Student Generated Graphs in LON-CAPA Homework

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Students and Graphs

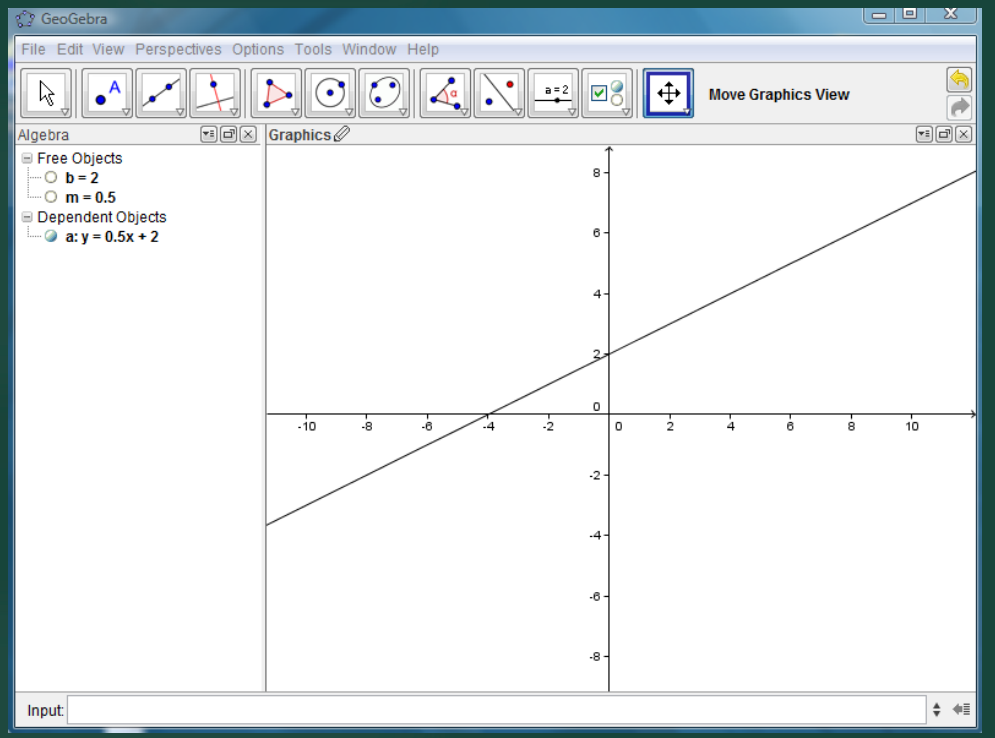
- Common Misconceptions
  - Discriminating between the height and slope of a graph (and changes in either)
  - Relating different graphs to each other
  - Matching narrative information with relevant features
  - Interpreting the area under the graph
- In physics, students often try to answer graph questions independently of the graph(s)

Purpose

- We would like to be able to improve students' understanding of graphs using the LON-CAPA system (specifically, their homework)
- To do this, we have created a new problem type in LON-CAPA

GeoGebra

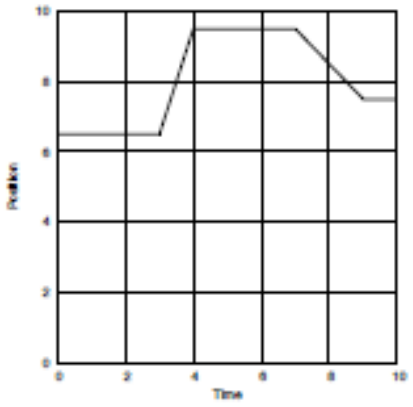
- GEOmetry & alGEBRA
- Free and Open Source
- Interface seamlessly merges graphics, algebra, and spreadsheets
- No one seems to know the correct pronunciation



