Functions: Design a Roller Coaster

Strand
Algebra 2, Functions

Mathematical Objective(s)
Students will create their own function based on different criteria.

Related SOL

AII.7
The student will identify and analyze functions (polynomials) algebraically and graphically. Key concepts include
a) domain and range, including limited and discontinuous domains and ranges;
b) zeros;
d) intervals in which a function is increasing or decreasing;

NCTM Standards

- understand operations on, and the general properties and behavior of, classes of functions.

Materials/Resources
- High lighter, activity Sheet 1 and 2 (attached), assessment, and assessment list,

Assumption of Prior Knowledge
Algebra
- Students should know if a graph is a function or not.
- Students should be familiar with function notation.
- Students should know how to represent a range of numbers in interval form and in inequality form.
- Students should know the degree of a polynomial by the graph.
- Students should be able to identify turning points of polynomials from a graph.
- Students should be able to identify maximums and minimums from a graph.
- Students should know that domain is the x-values and range is the y-values.

Misconceptions/difficulties:

- Students may use y-values to represent intervals of increasing and decreasing instead of x-values.

Introduction: Setting Up the Mathematical Task

- In this task, Algebra 2 students will create and investigate polynomial functions to include domain, range, zeros and intervals of increasing and decreasing.
- For the students to complete the activity sheet it will take 1 class period. The activity sheet is for the students and teacher to assess their understanding.
- For this task students will explore how to identify the domain, range, zeros and intervals of increasing and decreasing from a given graph. Students will then be able to create a graph of a polynomial based on given scenarios.
- To introduce the task students will be asked to identify where they notice quadratic functions in the world around them.
- To help the students with the task, ask the following questions:
    - Describe the path of a football being kicked to make a field goal. What would represent the domain/range of the path of the football? How would you describe the intervals of increasing/decreasing? What would the graph look like for the path of the football? Where on the graph would you represent the ball on the ground?
- The teacher will demonstrate how to identify domain, range, zeros and interval of increasing and decreasing using the path of a football with relationship to time and height, the path of a car ride with relationship to time and distance from home. The students will complete the activity using think/pair/share strategy. The students will think with a partner, pair with another group of two and share with the class as a whole. The students will complete the assessment on their own.

Student Exploration

Student/Teacher Actions:

- The student will create a roller coaster ride that will last 20 seconds.
- From the roller coaster the students designed, the students will identify intervals of increasing/decreasing, domain/range, and zeros.
- The teacher will walk around to help students with questions they may have. The teacher is to direct the students and not give answers.

Monitoring Student Responses

- Students will communicate their new knowledge with the class by presenting their roller coaster design.
- If students are have difficulty expressing their thoughts the teacher and students will ask clarifying questions.

- Summary
    - After completing the assessment the teacher will led the students through a series of questions to pull everything together.

Assessment List and Benchmarks

- Assessment List, Rubric and Benchmarks attached.

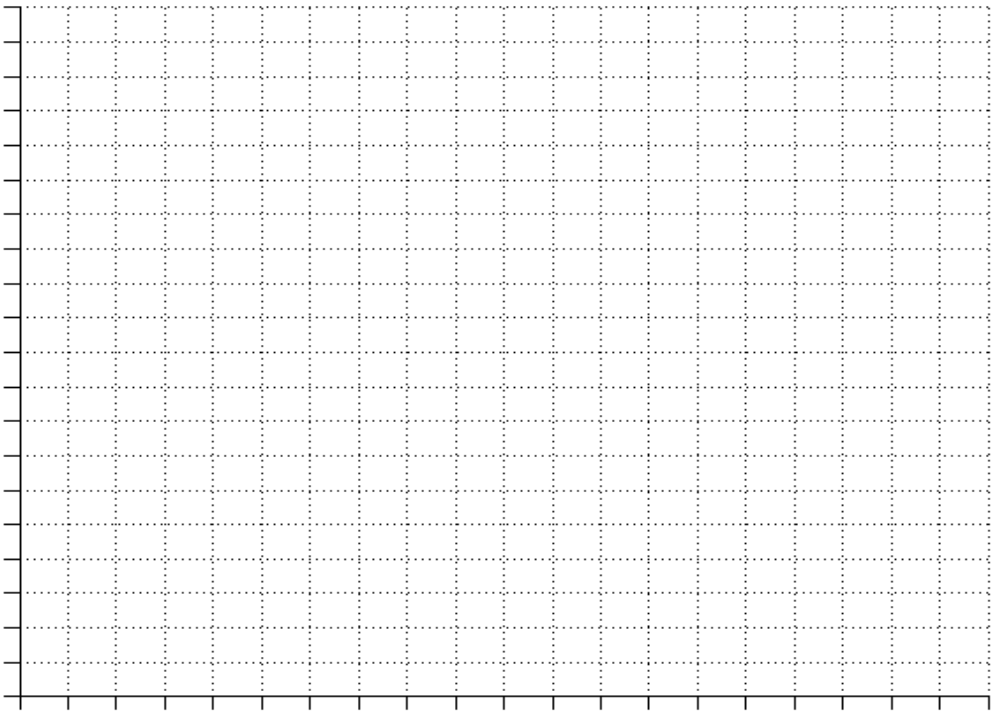
- **Questions**
    - What function has one interval of increasing and one interval of decreasing?

- **Journal/writing prompts**
    - Describe an airplane ride from Newport News, VA to Dallas, TX that includes the plane descends more than 20 feet two different times.

