

Pre-Calculus GIFT #2



ROLLER COASTER POLYNOMIALS

Weight = 2 Gift Grades

(PART 1: Application problems – small group in class)

(PART 2: Individual roller coaster design – outside of class)

Purpose:

In real life, polynomial functions are used to design roller coaster rides. In this project, you will apply skills acquired in Unit 2 to analyze roller coaster polynomial functions and to design your own roller coaster ride.

Project Components:

1. **Application Problems** – You will have to answer questions and solve problems involving polynomial functions presented in real life scenarios. Through your work, you are expected to gain an in depth understanding of real life application of concepts such as sketching and analyzing graphs of polynomial functions, dividing polynomials, determining zeros of a polynomial function, determining polynomial function behavior, etc.
2. **INDIVIDUAL Roller Coaster Design** – You will design your own roller coaster polynomial using the skills learned during the small group application problems.

Project Evaluation Criteria:

Your project will be assessed based on the following general criteria:

- **Application Problems – ONE GROUP ANSWER SHEET**

will be graded on correctness and accuracy of the answers.

Provide all answers in a full sentence form.

Make sure you clearly justify your answers where required

Possible points: 0-3 points per question based on accuracy 54 points

Professional appearance of the work 10 points

TOTAL POINTS = 64 points

- **Individual Roller Coaster Design Report** – will be graded as follows

All 10 questions are labeled in the report and answered fully 10 points

Roller Coaster design meets all minimum requirements 7 points

Clear and accurate response for each part 0-3 points 30 points

Professional appearance of your report 10 points

Creativity 7 points

TOTAL POINTS 64 points

Individual Roller Coaster Design REPORT CRITERIA:

Report **MUST** be completed on a separate sheet of clean, neat, **copy paper**.

All parts **MUST** be answered and final answers clearly labeled.

The graph showing your polynomial function **MUST** be printed from the calculator

- you can use TI Connect or Online Calculator

Graph print out **MUST** have

- the x-axis and the y-axis labeled with zeroes and the y-intercept clearly labeled

- you must show the window settings used to create the graph

ALL 10 parts of the report MUST be labeled !



ROLLER COASTER POLYNOMIALS

Name(s): _____

Date: _____ Period: _____

APPLICATION PROBLEMS:

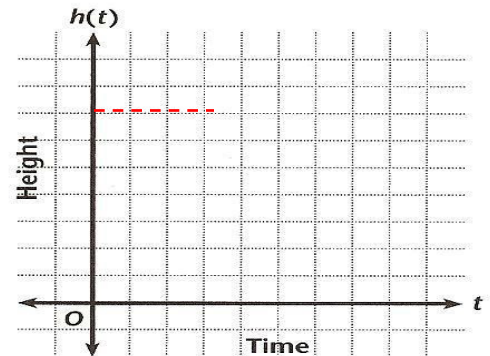
Fred, Elena, Michael, and Diane enjoy roller Coasters. Whenever a new roller Coaster opens near their town, they try to be among the first to ride.

One Saturday, the four friends decide to ride a new coaster. While waiting in line, Fred notices that part of this coaster resembles the graph of a polynomial function that they have been studying in their Pre-Calculus class.

1. The brochure for the coaster says that, for the first 10 seconds of the ride, the height of the coaster can be determined by $h(t) = 0.3t^3 - 5t^2 + 21t$, where t is the time in seconds and h is the height in feet. Classify this polynomial by degree and by number of terms.

2. Graph the polynomial function for the height of the roller coaster on the coordinate plane at the right.

3. Find the height of the coaster at $t = 0$ seconds.
 Explain why this answer makes sense.

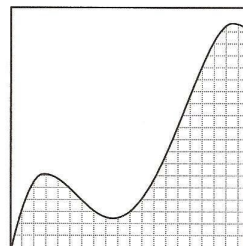


4. Find the height of the coaster 9 seconds after the ride begins. Explain how you found the answer.

5. Evaluate $h(60)$. Does this answer make sense? Identify practical (valid real life) domain of the ride for this model. CLEARLY EXPLAIN your reasoning. (Hint.: Mt. Everest is 29,028 feet tall.)

6. Next weekend, Fred, Elena, Michael, and Diane visit another roller coaster. Elena snaps a picture of part of the coaster from the park entrance. The diagram at the right represents this part of the coaster.

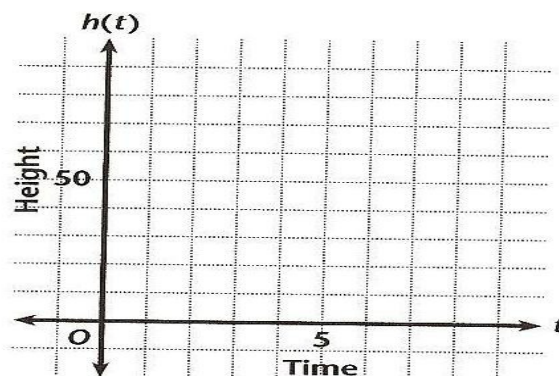
Do you think quadratic, cubic, or quartic function would be the best model for this part of the coaster? Clearly explain your choice.



7. The part of the coaster captured by Elena on film is modeled by the function below.

$$h(t) = -0.2t^4 + 4t^3 - 24t^2 + 48t$$

Graph this polynomial on the grid at the right.



8. Color the graph blue where the polynomial is **increasing** and red where the polynomial is **decreasing**. Identify increasing and decreasing intervals.

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9. Use your graphing calculator to approximate relative maxima and minima of this function. Round your answers to three decimal places.

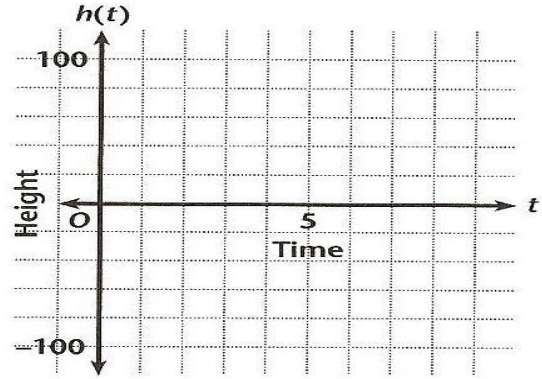
10. Clearly describe the end behavior of this function and the reason for this behavior.

11. Suppose that this coaster is a 2-minute ride. Do you think that $h(t) = -0.2t^4 + 4t^3 - 24t^2 + 48t$ is a good model for the height of the coaster throughout the ride? Clearly explain and justify your response.

12. Elena wants to find the height of the coaster when $t = 8$ seconds, 9 seconds, 10 seconds, and 11 seconds. Use synthetic division to find the height of the coaster at these times. Show all work.

Diane loves coasters that dip into tunnels during the ride. Her favorite coaster is modeled by $h(t) = -2t^3 + 23t^2 - 59t + 24$. This polynomial models the 8 seconds of the ride after the coaster comes out of a loop.

13. Graph this polynomial on the grid at right.



14. Why do you think this model's practical domain is only valid from $t = 0$ to $t = 8$?

15. At what time(s) is this coaster's height 50 feet? Clearly explain how you found your answer.

Diane wants to find out when the coaster dips below the ground.

16. Use the Rational Zeros Test to identify all possible rational zeros of $h(t) = -2t^3 + 23t^2 - 59t + 24$.

17. Locate all real zeros of this function. Clearly interpret the real-world meaning of these zeros.

18. Are there any non-real zeros for this polynomial? If so, identify them. Clearly explain your reasoning/show work.