Lab: Round and Round!

Physics 1P Mr. Traeger

Name: _____ Period: _____ Date: _____

Purpose

The purpose of this lab is to investigate the basics of circular motion such as tangential velocity, angular velocity, and acceleration.

Materials

- 12.2 m (40 ft.) long 1-1/4ò PVC pipe
- Stop watch
- Meter stick
- calculator

Procedure and Questions

1. Take the 4 sections of PVC pipe out to the softball field and assemble them together. Make sure that there are no obstructions to prevent a full 360° rotation of the pipe.
2. Position yourself along the length of PVC pipe and everyone picks up the pipe simultaneously. ALL students shall do this!
3. Have a person on the outside record the time it takes to make one complete revolution around the pivot point.
4. Walk around in a circle with your classmates while grabbing on to the pole in front of you. Note your position from the center of the pole by noting how many meters you are from the center.
5. Do this for at least three time trials. Note: The people on the outside should be good runners!
6. Record data and make calculations in the tables below:

Record what number student you are from the center pivot point here:

Time in seconds to make one complete 360° or 2´ radian revolution:

Trial 1	Trial 2	Trial 3	**Average**

Kinematics Formulae for Velocity:

Linear	Circular (Hint: Whatôs the distance around a circle?)

Calculations of Tangential Velocity. You will need to share data back in the classroom to get all of this. Record your information on the softball field. I suggest you plug your data in to a spreadsheet, write some formulae to calculate velocity, and then use that data to make the graph that I will ask you to make.

Student #	Radius	$Velocity_{tangential}$	Student #	Radius	$Velocity_{tangential}$
1			16		
2			17		
3			18		
4			19		
5			20		
6			21		
7			22		
8			23		
9			24		
10			25		
11			26		
12			27		
13			28		
14			29		
15			30		

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Student #	Radius	$Velocity_{tangential}$	Student #	Radius	$Velocity_{tangential}$
31			34		
32			35		
33			36		

7. Make a line graph of Radius on the x axis versus $Velocity_{tangential}$ on the y axis. You can do this by hand and it will take you forever to graph all 36 students, but I will give gobs more credit for learning how to use a spreadsheet to do it! Do on a separate sheet of paper and staple to this graph.

8. Look at your graph. What kind of relationship is this? Linear, quadratic, logarithmic, etc.?

9. Calculate the slope of the line of your graph. What is the name of this value?

10. The value that you previously found is measured in units of radians/second. Do some Internet research and/or look in some pre-calculus math books to tell me what a radian is and how many of them there are in a full circle.

11. Derive the formula for $Velocity_{tangential}$ in terms of radius and angular velocity.

12. Is the angular velocity the same for everyone? Explain.

13. Was everyone in this lab accelerating? Think about this and explain in detail. A discussion of vectors with a diagram must be included here!

14. State the kinematics Formulae for Acceleration:

Linear	Circular

15. Calculate what your centripetal acceleration was in this lab at the position you were at. What direction is this acceleration in?

16. Compare notes with other students to find out how your centripetal acceleration compared to theirs. Talk to at least one person inside of your position and outside of your position and describe what the trend is.

17. Using Newton's 2nd Law, calculate the centripetal Force required to keep you in circular motion given your mass is 85 kg. What direction is this force in?

18. How could we extend this lab and apply it to real-world problems? Give at least three examples.