Algebra 2CP – Project

ROLLER COASTER POLYNOMIALS

Purpose:
In real life, polynomial functions are used to design roller coaster rides. In this project, you will apply skills acquired in Chapter 6 to analyze roller coaster polynomial functions and to design your own roller coaster.

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 need to demonstrate clear and in depth understanding of the concepts such as sketching and analyzing graphs of polynomial functions, dividing polynomials, determining zeros of a polynomial function, determining polynomial function behavior, etc.
2. **Roller Coaster Design** – You will design your own roller coaster polynomial.

Materials to be turned in:

1. **Application Problems Section** – all 13 problems must be complete and all work/explanation must be shown. You have a choice of:
   a) typing your responses in by downloading the question sheet from the website, or
   b) neatly handwriting your responses on the question sheet.
   Do not complete this portion on a separate sheet of paper, use the template provided to you!

2. **Roller Coaster Design** – your own roller coaster design report MUST be completed on a separate sheet of clean, neat, copy paper. All parts MUST be answered and clearly labeled.

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

- **Application Problems** – 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:	0–2 points per question based on accuracy	26 points
	Professional appearance of the work	10 points
	TOTAL POINTS =	**36 points**

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

All 10 questions are answered (completion)	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**

Question Sheet

ROLLER COASTER POLYNOMIALS

Names: _____

_____

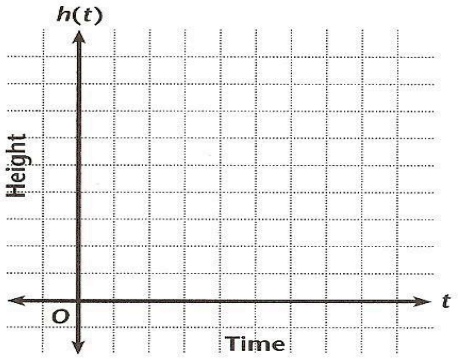
Date: _____ **Period:** _____

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 Algebra 2CP 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. (Use a table of values.)

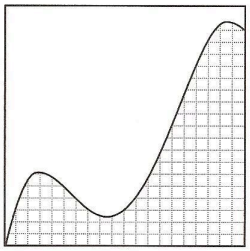


3. Find the height of the coaster at t = 0 seconds. Explain why this answer makes sense.

4. Find the height of the coaster 9 seconds after the ride begins.

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.)

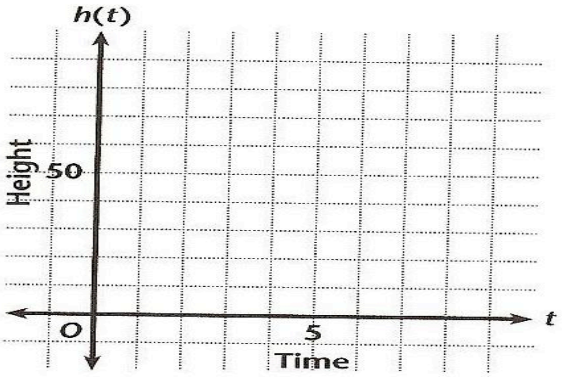
6. Next weekend, Fred, Elena, Michael, and Diane visit another roller coaster. Elena snaps a picture of part of the coaster from the park entrance. The diagram at the right represents this part of the coaster. Do you think quadratic, cubic, or quartic function would be the best model for this part of 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.
(Use a table of values.)



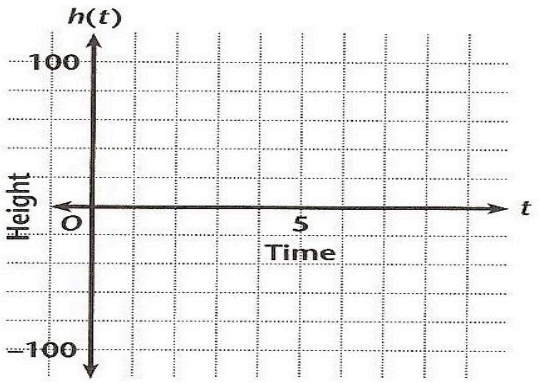
8. Color the graph blue where the polynomial is increasing and red where the polynomial is decreasing. Identify increasing and decreasing intervals.

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

10. 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.

11. Graph this polynomial on the grid at right.
(Use a table of values.)



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

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

ROLLER COASTER DESIGN:

You have decided to become structural engineers who specializes in roller coaster design.
Your job is to design your own roller coaster ride. To complete this task, please follow these steps:

The amusement park you are designing for gave you the following coaster requirements:
- your coaster ride must have at least 3 relative maxima and/or minima
- the ride length must be at least 4 minutes
- the coaster ride starts at 250 feet
- the ride dives below the ground into a tunnel at least once

Use a clean sheet of copy paper to complete the following tasks to write your report on you Roller Coaster Design. Label each part clearly. Your work MUST be neat, organized and must appear professional.

1. Draw a rough sketch of your "roller coaster" ride on a coordinate plane.
   Note: Be sure to illustrate your x-axis and y-axis scale to identify the length of the ride and the height of the ride you are designing. Make sure your design meets all the criteria listed above.
2. List all zeros or roots of your polynomial; be sure to include at least one of each of the following on your design: one double root (multiplicity of two) and at least 2 real roots.

It might be necessary to go back to your design and modify it according to these root requirements.

3. Write the complete factored form of your roller coaster polynomial.
4. Find the equation in standard form that represents your roller coaster ride.
5. Perform long division and/or synthetic division to verify the correctness of your equation.
6. Describe the end behavior of your function and give a reason for this behavior.
7. Draw an accurate graph of your polynomial.
8. State the practical domain of your graph (that is, the actual ride).
9. State the practical range of your graph (that is, the actual ride).
10. Color the graph blue where the polynomial is increasing and red where the polynomial is decreasing and identify increasing, decreasing, and constant intervals.