Roller Coaster Nation

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Warning: Extreme Entertainment

ROLLER COASTER

- Roller Coasters have two ways of getting their potential energy
- Magnets
  - Fast
  - Exhilarating
- Chain "Bike Chain"
  - Slow
  - Creepy
  - Loud

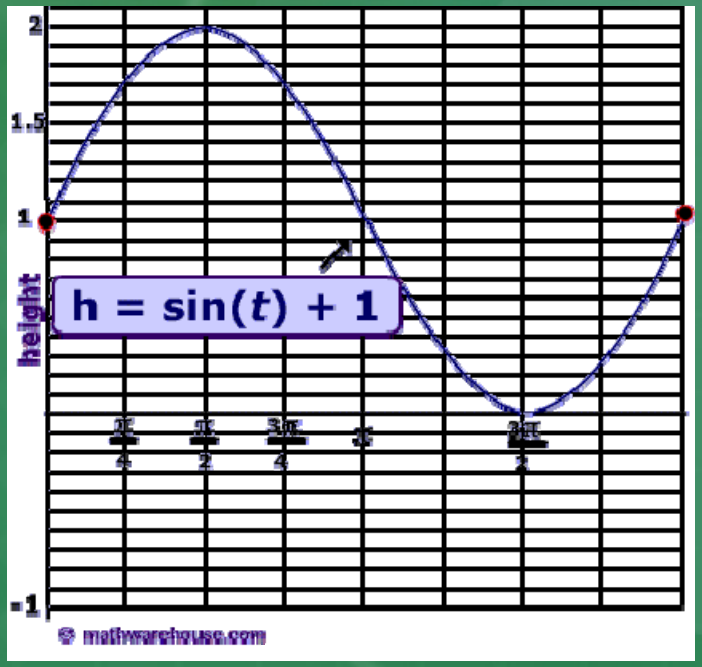
The Engineers Perspective

- Safety
  - People can’t handle over 9g’s
  - Age of riders
- Reliability
  - How often are repairs needed
  - Will it fall apart
- Cost
  - Dependent on reliability
  - Underlying factor of technology, length, etc

Engineering Physics

- Gravity
- Wind Resistance
- Potential Energy
- Kinetic Energy
- Angles
- Slopes
- Parabolas
- Friction

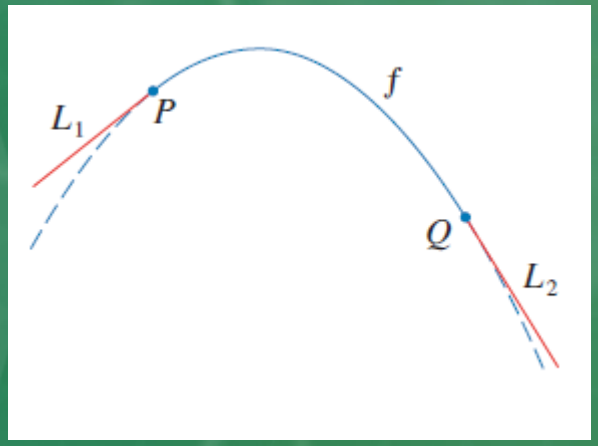
Mathematics



http://www.youtube.com/watch?v=dBdj7Lcz2Xc&feature=youtube_gdata_player

The Problem

- Find $f(x)$
- $L_1'(0) = 0.8$
- $L_2'(100) = -1.6$
- $f(x) = ?$
- L_1 and L_2 have to be tangent to $f(x)$ at points P and Q

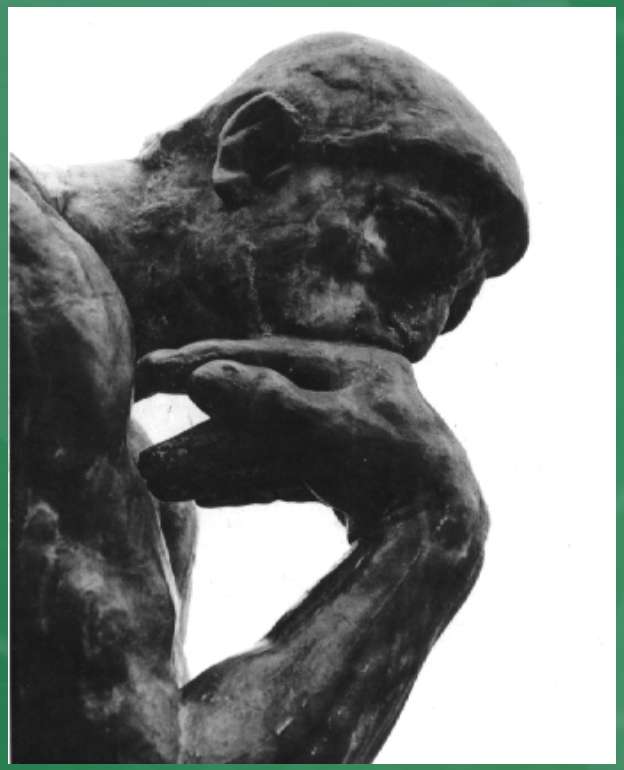


The Better Roller Coaster (A)

- Suppose the horizontal distance between P and Q is 100ft
  - Write $f(x)$ in terms of a, b, and c
  - Ensuring a smooth transition

The Better Roller Coaster (B)

- Solve $f(x)$ for a, b, and c



Trial and Error

- Trial #1: Use of trigonometric Identities
- $\tan\theta = \frac{\text{Opposite}}{\text{Adjacent}}$
- Adjacent Side = 100ft
- Opposite = X
- θ = ?