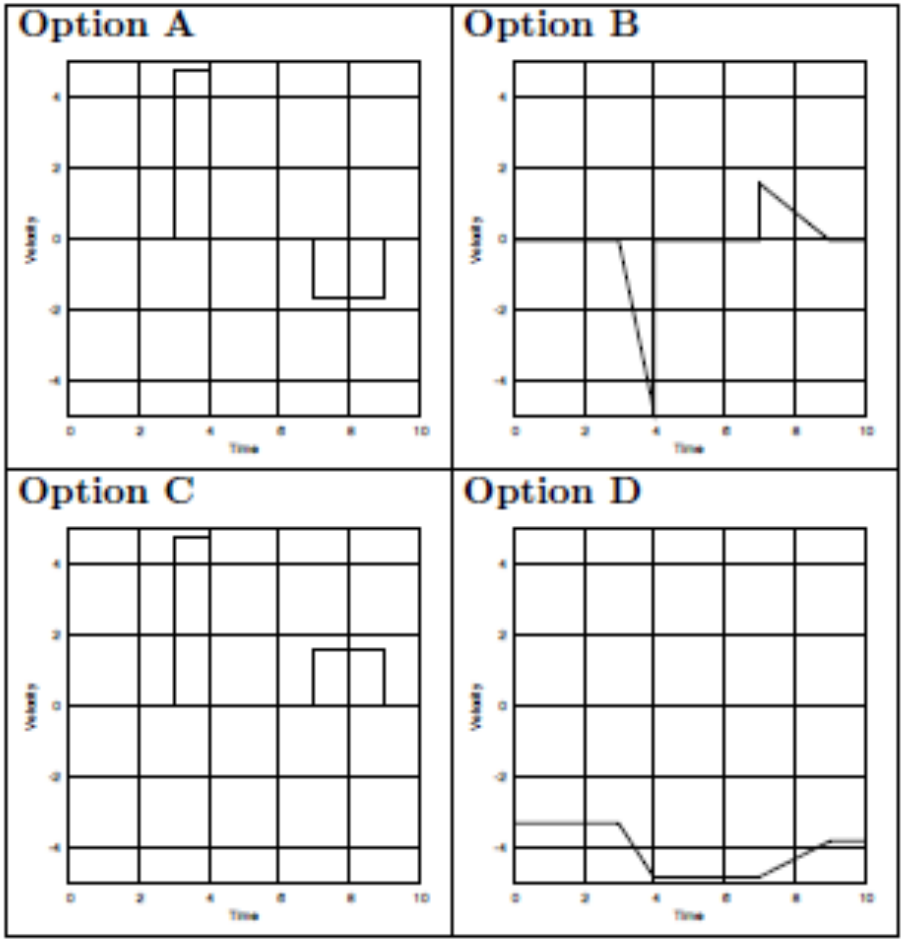
Graph Problems in LON-CAPA

- Current problems usually describe a graph, which students must then pick from a set of several graphs.
- Alternatively, students are given a graph, and then asked a question about it.

