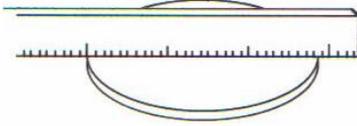


AP Physics C – Running Circles around derivatives

Purpose: To use derivatives to investigate the various characteristics of cardboard circles.

Materials: Compass, Cardboard, mass balance, ruler, meter stick

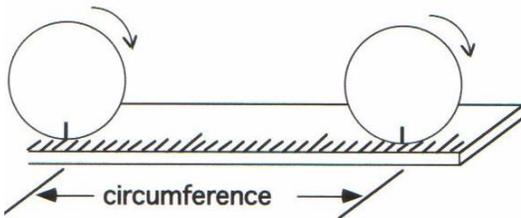
Procedure:



1. Measure and record the diameter of each of the disks in your set as shown in the figure. Always use METRIC units, therefore use METERS.

2. Mathematically record the radius of each of the disks as well.

3. To measure the circumference of the disk, make a mark on the disk and place the disk on the meter stick with the mark coinciding with a meter stick reading. Roll the disk for ONE REVOLUTION along the meter stick to obtain the circumference. Measure and record this value. Do this for each disk.



4. Measure and record the mass of each disk in KG.

Data Table

Disk	Diameter	Radius	Circumference	Mass
1				
2				
3				
4				
5				

Analysis

Part I – Circumference and diameter

1. Open up Graphical Analysis and place the diameter values on the X-axis and the Circumference values on the Y-axis.
2. Click on the first data point. HOLD AND DRAG to make a box around ALL of your data.
3. Then choose ANALYZE then REGRESSION (SLOPE). Record this value.
4. What does this value actually represent?
5. Was your graph LINEAR? Why or Why not?
6. Sketch your graph.
7. Determine a % error using the ACTUAL value as π . $\%error = \left| \frac{Actual - Experimental}{Actual} \right| \times 100$
(show the calculation)

Part II – Mass and diameter

1. Using Graphical Analysis again, click DATA then choose CLEAR ALL DATA.
2. Enter diameter on the X-Axis and MASS on the Y-axis.
3. Was your graph LINEAR? Why or Why not?
4. Sketch your graph
5. Using the above picture as a guide, Click on your graph then click on the **TANGENT LINE BUTTON**. This will give you a value for the SLOPE of the tangent line at that point. In other words, **THE DERIVATIVE! Record these values.**

6. What would be the units of the derivative?

Disk	Slope of tangent line (derivative)
1	
2	
3	
4	
5	

Part III – The derivative and diameter

- Using Graphical Analysis again, click DATA then choose CLEAR ALL DATA.
- Enter diameter on the X-Axis and the derivative on the Y-axis.
- Click on the first data point. HOLD AND DRAG to make a box around ALL of your data.
- Then choose ANALYZE then REGRESSION (SLOPE). Record this value.
- Sketch your graph.
- What would the UNITS of the SLOPE be?
- Was your graph LINEAR? Why or Why not?
- What do you think this could be a representation of?
- Describe an example of a mathematical graph that IS NOT LINEAR!
- Out of everything you know about CIRCLES, are there any “circle” equations that look like your NON-LINEAR example?

Find the _____ (answer above) for each of your disks and record below

Disk	_____ (fill in the blank)
1	
2	
3	
4	
5	

Now DIVIDE the MASS of each disk by the _____ of each disk found above and record below.

Disk	?
1	
2	
3	
4	
5	

What are the units for each value to the left?

What do you notice about EACH value?

Find the AVERAGE of each value above and record below.

AVERAGE = _____

Once again, what do you think this represents?

Find the % difference between the AVERAGE VALUE you found and the SLOPE of the derivative diameter graph.

$$\% \text{ difference} = \left| \frac{\text{Value1} - \text{Value2}}{\text{Average}} \right| \times 100$$

Explain the THEME of this experiment!