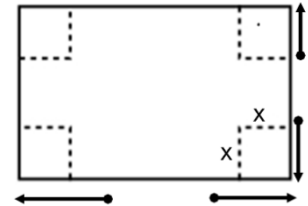


Lesson 2: Modeling with Polynomials—Using Equations

Opening Exercise – Discussion

In Lesson 1, your class created open boxes of various sizes, gathered data about the dimensions and volume of the boxes, and then graphed the data.

Often when scientists, engineers and mathematicians create a model, they turn to a formula or equation to describe the relationship.



1. Use the graphic organizer below to give reasons someone might prefer an equation or a graph and reasons someone may dislike an equation or a graph.

Mathematical Model	Pros – Reasons to Prefer this Model	Cons – Reasons to Avoid this Model
Equations		
Graphs		

Graphing Utility

Graphing calculators or graphing software can make the process of writing an equation much easier.

2. Use a graphing utility to get a regression equation for the function in Lesson 1 Exercise 6, with the data in Lesson 1 Exercise 4.

Equation to Model the Open-Box Problem: _____

Type of Function: _____

You can also determine the equation for the data by using the patterns you saw in the table.

3. A. Rewrite the last row of the table from Exercise 4 in Lesson 1.

Group	Size of Cut Out Square	Length	Width	Height	Volume
	$n \times n$				

B. What is the equation for the volume based on this table? _____

C. What are the restrictions on the height (domain)? _____

D. What are the restrictions on the volume (range)? _____

Discussion

4. A. How does the equation the graphing utility gave compare to the one from the table?

B. What are two ways you could check to see if they are the same equation or not?

Lesson Summary

A cubic function in standard form: $y = ax^3 + bx^2 + cx + d$, where a , b , c and d are real numbers and $a \neq 0$.

Cubic functions can also be written in factored form, such as $y = (x - e)(x - f)(x - g)$, where e , f and g are real numbers.

Homework Problem Set

1. A box is to be constructed so that it has a square base and no top.
- A. Draw and label the sides of the box. Label the sides of the base as x and the height of the box as h .

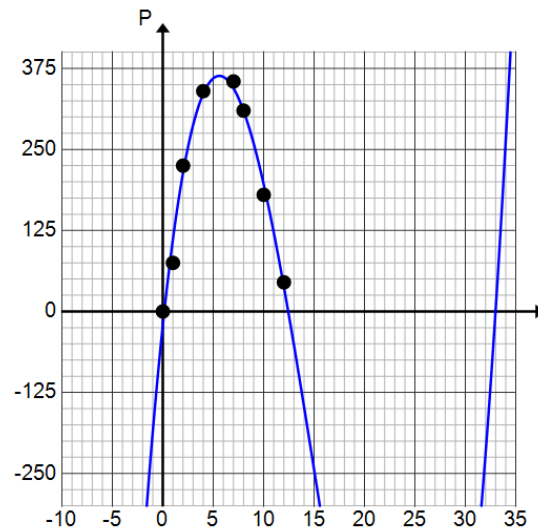
B. The surface area is 108 cm^2 . Write a formula for the surface area S , and then solve for h .

Geometry Review: The surface area is the area of all the outside faces or surfaces of the solid. In this case, the surface area is the area of all five faces. (Remember there is no top to this box.)

- C. Write a formula for the function of the volume of the box in terms of x .
- D. Use a graphing utility to find the maximum volume of the box.
- E. What dimensions should the box be in order to maximize its volume?

2. The owners of Dizzy Lizzy's, an amusement park, are studying the wait time at their most popular roller coaster. The table below shows the number of people standing in line for the roller coaster t hours after Dizzy Lizzy's opens. Jaylon made a scatterplot and decided that a cubic function should be used to model the data. His scatterplot and curve are shown below.

t (hours after park opens)	P (number of people in line)
0	0
1	75
2	225
4	345
7	355
8	310
10	180
12	45



- A. Do you agree that a cubic polynomial function is a good model for this data? Explain.
- B. What information would Dizzy Lizzy's be interested in learning about from this graph? How could they determine the answer?
- C. Estimate the time at which the line is the longest. Explain how you know.
- D. Estimate the number of people in line at that time. Explain how you know.
- E. What would be a reasonable domain for this function f ? Why?
- F. Use the regression feature of a graphing calculator to find a cubic function f to model the data.
- G. Use your function f to calculate the number of people in line 10 hours after the park opens. How close is this to the actual number of a people in the table?

REVIEW

3. Determine the number of terms in each polynomial. If you've forgotten what polynomials are, watch the YouTube video *Algebra Basics: What are Polynomials?* By Math Antics at <https://www.youtube.com/watch?v=ffLLmV4mZwU>.

A. $3x^3 - 7x^2 + 2x$

B. $6x^5 - 12x^4 + 3x^2 - 42$

4. Determine the degree of each polynomial.

A. $3x^3 - 7x^2 + 2x$

B. $6x^5 - 12x^4 + 3x^2 - 42$

5. Simplify each expression by adding or subtracting like terms. Math Antics also created a video on *Simplifying Polynomials* at <https://www.youtube.com/watch?v=DKC74YKJpNY>.

A. $(5x^3 + 4x^2 - 7) + (12x^3 - 8x^2 + 2x + 13)$

B. $(12x^2 + 8x^7 - 24x^3) + 2(4x^3 - 7x^7 + 33)$

C. $(11x^5 - 20x^4 + 17x - 9) - (13x^5 - 10x^4 - 3x + 12)$

D. $3(7x^4 - 4x + 5) - (23x^2 - 8x + 50)$

6. Determine the missing value that will make this equation true. Then explain how you found the correct value.

$$\underline{\hspace{2cm}}(3x^2 + 4x - 6) + 2(4x^2 - 5x + 2) = 17x^2 + 2x - 14$$

7. Determine which functions are linear, which are quadratic and which are neither.

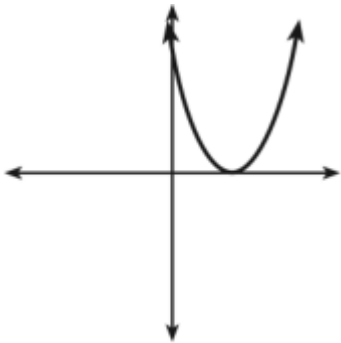
A. $x^2 + y^2 = 9$

B. $3y = 2x^2 + 6$

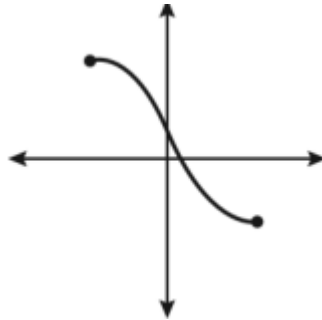
C. $3x + 2y = 6$

D. $y = |x - 7|$

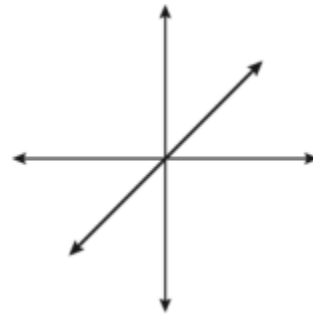
E.



F.



G.



8. Complete the table of values below so that the graph of the points is a parabola.

x	3	2	1	0	-1	-2	-3
y	-8	-3		1	0		