LON-CAPA Examples

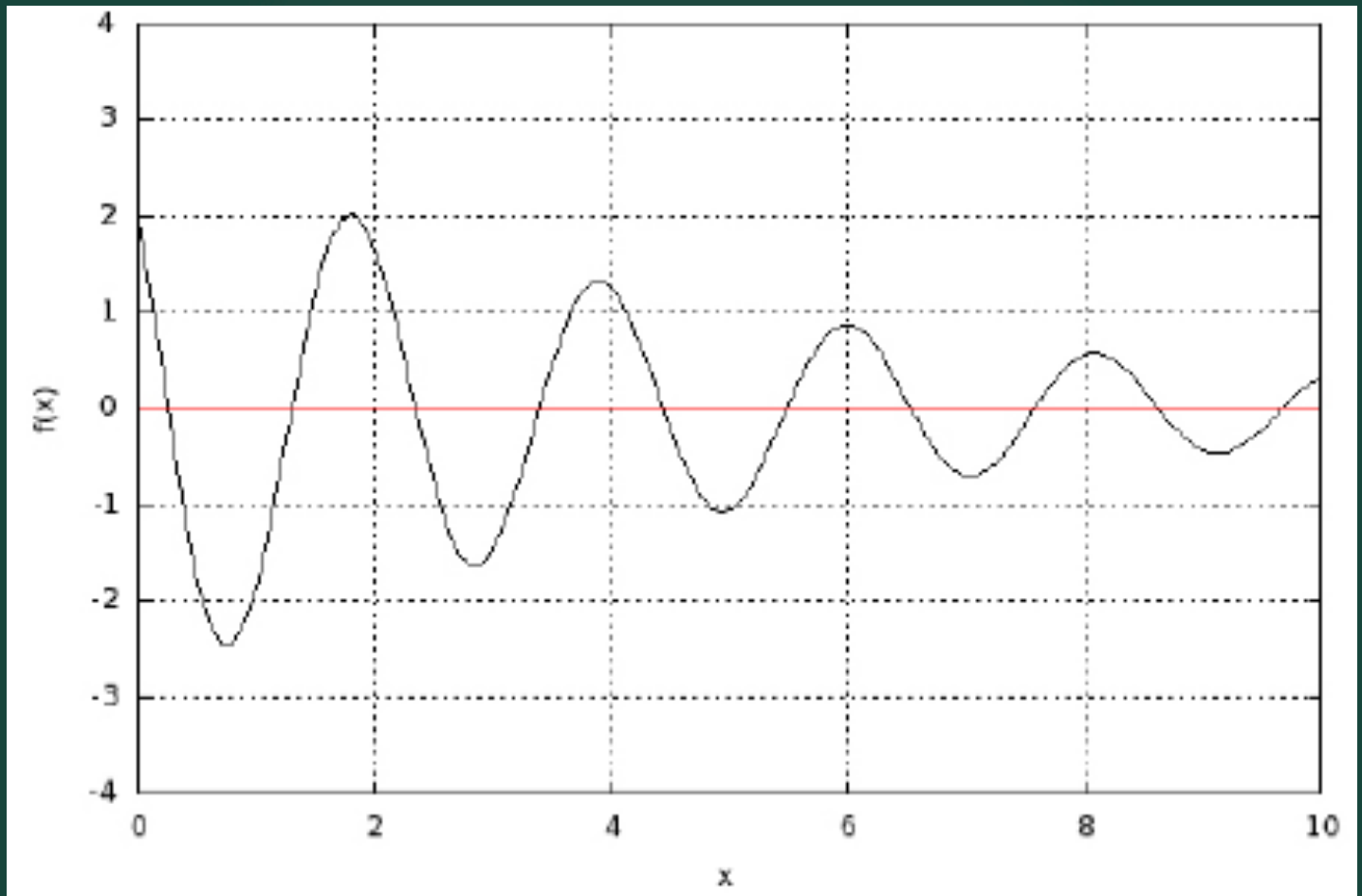


The position of a car moving in one dimension is shown as a function of time. The following are different predictions for the velocity of the car versus time:



Which of these options could be true?

LON-CAPA Examples



Match the function indicated in black.

