

Topic 8 enVision® STEM Project

Trigonometric Equations and Identities

Model a Roller Coaster Track

1. The first third of the track of Shivering Timbers, in Michigan, can be modeled by a piecewise function. Write a function to model each part of this section of track and combine them into one piecewise function. Identify any trigonometric functions.
 - lift hill (height: 122 ft)
 - first drop (drop: 107 ft)
 - first camelback hill (height: 100 ft)
 - second camelback hill (height: 95 ft)

Additional data about Shivering Timbers that you may want to consider while writing your piecewise function:

Total track length: 5,383 ft

Maximum speed: 65 mi/h

2. Use a piecewise function to model a section of track for a roller coaster of your design.

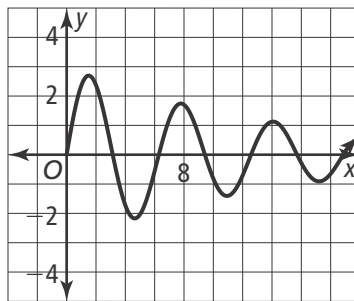
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Extend Your Model of a Roller Coaster Track

Multiplying a trigonometric function by a decreasing exponential can model a roller coaster's later hills, which are smaller than the first hill due to friction and air resistance.

The graph shows $f(x) = 3 \cdot 2^{-0.1x} \cdot \sin x$ for non-negative x .



1. Write a decreasing trigonometric function to model part of your roller coaster.
2. Extend your piecewise function from Question 2 of your **Model a Roller Coaster Track** worksheet to include your decreasing trigonometric function.

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Graphing Your Roller Coaster Track

1. A piecewise function allows you to insert additional functions, such as a wave with a different height or period or a circle for a loop. Insertions are usually made at peaks or valleys along the track. Write a piecewise function for your entire roller coaster track.

2. Graph the piecewise function that models your roller coaster track.



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Finalizing Your Roller Coaster Track

1. Use your graph from your **Graphing Your Roller Coaster Track** worksheet. Find and label the point at which your roller coaster would be traveling at its maximum speed. Explain your reasoning.
2. Use your graph from your **Graphing Your Roller Coaster Track** worksheet. Find and label a point at which your roller coaster is likely to make its riders feel airborne. Explain your reasoning.

Extensions

- The acceleration of the roller coaster is determined by its slope at any given time. Determine your roller coaster's acceleration, and calculate its maximum speed.
- Design a coaster that "comes back" by writing a second function that returns the coaster to its starting point.