Names: _____ _____ _____

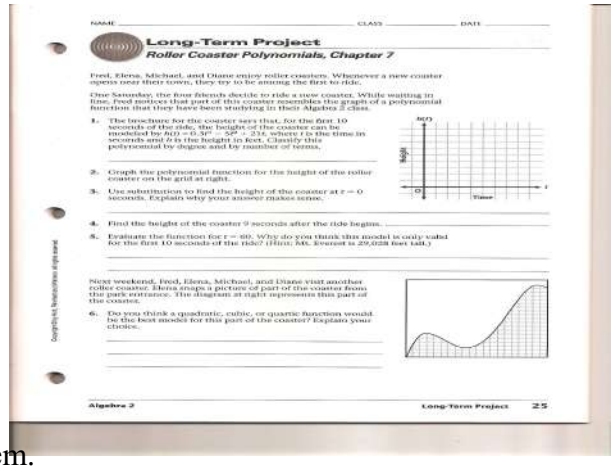
ROLLER COASTER PROJECT: Part 1

APPLICATION PROBLEMS:

Reed, Raven, Sergio, and Erin 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, Reed notices that part of this coaster resembles the graph of a polynomial function that they have been studying in their Algebra II 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 the number of terms.

2. Accurately graph the height of the roller coaster in terms of time.



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Roller Coaster Polynomials, Chapter 7

Fred, Elena, Michael, and Diane enjoy roller coasters. Whenever a new 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 2 class.

1. The brochure for the coaster says that, for the first 10 seconds of the ride, the height of the coaster can be modeled 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 grid at right.

3. Use substitution to find the height of the coaster at $t = 0$ seconds. Explain why your answer makes sense.

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

5. Evaluate the function for $t = 60$. Why do you think this model is only valid for the first 10 seconds of the ride? (Hint: Mt. Everest is 29,028 feet tall.)

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 right represents this part of the coaster.

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

h(t)

Height

0

Time

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3. Find the height of the coaster at t = 0 seconds. Explain what this value means in context of the problem.

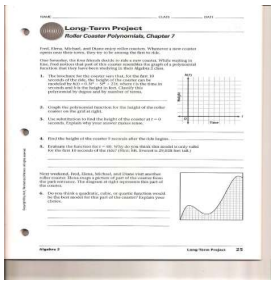
4. Find the height of the coaster 9 seconds after the ride begins. Explain how you found the answer.

5. Evaluate h(60) and give proper reasoning how this answer is relevant or not relevant in context of the situation. State a reasonable domain for the polynomial function.

Resource: Google: Polynomial Roller Coaster Project
[Doc] **GIFT 2 Roller Coaster Polynomials KEY**
*www.gvsu.edu/.../gift_2_**roller_coaster_polynomials**_key-1.doc*

6. Next weekend, Reed, Raven, Sergio, and Erin visit another roller coaster. Raven snaps a picture of part of the coaster from the park entrance. The diagram at the right represents this part of the coaster.

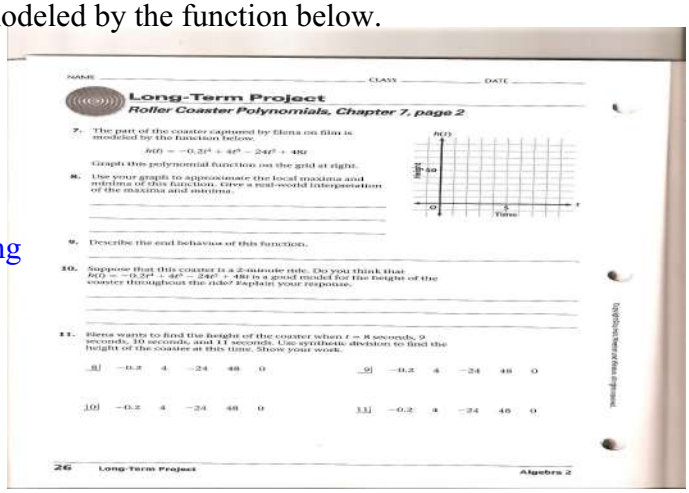
Do you think quadratic, cubic, or quartic function would be the best model for this part of the coaster? Clearly explain your choice.



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

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

Graph this polynomial over the first 10 seconds.



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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 function on the grid at right.

8. Use your graph to approximate the local maxima and minima of this function. Give a real-world interpretation of the maxima and minima.

9. Describe the end behavior of this function.

10. 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? Explain your response.

11. 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 this time. Show your work.

8 | −0.2 4 −24 48 0

9 | −0.2 4 −24 48 0

10 | −0.2 4 −24 48 0

11 | −0.2 4 −24 48 0

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

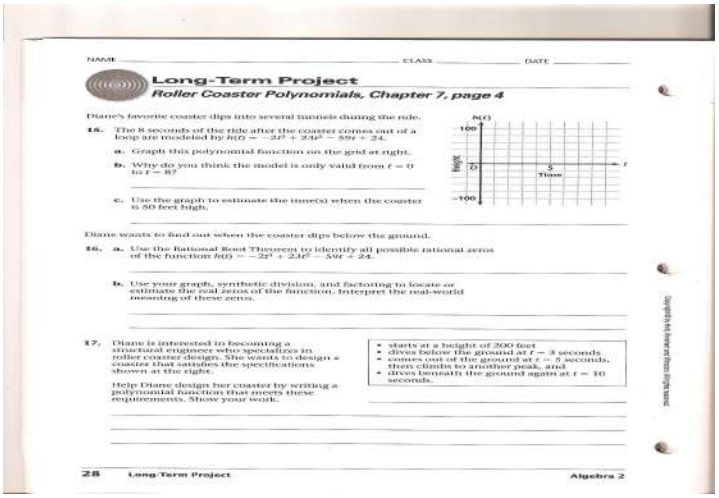
9. Use your graphing calculator to approximate relative maxima and minima of this function. Round your answers to three decimal places.

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

11. Suppose that this coaster is a 1-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. Erin 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.

Sergio loves coasters that dip into tunnels during the ride. His favorite coaster is modeled by $h(t) = -2t^3 + 23t^2 - 59t + 24$. This polynomial illustrates the 8 seconds of the ride after the coaster enters a tunnel.



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Diane's favorite coaster dips into several tunnels during the ride.

18. The 8 seconds of the ride after the coaster comes out of a loop are modeled by $h(t) = -2t^3 + 23t^2 - 59t + 24$.

a. Graph this polynomial function on the grid at right.

b. Why do you think the model is only valid from $t = 0$ to $t = 8$?

c. Use the graph to estimate the time(s) when the coaster is 50 feet high.

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

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

b. Use your graph, synthetic division, and factoring to locate or estimate the real zeros of the function. Interpret the real-world meaning of these zeros.

17. Diane is interested in becoming a structural engineer who specializes in roller coaster design. She wants to design a coaster that satisfies the specifications shown at the right.

- starts at a height of 200 feet
- dives below the ground at $t = 3$ seconds
- comes out of the ground at $t = 5$ seconds, then climbs to another peak, and
- dives beneath the ground again at $t = 10$ seconds.

Help Diane design her coaster by writing a polynomial function that meets these requirements. Show your work.

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14. Why do you think a reasonable domain is [0, 8]? Give a complete explanation.

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

16. Reed wants to find out when the coaster dips below the ground. Use the Rational Zeros Test to identify all possible rational zeros of $h(t) = -2t^3 + 23t^2 - 59t + 24$.

17. Use synthetic division to 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.