f(x)=

Submit Answer Tries 0/99

New Problem Type

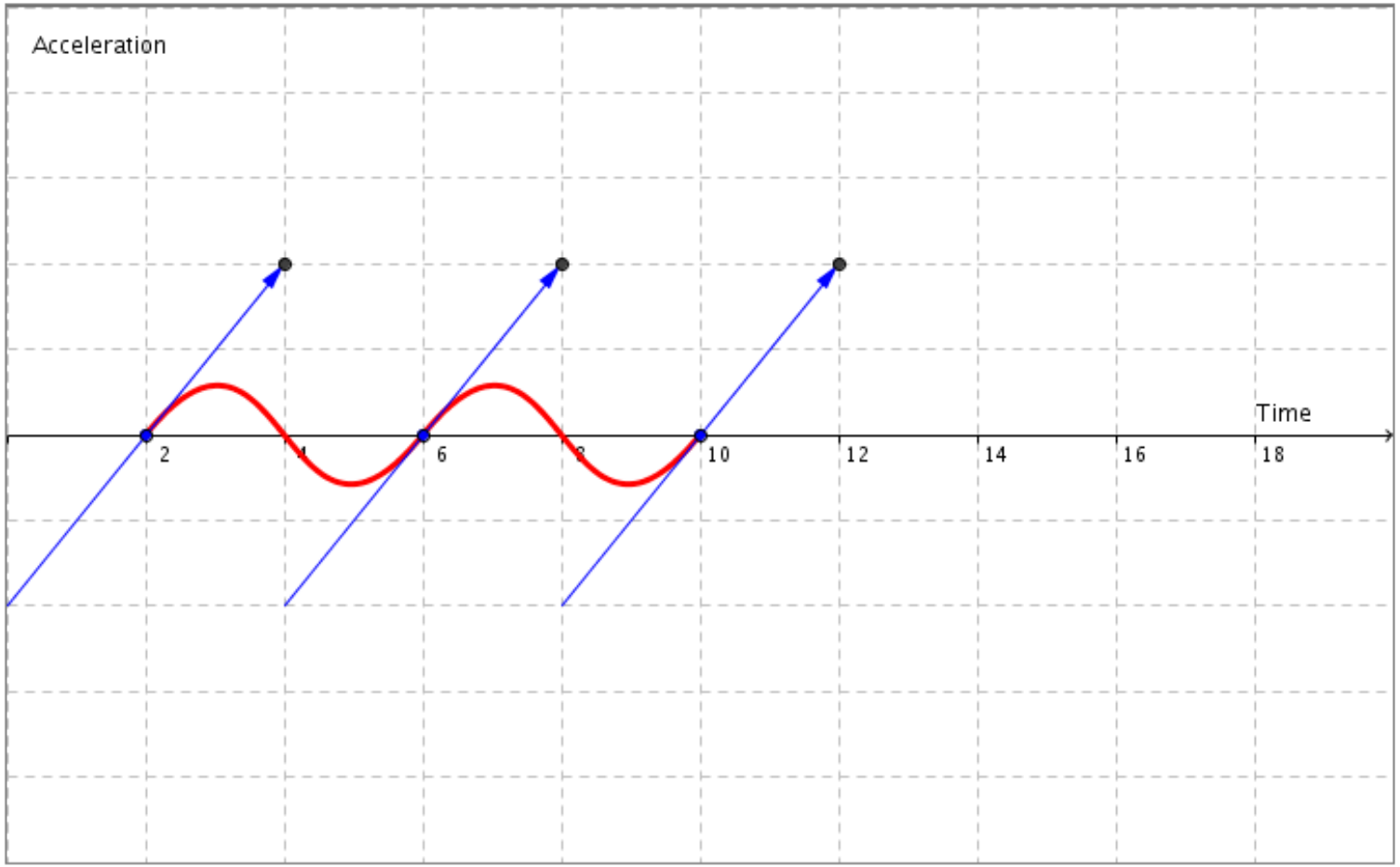
- Function Response Plot (FRP)
- Allows students to create a graph themselves using the interface developed in GeoGebra
- The LON-CAPA server is then able to decide whether or not the problem is correct based on a set of rules, written by the author
- No Hand Grading!

FRP Live Demonstration

- Hopefully...

FRP in LON-CAPA (Initial Load)

