**Jefferson County Educational Service Center**

**Virtual Learning Academy**

**SCIPHYSICS\_AP Unit 20**

**ROTATIONAL MOTION LAB**

**Part I and II**

Instructions: Go to <http://phet.colorado.edu/simulations/sims.php?sim=Ladybug_Revolution> and launch the app found there. (You could also search for “Ladybug Revolution” to find the app.)

**PART 1: Follow the directions for each number below while manipulating the simulation and answer the corresponding questions.**

1. Click on the left tab at the top that says “Rotation”. Then under show graphs click on θ, ω, v. Click the minimize button on the θ graph. Type 180 in for angular velocity and click “go”. This will make the turntable turn at a rate of 180o per second. Look at the vector arrows coming from the ladybug.
	* 1. What direction is her centripetal acceleration?

* + 1. What direction is her velocity?
1. Set the ladybug in a similar position to the ladybug above and enter an angular velocity of 150 degrees/second. Draw your results below.



1. Did your results agree with your predictions from the pre-lab question #5?
2. Experiment with changing the location of the ladybug and beetle on the wheel. How does position relative to the center of the wheel affect the angular velocity?
3. Click on the ruler box at the bottom left of the screen. How wide is each band of color on the turntable?
4. Place the ladybug a known distance from the axis (center) of the turntable.
	1. Record the ladybug’s tangential velocity as VL. (This is simply referred to as velocity on this simulation, and it is written in green on the velocity graph.)
	2. Place the beetle twice as far from the axis. Record the beetle’s tangential velocity as VB1.
	3. Move the beetle three times as far from the axis. Record the beetle‘s tangential velocity as VB2.
	4. Explain how the radius (distance from the axis of the turntable) affects the tangential velocity?
5. Now place both the beetle and the lady bug on the wheel at any location. Record both bugs’ tangential velocities. Double the angular velocity to 360o/s and record the new tangential velocities. How does doubling the angular velocity affect the velocity of the bugs?
6. Since the angular velocity is currently 360o/s, the period T is 1 rotation/s. Using v = 2πr/T.
	1. Calculate the tangential velocity the beetle would have if you moved him to the edge of the turntable (a radius of 4 m from the axis).
	2. Move the beetle to r = 4 m and record his tangential velocity.
7. At r= 4cm If the huge beetle has a mass of 8.0 kg: Find the following assuming angular velocity is still 360 rad/s
	1. Find his centripetal acceleration ac.
	2. What is the average centripetal force Fc on the beetle?
8. If the ladybug has a mass of 6.0 kg and is at a distance r = 1 m, find the following assuming angular velocity is still 360 rad/s
	1. Linear Velocity
	2. Centripetal acceleration
	3. Centripetal force.

**PART 2**

1. Now click on the rotation tab. Bring up the ruler and make sure the bug is at 2mm from the center and remove the ruler.
2. Fill out the following table using different angular velocities for the given radius. Run each simulation for 5 seconds and observe the graphs.
	1. Underneath “Show graphs” you will need to click ,ω,a to get your acceleration.
	2. Underneath “Show graphs” you will need to click ,ω,v to get your velocity.

|  |  |  |  |
| --- | --- | --- | --- |
| **Angular velocity** | **Radius**  | **Velocity**  | **Acceleration**  |
|  | 2 m |  |  |
|  | 2m |  |  |
|  | 2m |  |  |
|  | 2m |  |  |

1. Repeat step 2 using a radius of 3 m and use the same angular velocity as step 2.

|  |  |  |  |
| --- | --- | --- | --- |
| **Angular velocity** | **Radius**  | **Velocity**  | **Acceleration**  |
|  | 3m |  |  |
|  | 3m |  |  |
|  | 3m |  |  |
|  | 3m |  |  |

**Conclusion Questions for Part 2**

1. Do you notice any relation between the velocity, radius, and acceleration?
2. From the graphs do you notice the magnitude of the velocity or the magnitude of acceleration changing as angular velocity stays the same, if so how?
3. In linear motion, when you have a constant acceleration, how does this affect the velocity? Is this different from rotational motion? Explain.

**Looking Ahead:**

In the next unit, we will be learning about the dynamics of fluids. We learn about density and pressure and how they relate to one another. We will also explore very famous ideas and equations written by Pascal and Archimedes. We will also be exploring buoyancy and how viscosity affects fluids in motion.