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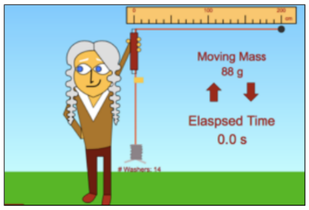

P20 Unit C – UCM Speed and Radius Online Lab

Name: ______________

Date: ______________

URL: http://thephysicsaviary.com/Physics/Programs/Labs/ClassicCircularForceLab/ *(Note: do not follow the instructions on this web page, we're doing a different activity from what is explained online, using the same animation).*

Objective: to explore the relationship between speed, radius, period, mass and centripetal force in horizontal uniform circular motion. These relationships are present in the equations:

$$v = \frac{2\pi r}{T} \qquad \left|\vec{F}_C\right| = \frac{mv^2}{r} \qquad \left|\vec{F}_C\right| = \frac{4\pi^2 rm}{T^2}$$

Design: A mass is placed on the end of a rope and is swung in horizontal uniform circular motion. The web animation allows the user to vary:
- the radius of the circle (click on the little piece of tape on the rope)
- the centripetal force (the tension in the rope, click on the washers on the end of the rope)
- the mass on the end of the rope (click on the ↑ or ↓ arrows)

Part One: Calculate a Centripetal Speed

Complete the table below by measuring two different periods for two different radii. The first row of the table has been completed for you. You may choose any values of *r* you wish.

(*Hint: period is the time needed to make one full circular revolution. To make this measurement easier, consider timing 10 full revolutions, then dividing your time by 10 to get the period)

Trial	total mass of washers (kg)	moving mass, m, (kg)	radius, r (m)	period, T (s)	speed, v (m/s)
1	0.070 kg*	0.025	2.00	1.69	7.44
2	0.070 kg	0.025			
3	0.070 kg	0.025			

*Each washer is 10 g, so the total mass of the washers to start is 7 washers x 0.010 kg = 0.070 kg

To find the speed, use $v = \frac{2\pi r}{T}$

Analysis:
a) Based on your data table above, complete the following statements by circling the correct word.

"When the **radius** decreases, the **speed** of the moving mass increases/decreases. Therefore, ***r*** has a(n) direct/inverse relationship to ***v***."

Part Two: Calculate a Centripetal Force

Use your data from above to determine the $\vec{F}_C$ present in each of your trials. Complete the table below. The first row has been completed for you.

Trial	total mass of washers (kg)	moving mass, m, (kg)	speed, v (m/s)	radius, r (m)	centripetal force, $\vec{F}_C$ (N)
1	0.070 kg	0.025	7.44	2.00	0.692
2	0.070 kg	0.025			
3	0.070 kg	0.025			

To find the force, use $|\vec{F}_C| = \frac{mv^2}{r}$

Analysis:

b) Determine the force of gravity acting on the washers. Use Newton's Second Law, $\vec{F}_g = m\vec{g}$.

c) What observation can you make between the force of gravity on the washers and the average centripetal force?

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Part Three: Predict a Period

Pick your own unique set of data (moving mass, radius and total mass of washers) and complete the data table below. Then, perform a calculation to predict a theoretical period. Lastly, use the animation to measure the experiment period and see how close you came to the theoretical. The first row has been completed as an example for you.

total mass of washers (kg)	$\vec{F}_g$ on washers (N)	moving mass, m, (kg)	radius, r (m)	Experimental Period, T (s)	Theoretical Period, T (s)
0.200 kg	1.96 N	0.075	1.60	1.55 s	1.55 s

To find the theoretical period, use $|\vec{F}_C| = \frac{4\pi^2 rm}{T^2}$

Analysis:

e) How close did you come to having your experimental and theoretical periods be equal? What change could you make to your procedure in order to have the values become even closer?

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