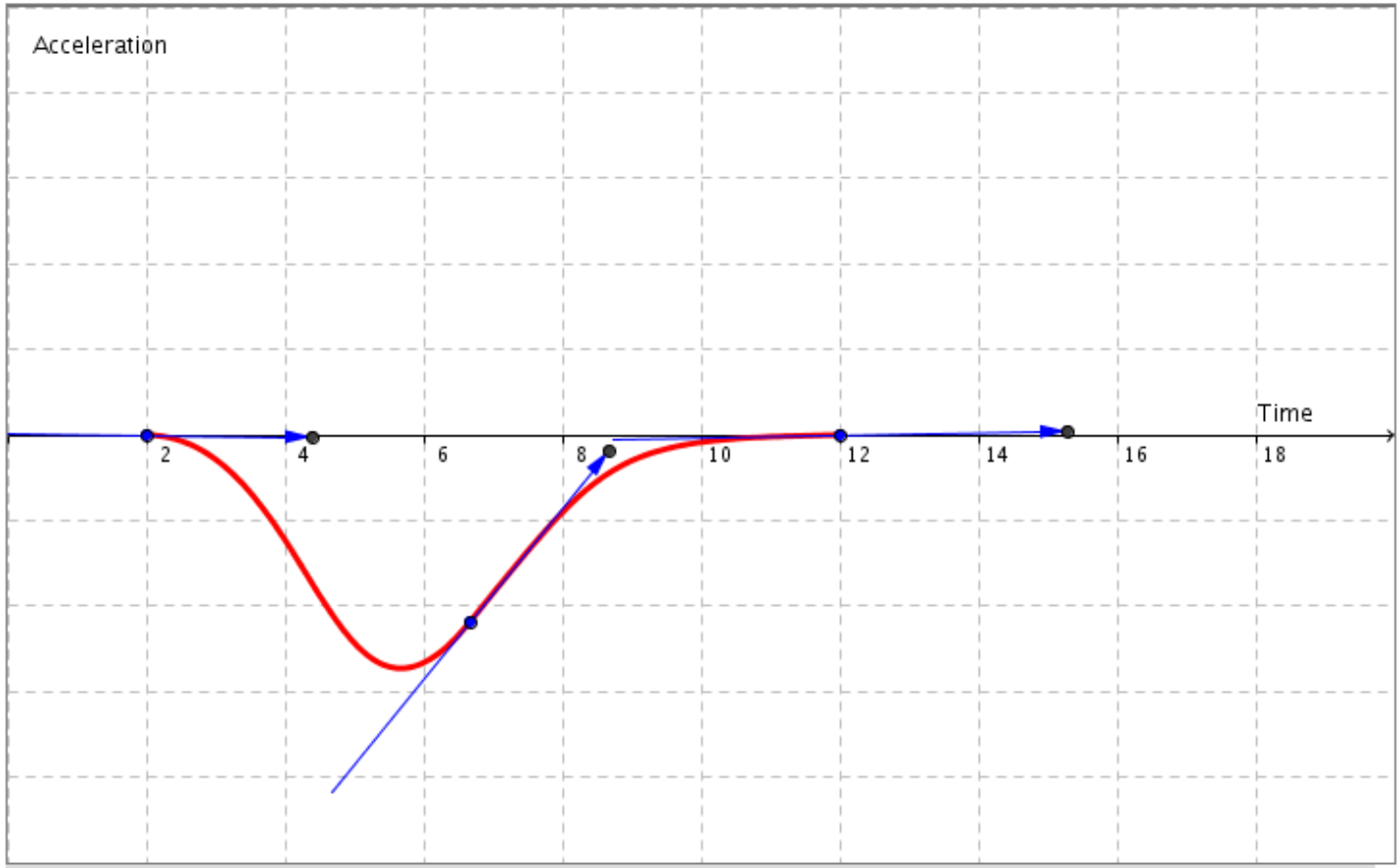
At t=0, a car is sitting at a stop sign. The car then smoothly accelerates forward, until it reaches a constant velocity.
Draw an acceleration vs. time graph (the red curve) for this situation.



Submit Answer Tries 0

FRP in LON-CAPA (Incorrect)

At t=0, a car is sitting at a stop sign. The car then smoothly accelerates forward, until it reaches a constant velocity.
Draw an acceleration vs. time graph (the red curve) for this situation.

