FINDING VOLUMES OF SOLIDS OF REVOLUTION

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Calculus Project – Volumes of Revolution Name _____

1. SHAPE_____

Using the ¼ inch graph paper provided, trace the area onto a coordinate plane. Label the x and y axes and the axis of revolution.

2. POINTS AND EQUATIONS

Decide how many curves you will need to use. Label the curves on your graph (y_1,y_2,y_3...) Find points on each curve. Label them on the graph and write them in the chart below. Use your graphing calculator to find the regression equation for each set of points. Store your equations in y=.

	POINTS	REGRESSION EQUATION
1		y_1=
2		y_2=
3		y_3=
4		y_4=
5		y_5=
6		y_6=

3. INTEGRALS

Decide how many regions you will need to use. Label the regions on your graph (A, B, C...) Find the limits of integration for each region. Set up the integral to find the volume of the region. Use the **FnInt** function on your graphing calculator (MATH – 9) to evaluate the integral. Find your final volume in cubic inches.

	INTEGRAL	VOLUME
A		
B		
C		
D		
E		
F		

4. TOTAL VOLUME: _____ **cubic inches**

5. ANSWER THE FOLLOWING CONCEPT QUESTIONS:

a. What challenges did you encounter when you were choosing your points ? How did you resolve them?

b. What challenges did you encounter when you were deciding how many equations to use? How did you resolve them?

c. What challenges did you have when you were setting up your integrals? How did you resolve them?

d. What did you have to consider when you were finding the total volume in cubic inches?

e. Do you think that your estimate is an overestimate or an underestimate and why?

¼" Grid Paper

Regression Steps on TI-8X

1. **Enter Data**:
- STAT – EDIT
- clear lists by going up to the label L1 and hitting CLEAR – ENTER, repeat for L2
- Enter x values in L1 and y values in L2

2. **Set your domain and range**:
- WINDOW
- xmin = 0, xmax = (maximum of x values in L1), xscl – anything appropriate (this is the number of marks on the x-axis)
- ymin = 0, ymax = (maximum of y values in L2), yscl – anything appropriate (this is the number of marks on the y-axis)
- leave xres at 1

3. **Graph the points**:
- 2^{ND} – STAT PLOT – ENTER
- Turn On Plot 1
- GRAPH

4. **Find Regression Equation:**
- 2^{ND} – QUIT (takes you to home screen)
- STAT – CALC – (4) LinReg(ax+b) – ENTER
- Record R^2 (The ideal R^2 value is 1)
- Repeat as needed for other regressions (quadratic, cubic, quartic, lnreg, expreg, pwrreg, logistic)

5. **Graph Regression Equation**:
- Y= - VARS – 5(Statistics) – EQ – RegEQ – ENTER
- GRAPH

6. **Predictions for a given x value:**
- GRAPH – 2^{nd} – CALC – 1(value)
- Enter the x value – ENTER (If you get an error, you may need to change your WINDOW)
- Look at the predicted y value

7. **Predictions for a given y value:**
- GRAPH – Y_2= given y value
- 2^{nd} – CALC – INTERSECT (hit ENTER, ENTER, move to the intersection point and hit ENTER)
- the x value at the bottom of your screen is the x value for this given y value

Calculus Project – Volumes of Revolution Name Key * answers will vary *

1. SHAPE Bell

Using the ¼ inch graph paper provided, trace the area onto a coordinate plane. Label the x and y axes and the axis of revolution.

2. POINTS AND EQUATIONS

Decide how many curves you will need to use. Label the curves on your graph (y_1, y_2, y_3...) Find points on each curve. Label them on the graph and write them in the chart below. Use your graphing calculator to find the regression equation for each set of points. Store your equations in y=.

	POINTS	REGRESSION EQUATION
1	(0,0) (1,2.5) (2,5) (4,8) (6,10) (8,11) (11,12) (16,12.5) (20,13) (24,14) (27,15) (30,17) (33,19.5)	$y_1 = .002x^3 - .113x^2 + 2.059x + .763$
2	(33, 19.5) (37,23) (40, 23) (41.5, 21)	$y_2 = -.164x^2 + 12.397x - 211.471$
3	(41.5,21) (40,18) (39,15) (38,13) (36,10) (33.5,6)	$y_3 = .079x^2 - 4.039x + 52.837$
4	(33.5,6) (37,3) (37.75,0)	$y_4 = -.739x^2 + 51.277x - 881.891$
5		$y_5 =$
6		$y_6 =$

3. INTEGRALS

Decide how many regions you will need to use. Label the regions on your graph (A, B, C...) Find the limits of integration for each region. Set up the integral to find the volume of the region. Use the **FnInt** function on your graphing calculator (MATH – 9) to evaluate the integral. Find your final volume in cubic inches.

	INTEGRAL	VOLUME
A	$\pi \int_{0}^{33.5} y_1^2 \, dx$	17704.381
B	$\pi \int_{33.5}^{41.5} y_2^2 - y_3^2 \, dx$	8127.163
C	$\pi \int_{33.5}^{37.75} y_4^2 \, dx$	417.967
D		
E		
F		
	TOTAL:	26249.511

4. TOTAL VOLUME: 410.149 **cubic inches**

5. ANSWER THE FOLLOWING CONCEPT QUESTIONS: (answers will vary)

a. What challenges did you encounter when you were choosing your points ? How did you resolve them?

- had to estimate some of the values
- needed more points to do the regression

b. What challenges did you encounter when you were deciding how many equations to use? How did you resolve them?

- each equation needed to be a function

c. What challenges did you have when you were setting up your integrals? How did you resolve them?