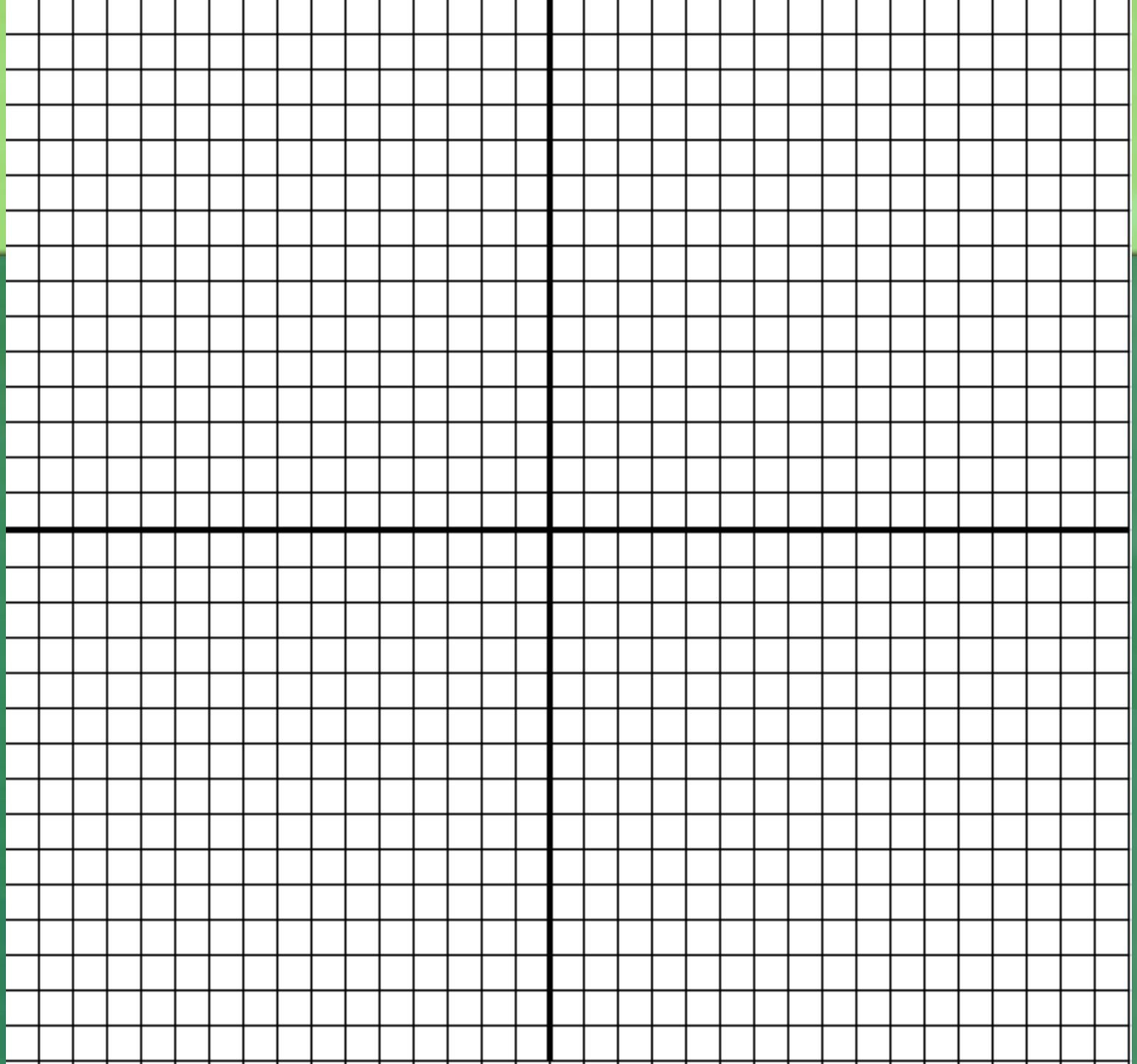
- Result: Too many unknowns

Trial and Error

- Trial #2: Use of slope-intercept form to find the y value of *Q*
- Slope Intercept form
  - Y = mx + b
  - m = -1.6
  - x = 100
  - b = y-intercept = ?
- Find equation of L_2 to find Q
- Result: Too many unknowns

Trial and Victory

- $f'(0)$ = Slope of L_1
  - Solve $f'(0)$ for b and c
- $f'(100)$ = Slope of L_2
  - Solve $f'(100)$ for a
    - b is now known



The Better Roller Coaster (D)

- Find the difference in elevation of P and Q
- $f(100) - f(0)$
- Difference in elevation is 40