Activity Worksheet

Domain/Range, Increasing/Decreasing and Zeros

1. Create a roller coaster ride that will last 20 seconds that represents a polynomial function. You will graph your ride and describe your ride using your graph. Make sure to include appropriate units of measurement.



2. Identify the time interval(s) when the roller coaster is increasing.

3. Identify the time interval(s) when the roller coaster is decreasing.

4. How high is the roller coaster when it is at its maximum height?

5. Identify the domain and range.

Rubric for Domain, range, intervals of increasing/decreasing and zeros

#	2	1	0
1.	Graphed an appropriate polynomial function with starting point at (0,0) and ended at the point (20, 0)	Graph a polynomial function that didn't start at (0,0) or end at (20,0)	Did not graph a polynomial function.
2.	Based on the roller coaster created, the student appropriately identifies intervals of increasing.	Used the height values to identify the intervals.	Did not identify intervals correctly.
3.	Based on the roller coaster created, the student appropriately identifies intervals of increasing.	Used the height values to identify the intervals.	Did not identify intervals correctly.
4.	Based on the roller coaster created, the student identifies the appropriate maximum height.	Used the time value instead of the height value	Did not identify the maximum height.
5.	Gives the appropriate domain and range.	Identified one incorrectly.	Did not get either domain or range correct.

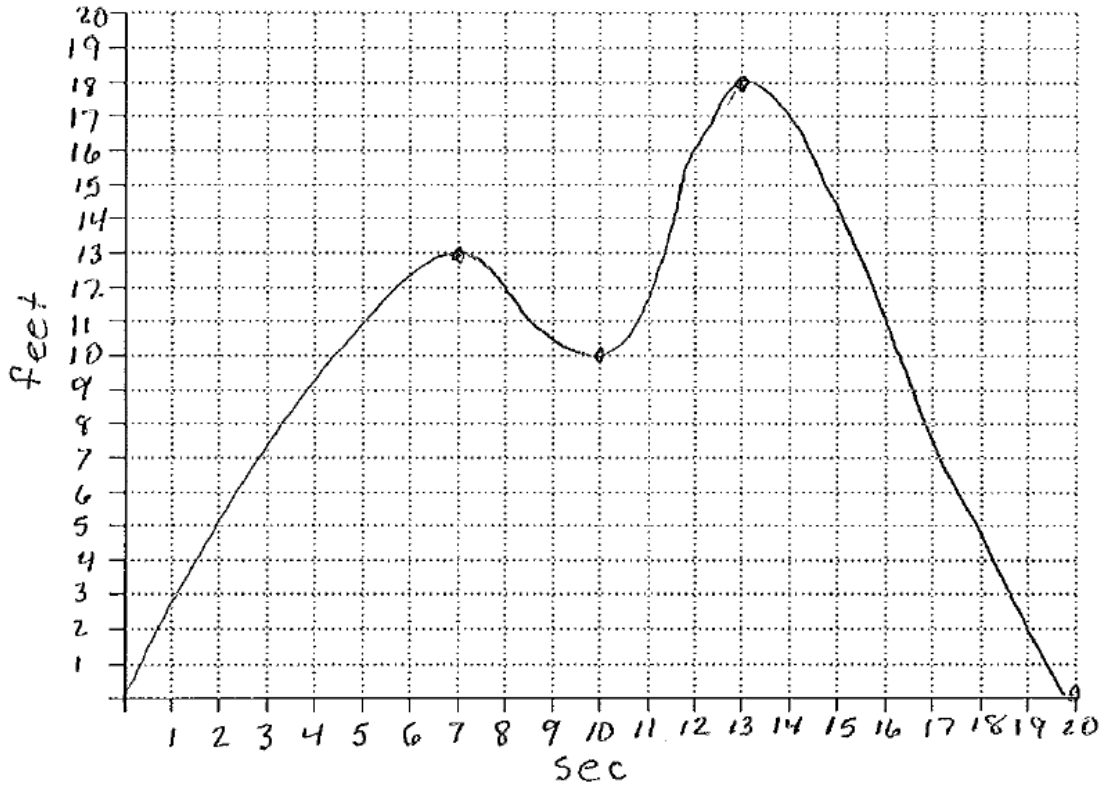
Assessment List

	Assessment points		
Element	Points Possible	Earned Assessment	
		Self	Teacher
1. Graphed an appropriate polynomial function with the appropriate end point.	2		
2. Based on the roller coaster created, identified appropriate intervals of increasing.	2		
3. Based on the roller coaster created, identified appropriate intervals of increasing.	2		
4. Based on the roller coaster created, the student identifies the appropriate maximum height.	2		
5. Gives the appropriate domain and range.	2		

Activity Worksheet

Domain/Range, Increasing/Decreasing and Zeros

1. Create a roller coaster ride that will last 20 seconds that represents a polynomial function. You will graph your ride and describe your ride using your graph. Make sure to include appropriate units of measurement.



2. Identify the time interval(s) when the roller coaster is increasing.

(0,7), (10, 13)

3. Identify the time interval(s) when the roller coaster is decreasing.

(7, 10) (13, 20)

4. How high is the roller coaster when it is at its maximum height?

18 feet

5. Identify the domain and range.

Domain: (0, 20) or $0 \leq x \leq 20$

Range: (0, 18) or $0 \leq y \leq 18$