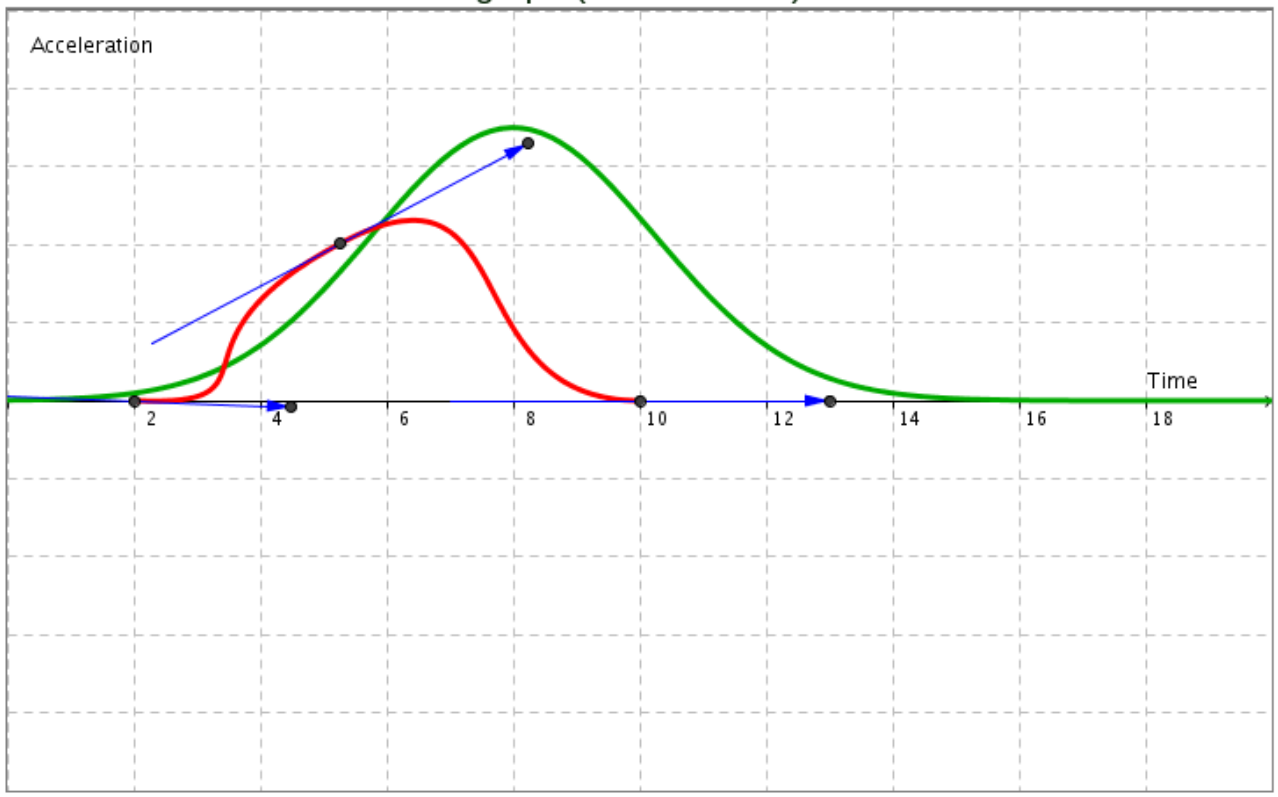


The car is accelerating forward. Should the acceleration be positive or negative?

Submit Answer Incorrect. Tries 1 Previous Tries

FRP in LON-CAPA

At t=0, a car is sitting at a stop sign. The car then smoothly accelerates forward, until it reaches a constant velocity.
Draw an acceleration vs. time graph (the red curve) for this situation.

