PHYSICS 207

Circular Motion Lab

In this lab you are using two simulations:

First – The Physics Aviary Circular Motion Learning Lab found here:

https://www.thephysicsaviary.com/Physics/singlepage.php?ID=21

Second – The Physics Aviary Circular Force lab, found here:

https://www.thephysicsaviary.com/Physics/Programs/Labs/CircularForceLab/index.html

Procedure

Part I – Exploring variables associated with circular motion

1. Click on first simulation url to open The Physics Aviary Circular Motion Learning Lab: https://www.thephysicsaviary.com/Physics/singlepage.php?ID=21

2. Click on grid area to access simulation start page. This simulation experiment has onscreen guided instructions which you follow and complete associated task, in order to get to the next round of simulation. There are seven short sessions/rounds of this experiment. Please read fully and follow onscreen instructions.

3. Click 'Begin' to start experiment. Upon completion of all eight iterations of this experiment enter your first and last name in the slot provided. The next screen shows your completion certificate. Take a screenshot of this completion certificate complete with your name and date, time of completion and eight rows of results. Include this screenshot in your lab report.

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Part II – Exploring force associated with circular motion (centripetal force, F_C).

A – Varying Moving Mass

1. Click on second simulation url to open The Physics Aviary Circular Force Lab https://www.thephysicsaviary.com/Physics/Programs/Labs/CircularForceLab/index.html
2. Read onscreen information on what this simulation experiment explores in circular motion. Also read instructions on how to adjust simulation variables of moving or rotating mass, rotating velocity and radius of string.
3. Click on 'Begin' to start experiment.
4. Click on 'Blue down arrow' at lower right of screen to reduce moving mass m_{moving} to lowest value of 0.50 kg. Speed Randomizer stays constant/fixed for this part of simulation. Set 'Radius', r, to maximum value of 2.00 m and leave it fixed there for this first part of simulation experiment. Therefore, for this first part of simulation you have one variable m_{moving} and two constants in the form of radius, r, and rotating speed, $v_{rotating}$.
5. Click 'Start'. Thereafter click on "Start Timer' as say when moving blue radius line just crosses broad dark lines at 9 am, 12 noon, 3 pm, or 6 pm to make it easier to count number of revolutions in order to determine periodic time 'T'. Use say ten or twenty rotations as opposed to one rotation to determine periodic time. [Periodic time, T = (time for 20 rotations)/(20)] Click 'Stop Timer' after counting your number of rotations. Record periodic time T_1 in Table 1 below. Do two time trials by clicking 'Reset Timer' to reset timer and get second periodic time recording for same mass. Record this second time T_2 in Table 1.
6. After successfully recording two periodic times T_1 and T_2 in Table 1, click on 'Stop' and change moving mass by clicking on up arrow to increase mass.
7. Repeat steps 5 and 6 above until you have recorded in Table 1 below seven different masses and the associated periodic times.

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8. Centripetal force $F_C = mv^2/r$. Recall angular speed $\omega = 2\pi/T$ and linear speed, $v = r\omega$. Hence $v^2 = r^2\omega^2 = r^2 4\pi^2/T^2$.
   Therefore, centripetal force, $F_C = mr4\pi^2/T^2$

   Table 1: Data for variable Moving Mass values in circular motion simulation experiment. (Fixed radius and rotating speed)

Radius, r (m)	Rotating speed, $v = r\omega = 2\pi r/T_{avg}$	Moving mass, m (kg)	Periodic Time, T (s)			Force Probe F_{Probe}	Force, $F_C = mr4\pi^2/T^2$
			T_1	T_2	T_{avg}		
2.0		0.5					
		0.8					

9. Plot a graph of Force, F_C on the Y – axis versus moving mass, m_{moving} on the X – axis. Use information in Table 1 and this graph to determine how changing the rotating mass affects centripetal force for circular motion. What can you infer concerning varying values of rotating masses and centripetal force?
10. For each force probe value you recorded in Table 1 above there is a corresponding centripetal force F_c, value. Is there a difference in these two recorded values in Table 1? What has contributed to this difference in values between force probe and centripetal force? Is it possible for these two values to be the same? Why? Why not?

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B – Varying Radius

1. Click on 'Stop' and reset simulation page. Change 'Mass' to any value greater than 0.5 kg and keep it fixed there for this part of the experiment. Leave speed randomizer fixed on one number.
2. Set 'Radius' to minimum value of approximately 0.5 m.
3. Just as in Part II-A steps 5 through 7, do several runs of this experiment, only difference is now you are varying 'Radius' instead of 'Mass'. Here you have four data points because of limitation with simulation radius increments.
4. Record data in Table 2 below.

Table 2: Data for variable Radius values in circular motion simulation experiment. (Fixed mass and rotating speed)

Radius, r (m)	Rotating speed, $v = 2\pi r/T_{avg.}$	Moving mass, m (kg)	Periodic Time, T (s)			Force Probe F_{Probe}	Force, $F_C = mr4\pi^2/T^2$
			T_1	T_2	T_{avg}		
0.5		1.0					
1.0		1.0					
1.5		1.0					
2.0		1.0					

5. Plot a graph of Force, F_C on the Y – axis versus radius, r on the X – axis. Use information in Table 2 and this graph to determine how changing the radius affects centripetal force for circular motion. What effect does changing the radius have on centripetal force?

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C – Varying Rotating Speed

6. Click on 'Stop' and reset simulation page. Change 'Mass' to any value greater than or equal 1.0 kg and set radius to 1.0 m and keep both variables fixed for this part of experiment.
7. Set 'Speed Randomizer' to #:1 to begin simulation.
8. Just as in Part II-A steps 5 through 7 do several runs of this experiment, only difference is now you are varying 'Speed Randomizer' instead of 'Mass'. Do several runs of the simulation for seven different speed randomizer values (or seven different velocity values).
9. Record data in Table 3 below.

Table 3: Data for variable Speed Randomizer (velocity) values in circular motion simulation experiment. (Fixed mass and radius)

Radius, r (m)	Rotating speed, $v = r\omega = 2\pi r/T_{avg}$	Moving mass, m (kg)	Periodic Time, T (s)			Force Probe F_{Probe}	Force, $F_C = mr4\pi^2/T^2$
			T_1	T_2	T_{avg}		
1.0		1.0					
1.0		1.0					
1.0		1.0					
1.0		1.0					

10. Plot a graph of Force, F_C on the Y – axis versus rotating speed, v, on the X – axis. Use information in Table 3 and this graph to determine how changing the rotating speed affects centripetal force for circular motion. What effect does changing the rotating speed have on centripetal force?