

Math 171 Group Worksheet 3

on Chapter 3 ending ideas

Due Monday, October 15, 2018

One submission per group. Grade will be based on mathematical processes, precision, proper notation and participation. Make sure to write legible and explain your steps. If needed, staple multiple pages together before handing in work. You may also submit electronically through D2L.

Problem 1. You will be determining the rate of change of the volume of a Tootsie Roll Pop (TRP) as you consume it.

Step 1: Create a plan to measure the radius of the TRP. Assume it is a perfect sphere. Write up a description of how you will measure your TRP's radius for each round.

Step 2: Each group member will need to find their personal data for the following.

- i) Determine the initial radius of your TRP.
- ii) Place the TRP in your mouth and suck for 60 seconds (1 minute).
- iii) Measure the radius (however you can) and record the time and radius in a table similar to that below.

Time (s)	Radius (mm)

... ..

- iv) Repeat until 10 minutes has expired or you reach the chewy center.
- v) You should probably go brush your teeth at this point!

Step 3: For each of your group members' data, create a scatter plot of your time vs. radius data and your line of best fit. It is okay to use a calculator, Excel or other program to create this information. Each member should have a separate graph.

Step 4: For each group member, state their personal mouth power $\left(\frac{dr}{dt}\right)$ and how you found it. What group member "sucks" the most?

Step 5: Use your personal mouth power to determine the rate of change of the volume of the TRP with respect to time. Be sure to think about units in your calculation.

Grading on Problem 1 will be on the following criteria:

Item	Criteria	Points
1.	An explanation of the method you used to find the radius after each time interval	4
2.	Data for each group member is given in a concise matter.	4
3.	Scatterplot and linear regression lines for each member is produced either using technology or is neat and well-detailed by hand. Be certain to scale and label the axes and title your graphs.	4
4.	Explanation of $\frac{dr}{dt}$	4
5.	Calculus is used to calculate the rate of change of the volume with respect to time.	4
6.	The problem is well-organized and easy to follow. Computations are presented neatly by hand or typed.	4
	Participation Multiplier (full=1, some =0.5, very little=0)	

Where did the first question originate? - It all started with a commercial. You can view it on YouTube at: <https://www.youtube.com/watch?v=O6rHeD5x2tI>

Here is some scientific research to find the answer:

Purdue University -

A group of engineering students from Purdue University reported that its licking machine, modeled after a human tongue, took an average of 364 licks to get to the center of a Tootsie Pop. Twenty of the group's volunteers assumed the licking challenge-unassisted by machinery-and averaged 252 licks each to the center.

University of Michigan -

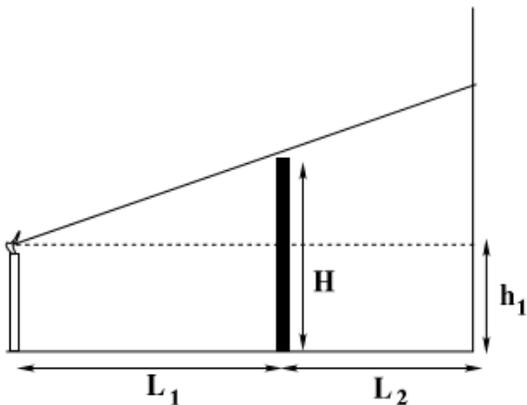
Not to be outdone by a Big Ten rival, a chemical engineering doctorate student from the University of Michigan recorded that his customized licking machine required 411 licks to reach the Tootsie Roll center of a Tootsie Pop.

Swarthmore Junior High School -

Rejecting the notion that one needed active college status to undertake the Tootsie Pop licking challenge, a group of junior high students at Swarthmore School used human lickers, reporting an average of 144 licks to reach the center of a Tootsie Pop.

Based on the wide range of results from these scientific studies, it is clear that the world may never know how many licks it really takes to get to the Tootsie Roll center of a Tootsie Pop.

Problem 2. A candle is placed a distance L_1 from a thin block of wood of height H . The block is a distance L_2 from a wall as shown below. The candle burns down so that the height of the flame, h_1 decreases at the rate of 3 cm/hr. Find the rate at which the length of the shadow y cast by the block on the wall increases.



Grading on Problem 2 will be on the following criteria:

Item	Criteria	Points
1.	Sets up correct related equation.	4
2.	Finds derivative accurately and with correct notation	4
3.	Answers question completely including units.	4
4.	The problem is well-organized. The computations are presented neatly and are easy to follow.	4
	Participation Multiplier (full=1, some =0.5, very little=0)	