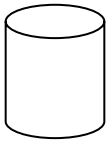
AP Calculus AB Name: _____

Revolutionary Volume Lighting Name: _____

A new company, RRVLV (Rolesville Revolutionary Volume Lighting Visions) has opened for business to sell updated versions of tea lanterns. They contacted me because they know I have amazing AP Calculus students that have their fingers on the pulse of not only mathematics, but on the aesthetics of modern lighting.

They want to create tea lanterns that have a hollow core, but are completely filled around with a honeycombed-style amount of paper. They have asked for prototypes of fresh new modern designs with specs for the volume of material they need to purchase, so that they can make their design decisions for their line of products.

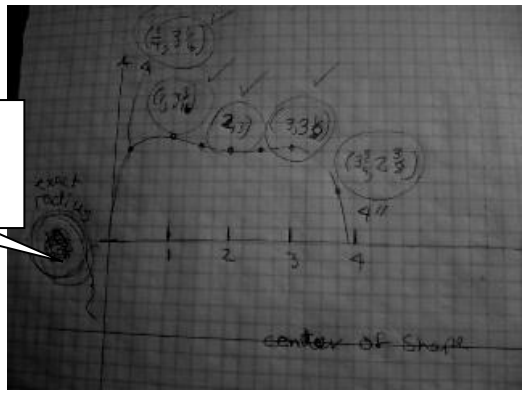
Your boss has written up a list of tasks for you to complete so that we can be paid.



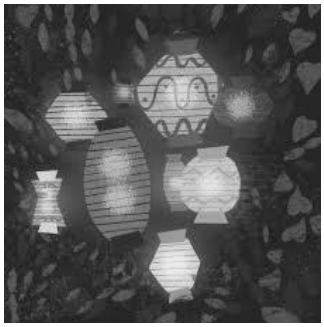
circumference: 8”
height: 4.25”

1. The hollow core will be of the shown dimensions, so create a prototype out of scratch paper (do not tape into a cylinder yet).
2. Create **one** shape that will be repeatedly taped around the cylinder (eventually) to be your prototype of a final version that has these shapes ALL the way around. Brainstorm to design solid 2-dimensional shape you want to create, but remember the following:
    a. The base should correspond with the height of your inner cylinder: 4.25’’
    b. You will need a thin tab for folding over and taping (see pic at right).
    c. Be reasonable: You will eventually need to create 12 of these shapes to create your lantern.

3. Once you have designed your 2-dimensional shape, use graph paper to trace out your shape. Specifics are important:



    a. Graph paper squares are often 0.25’’ in width.
    b. Draw axes to create a 1st quadrant and trace out your shape in the appropriate place.
    c. You ultimately want to determine the equation of your curve, so don’t forget about the cylinder radius. That means the center of the radius should be your x-axis and the height of the radius should be x = ___.
    d. Decide if your whole curve should be considered one function or if your design would be best described as a piecewise graph.



4. Identify ***at least*** 12 points on your graph. Be as accurate as possible. The closer the decimal approximation the better! The more points the better!
5. Perform a polynomial regression to determine an equation for your graph. Remember, if your curve is piecewise you may need to perform more than one regression.
    a. Create a table of values (x,y) for each potential equation and save this table in Google Sheets or in Microsoft Excel.
    b. Go to this link: http://www.xuru.org/rt/pr.asp.
    c. Follow the directions and write down each equation below. Feel free to round coefficients to 3 decimal places.

7. Once you have your equation(s), go to desmos.com, and
    a. Enter your equation(s) in Y1, Y2, etc. Make to restrict your domain for each curve if you have more than one equation.
    b. Enter the equation for the radius in Y3 (or 4 or 5).
    c. Copy/paste your data from part 6A.
    d. You should be able to see both your curves as well as your original data.
8. Oooh and aaah and adjust as needed to try to make your desmos graph look like your actual curve.
9. Use your calculus skills to find the volume of your prototype lantern.
10. Create a magnificent version of your lantern to be hung in the classroom. (To do this you will need to create 12 identical versions of your original shape. Make sure each has a small tab that can be folded over and taped. On your un-taped cylindrical core, evenly space each shape. Wrap the cylinder around, tape, and voila, you have a lantern!

When you turn in your project, I will be looking for the following:

1. Completed Lantern
2. ONE ½ sheet of poster board including the following (ON ONE SIDE)
    a. The sketch of original prototype on graph paper
    b. A table of your data (should be typed)
    c. The Desmos graph and scatter plot
    d. Your Calculus work to determine the volume (Can be hand-written but should be exceptionally neat.)
3. Reflection Paragraph (ONE PER STUDENT) – should be typed and turned in on a separate sheet of paper. Tell me what you liked/didn't like, what interested you, what would you have done differently if you could begin again? What part did you play in completing the project?

See the below for your grading rubric.

	Exemplary	Good	Satisfactory	Needs Improvement
Completed Lantern	Lantern is creative, neat, and matches the accompanying sketches and calculations. (8)	Lantern is a neat and accurate representation of the accompanying sketches and calculations. (6)	Lantern is a sufficient representation of the accompanying sketches and calculations. (4)	Lantern does not sufficiently represent the accompanying sketches and calculations. (2)
Original Graph	The original graph and accompanying data points neatly and accurately depict a cross section of the lantern. (6)	The original graph and accompanying data points accurately depicts a cross section of the lantern. (4)	The original graph and accompanying data points are mostly accurate in depicting a cross section of the lantern. (2)	The original graph and accompanying data points do not accurately depict a cross section of the lantern. (1)
Desmos/ Regression	The Desmos graph and polynomial regression equations excellently model the data and prototype. (10)	The Desmos graph and polynomial regression equations sufficiently model the data and prototype. (8)	The Desmos graph and polynomial regression equations are some-what accurate in their model of the data and prototype. (6)	The Desmos graph and polynomial regression do not accurately model the data and prototype. (2)
Volume Calculation	The volume calculations are neat and accurate. (10)	The volume calculations are adequately neat and accurate. (8)	The volume calculations are mostly neat and accurate. (6)	The volume calculations are not accurate. (2)
Reflection	The reflection paragraph meets all requirements and provides excellent feedback for the teacher. (4)	The reflection paragraph meets most requirements and provides sufficient feedback for the teacher. (3)	The reflection paragraph provides some feedback for the teacher. (2)	The reflection paragraph provides minimal feedback for the teacher. (1)

Grade _____/38

Additional points may be awarded to students with more complicated graphs (i.e. piecewise functions).