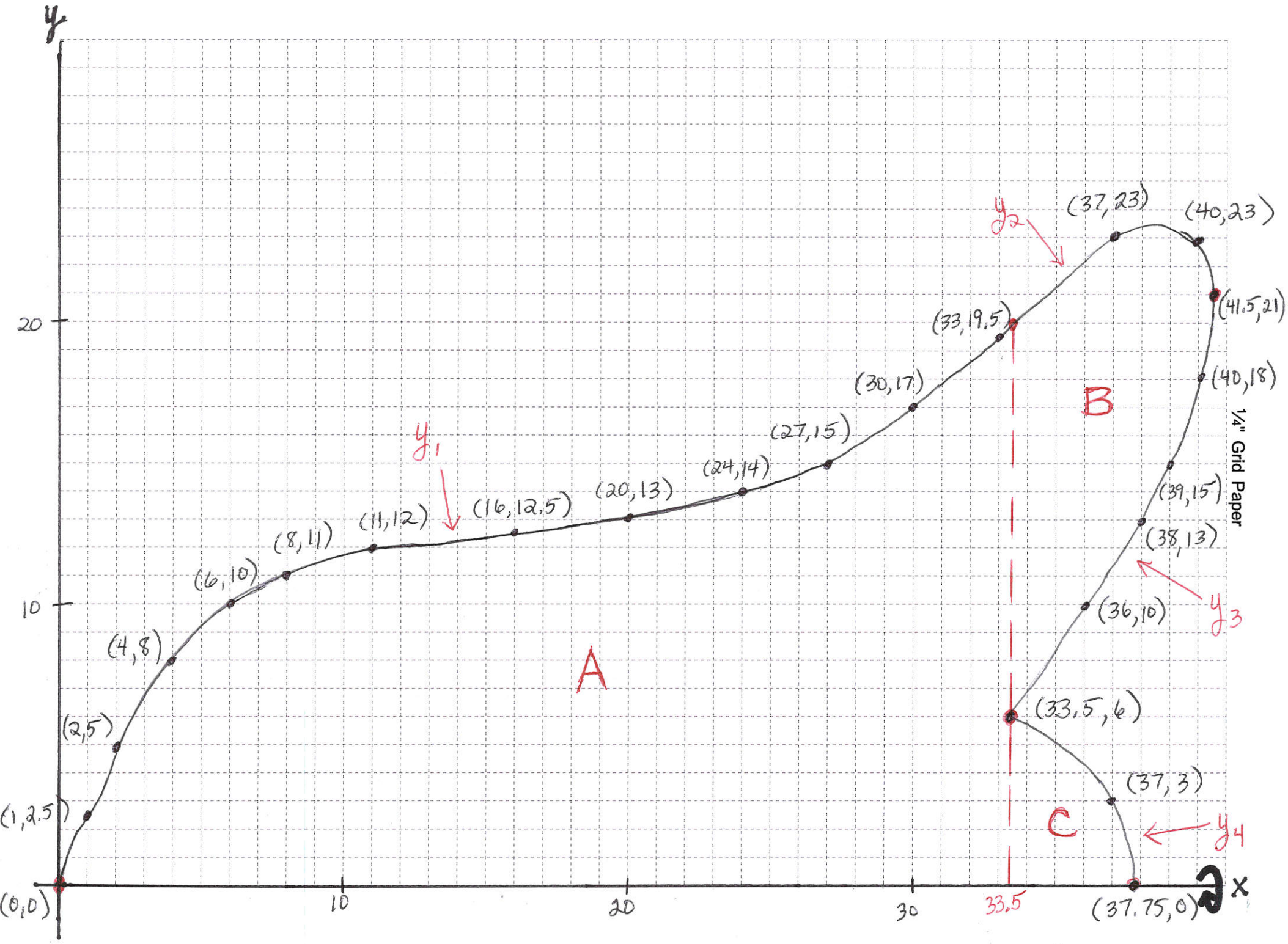
- deciding on disc or washer method
- finding the correct limits

d. What did you have to consider when you were finding the total volume in cubic inches?

- I had to divide by 4^3

e. Do you think that your estimate is an overestimate or an underestimate and why?

- compare regression equation to actual curve


y
x
20
10
10
20
30
33.5
(0,0)
(1,2.5)
(2,5)
(4,8)
(6,10)
(8,11)
(11,12)
(16,12.5)
(20,13)
(24,14)
(27,15)
(30,17)
(33,19.5)
(37,23)
(40,23)
(41.5,21)
(40,18)
(39,15)
(38,13)
(36,10)
(33.5,6)
(37,3)
(37.75,0)
A
B
C
y1
y2
y3
y4
1/4" Grid Paper

GRAPHING YOUR SHAPE ON THE CALCULATOR:

The calculator assigns "1" to a true statement and "0" to a false statement. Also, the calculator will not graph anything that is divided by zero. These two facts combined can help you to graph only *part* of a function. Be sure to put parentheses around the *entire* numerator and the *entire* denominator. You can find the inequality symbols under **2nd-Math (Test)**. Choose an appropriate viewing window. I used Xmin=0, Xmax=45, Ymin=0, Ymax=25.

For the bell example:

$$y_1 = \frac{.002x^3 - .113x^2 + 2.059x + .763}{(x \geq 0)(x \leq 33.5)}$$

$$y_2 = \frac{-.164x^2 + 12.397x - 211.471}{(x \geq 33.5)(x \leq 41.5)}$$

$$y_3 = \frac{.079x^2 - 4.039x + 52.837}{(x \geq 33.5)(x \leq 41.5)}$$

$$y_4 = \frac{-.739x^2 + 51.277x - 881.891}{(x \geq 33.5)(x \leq 37.75)}$$

FOLLOW UP ACTIVITY

Label the following decorations in their order of difficulty.
Make 1 the easiest and 10 the hardest.

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_____

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