

Name: _____

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Related Rates and Rotten Teeth

Objective:

To determine the rate of change of the volume of the Blow Pop as you consume it.

Equipment Needed:

- Blow Pop®
- Ruler (use mm)
- Timer (use the timer on your cell phone)
- Calculator
- Dental Floss



Part 1 - Data Collection:

Step 1: Determine the initial radius of the Blow Pop. (Assume it is a perfect sphere.)

Step 2: Take the Blow pop and suck on the lollipop for 30 seconds.

Step 3: Take out after every 30 seconds. Measure the radius with dental floss (use circumference to help you find r) and record all of your data into the table.

Step 4: Repeat step 2 and 3 as many times as possible.

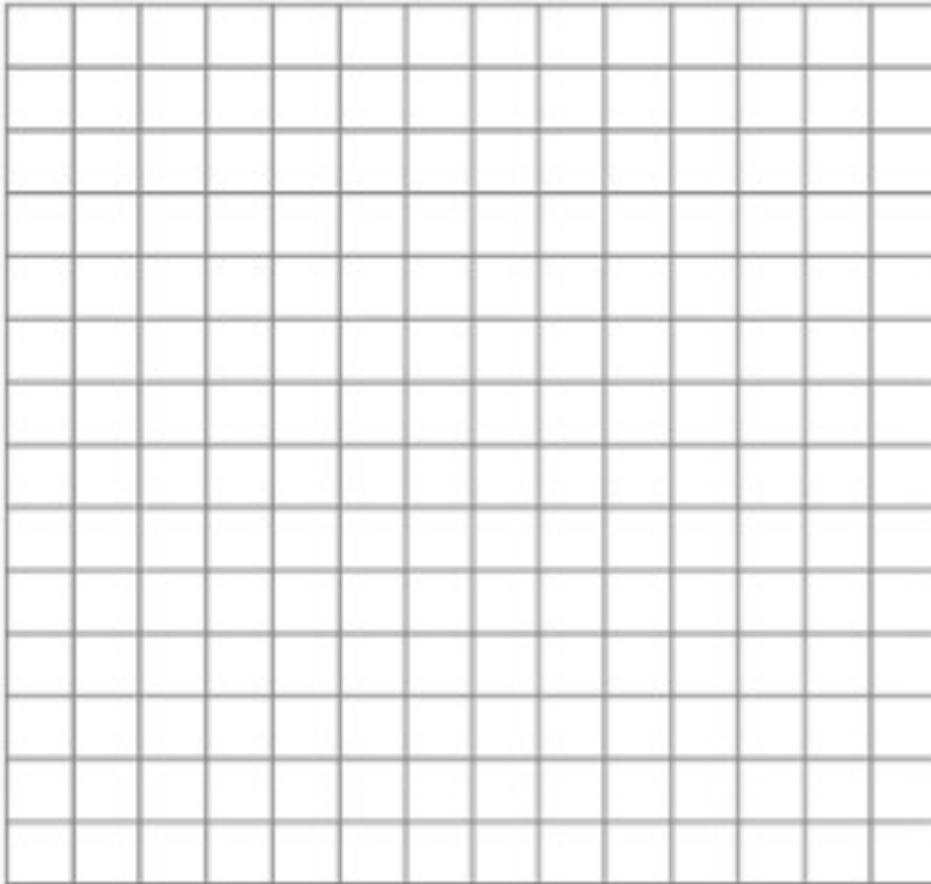
Time (s)	Circumference $C = 2\pi r$ (mm)	Radius (mm)
0		
30		
60		
90		
120		
150		
180		
210		
240		
270		

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Part 2 - Data Analysis: Based on the data, determine the rate of change of the radius as a function of time.

Using the data from your table, graph the radius as a function of time on graph paper. From this graph estimate the rate of change of the radius with respect to time of the Blow Pop for your mouth power. Assume your data points are linear.



Part 3: The Mission: Using these results and what you learned about related rates from Calculus class, determine how fast the volume of the Blow Pop is decreasing with respect to time. Be sure to include all calculus support and calculations. Use good units.

Get a general formula for dV/dt :

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Using your dV/dt formula, find the following:

Radius compared to original	Radius Length (in mm)	dV/dt
80%		
60%		
40%		
20%		

Part 4- Reflection

Answer the following questions using complete sentences.

1. What happens to dV/dt as the radius decreases? Use data from above to assist you in your explanation.
2. A well-known calculus text states that when sucked, a blow pop gives up volume at a rate of 0.8 cubic centimeters per minute. Based on your experiment, comment on how accurate your solution was using the percent error formula. Note: $1\text{cm}^3 = 1000\text{mm}^3$ and $1\text{ min} = 60\text{ sec}$.

$$\% \text{ error} = \frac{|\text{Accepted} - \text{Measured}|}{\text{Accepted}} \times 100$$

3. Discuss any assumptions made and/or any difficulties that you had that may contribute to the reasonableness of your answer.

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Rubric

	3	2	1
1: Data Collection	At least 8 data points are given and reasonable.	At least 6 data points are given and reasonable.	At least 4 data points are given and reasonable.
2: Data Analysis	Graph is neat and accurate. Slope line fits data and is calculated correctly.	Graph is somewhat neat and accurate. Slope line somewhat fits data and is calculated correctly.	Graph shows points. Slope is calculated.
3: The Calculus	Calculus is accurate and well-explained.	Calculus is somewhat accurate.	An attempt is made to complete the Calculus.
4: Reflection	Reflection is thoughtful. All questions are answered accurately and supported with evidence.	Reflection is complete. Questions are answered somewhat accurately and supported with evidence.	Reflection is attempted.
Poster (display of information)	The poster is thorough and informative. All information is complete and easy to understand.	The poster is thorough and informative but lacks some information.	Poster is incomplete and/or difficult to understand.
Independence	Students worked independently with little/no teacher assistance.	Students worked independently with some teacher assistance.	Students utilized teacher help frequently.
Poster (neatness)	Work is neat and presentable.	Work is somewhat neat and presentable.	Parts of the work are presentable.
Total		_____ /21	
The final grade will be graded out of 50 Points.			

Of Times Assisted (tally marks made by teacher)