ROLLER COASTER POLYNOMIALS

Purpose:
In real life, polynomial functions are used to design roller coaster rides. In this assignment, you will apply skills acquired in class to analyze roller coaster polynomial functions.

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 Math 3 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.

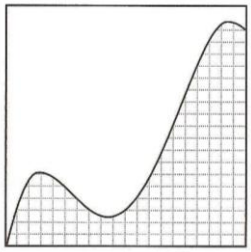
3. Find the height of the coaster at t = 0 seconds. Explain why this answer makes sense.

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 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.

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

13. 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.

14. Graph this polynomial.

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

16. 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.

17. Identify all rational zeros of $h(t) = -2t^3 + 23t^2 - 59t + 24$. 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.