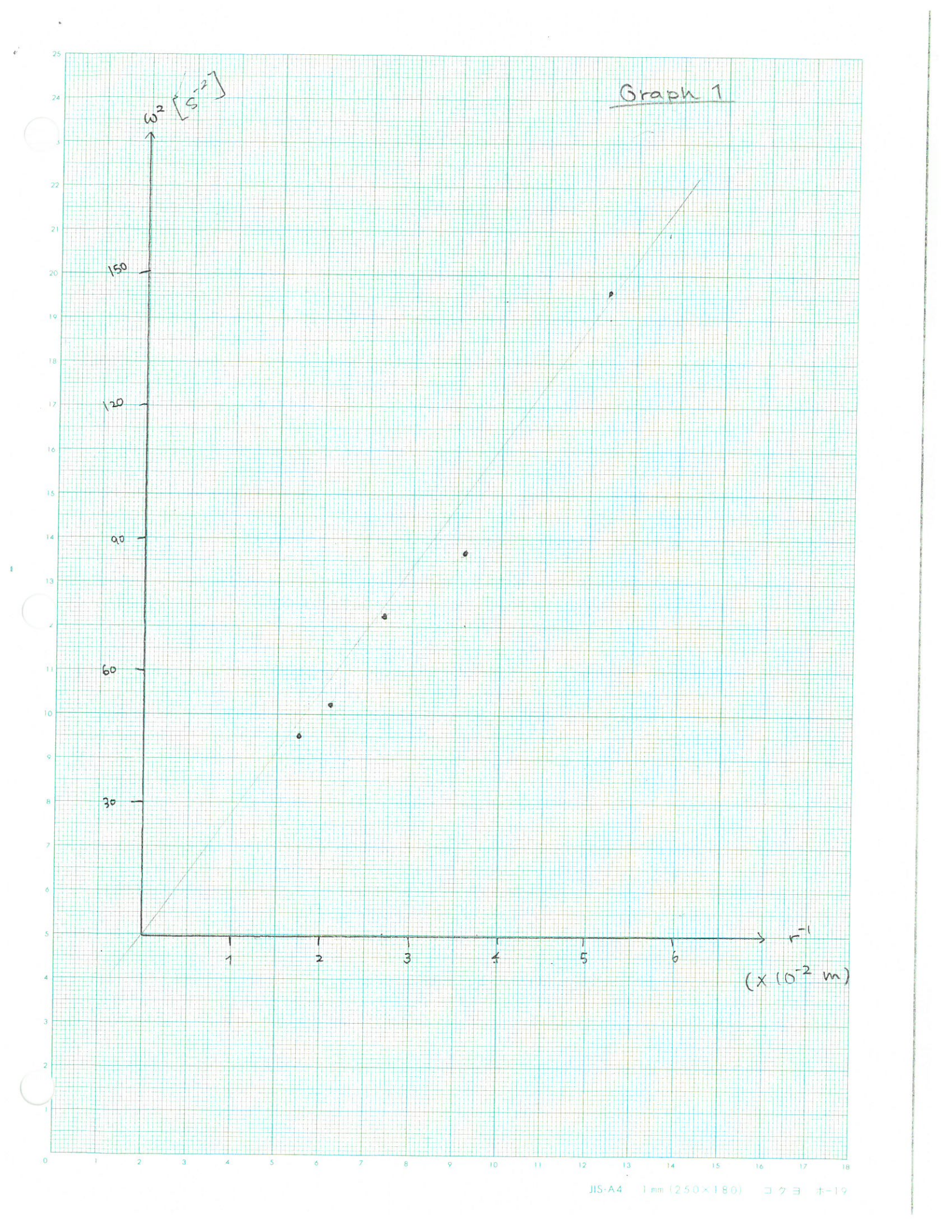
Mass of washers M:	6.51g
F'=Mgsinθ:	

L = 30 cm
$(3\times10^{-2}$ m)

Table #2 # of washer 3 4 5 6 7

No		1	2	3	4	5	6
M	x 10^{-3} kg	19.53	26.04	32.55	39.06	45.57	
$\theta=\cos^{-1}(m/M)$		59.20°	67.42°	72.11°	75.17°	77.32°	
F=Mgsinθ	$\times10^{-3}$ N	164.4	235.6	303.6	370.0	435.7	
r = Lsinθ	x 10^{-2} m	25.8	27.7	28.5	29.0	29.3	
(L-r)/L x 100	%	14.0	7.67	5.0	3.3	2.3	
20T	s	16.16	14.56	13.69	12.09	11.53	
T	s	0.808	0.728	0.685	0.605	0.577	
ω^2	s^{-2}	60.47	74.49	84.14	107.9	118.6	

Draw a graph showing the relation between ω^2 and F=Mgsinθ (OK)


Graph 1
ω^2 [s^{-2}]
150
120
90
60
30
1
2
3
4
5
6
r^{-1}
($\times 10^{-2}$ m)

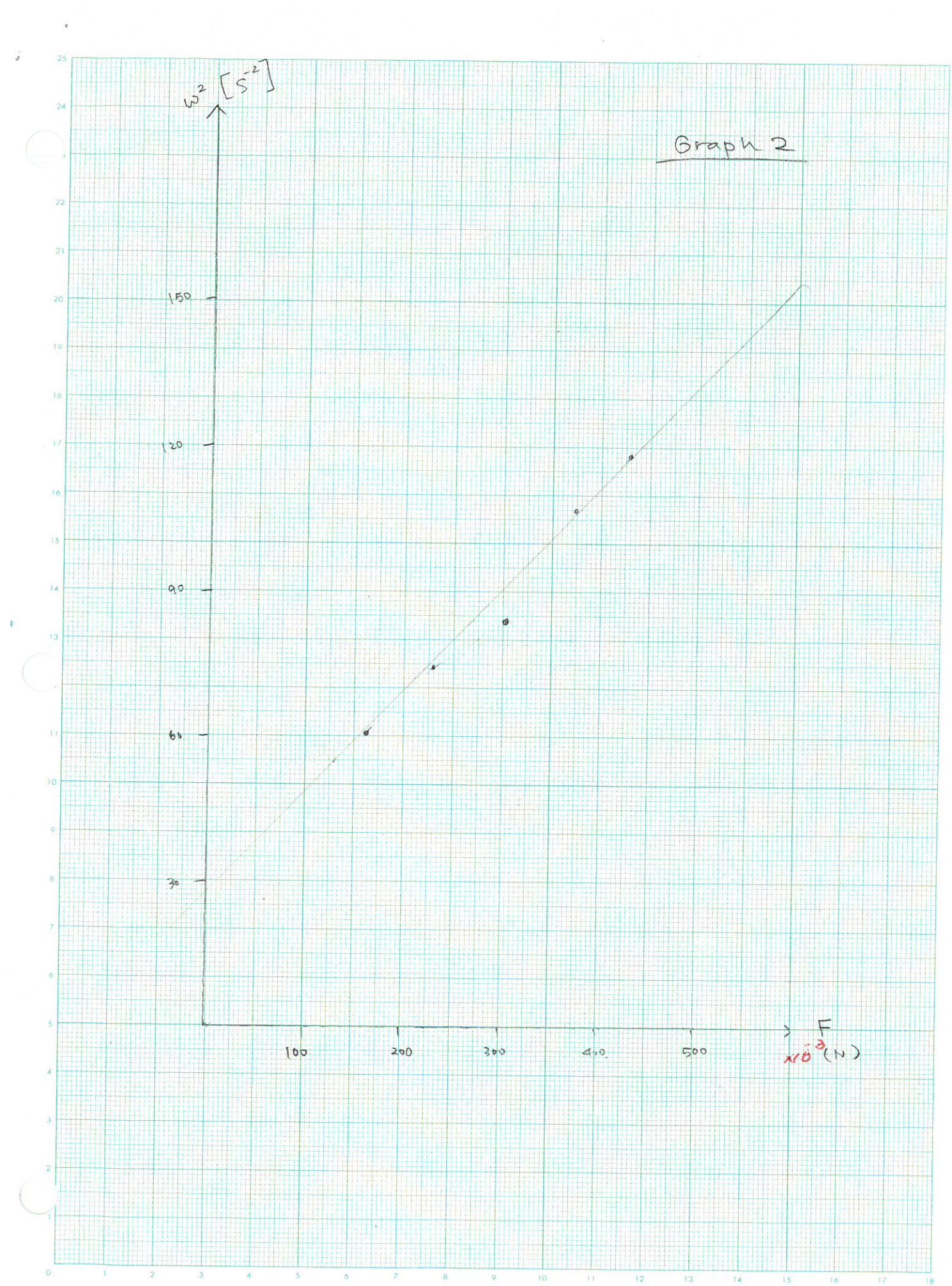


Table #3

Relationship between Angular Velocity and Inverse of Radius

$1/r$ [$\times 10^{-2}$ m]	$\omega^2 [s^{-2}]$	Theoretical $\omega^2 [s^{-2}]$	% Error [%]
0.0541	146.6	127.6	14.9
0.0361	87.16	85.1	1.2
0.0271	72.88	63.8	14.2
0.0217	52.88	51.0	3.7
0.0181	45.45	42.5	6.9

Table #4

Relationship between Angular Velocity and Centripetal Force

Force [N]	$\omega^2 [s^{-2}]$	Theoretical $\omega^2 [s^{-2}]$	% Error [%]
164.4	60.47	32.63	85.3
235.6	74.49	32.66	128.1
303.6	84.14	32.73	157.1
370.0	107.9	32.66	230.0
435.7	118.6	32.63	263.4

Discussion

As a result of the Experiment #1, Table #1 can be drawn and the Graph #1 shows the relationship between angular velocity (ω^2) and inverserve of radius (r^{-1}), both calculated from Table #1. In the experiment, we changed the radius and measured the time it took to spin 20 times in order to figure out the centripetal force and angular velocity. As shown in Graph #1 (on a separate sheet of paper), angular velocity and inverse of radius is almost proportional to each other. This can be explained by the theory of centripetal force, which is defined by the equation $F = mr\omega^2$. When the centripetal force (F) and the mass of the rubber (m) are constant, the angular velocity and radius is inverse proportional to each other. This concludes that the angular velocity is proportional to the inverse of radius.

In Experiment #2, we tried to figure out the relationship between centripetal force and the period (T). We measured how many seconds the rubber took to spin 20 times and divided the number by 20 to figure out the period. We did this with different numbers of washer, which changed the mass. The results are shown in Table #2, which we calculated the centripetal force with the equation, $F = Mgsin\theta$, and angular velocity (ω^2). Graph #2 shows the relationship between the angular velocity and the centripetal force according to our calculations from Table #2. Theoretically, they should be proportional, meaning the line should go through origin. However, Graph #2 does not, which concludes that there are some errors in our experiment. For example, the mass of each washer are different, but we calculated them as same mass, which could have made the experiment less accurate. According to Table #4, which compares the theoretical value of angular velocity and the actual value from the experiment, the percentage of error is very high. There were probably many elements that messed up this experiment.