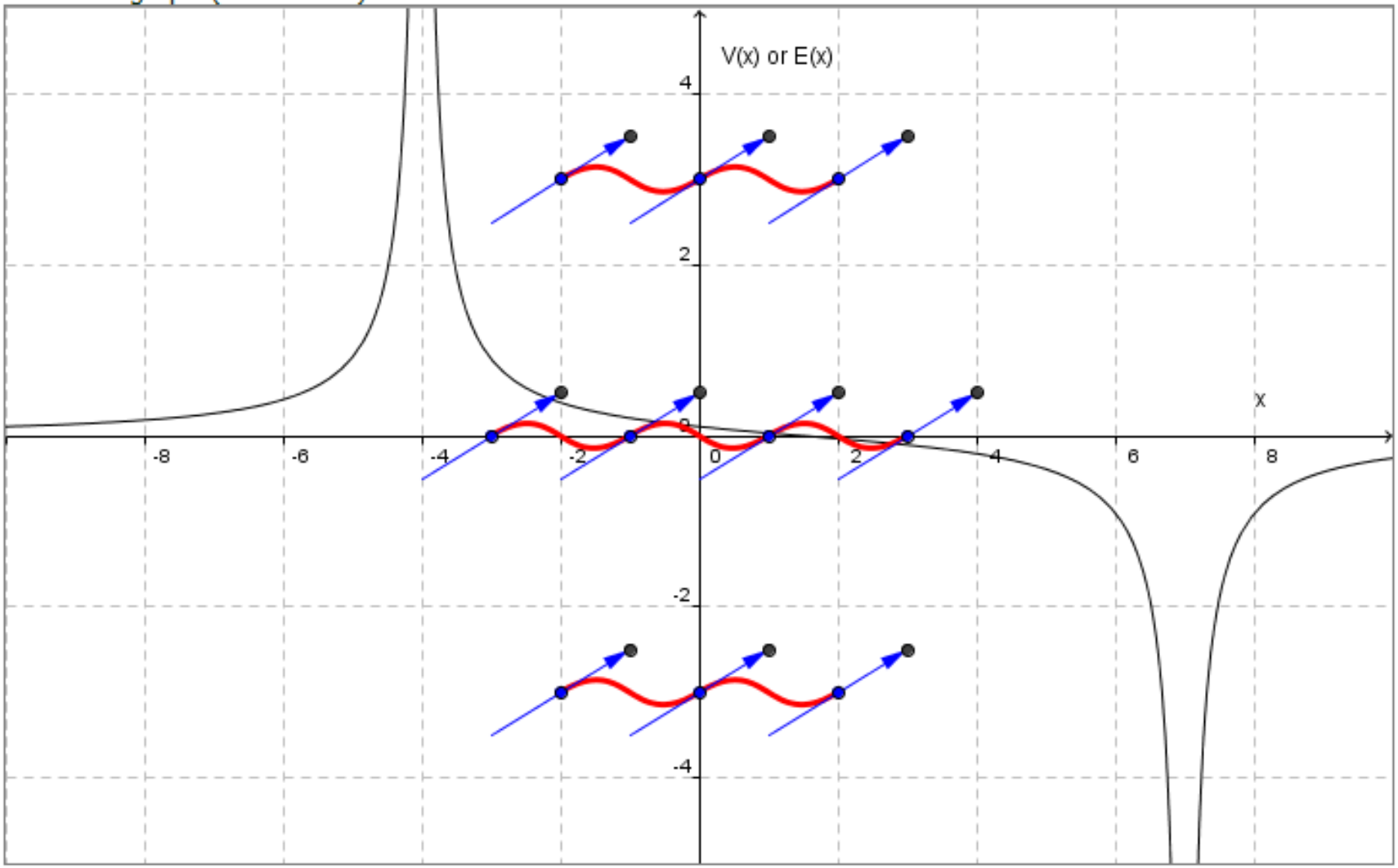


Note: The computer's answer is just one of many possible answers. It is possible your answer does not match up with it.

You are correct. Previous Tries

FRP in LON-CAPA

The electric potential is shown (in black) for a system with two point charges.
Draw the graph (red curves) of the electric field.



Submit Answer Tries 0

Creating FRP Problems

- Interface Options
  - Axes On/Off
  - Beginning and end of each axis (Domain & Range)
  - Grid On/Off
  - Axis Labels
  - Background Plot
  - Number of splines (and length of each spline)
  - Hints

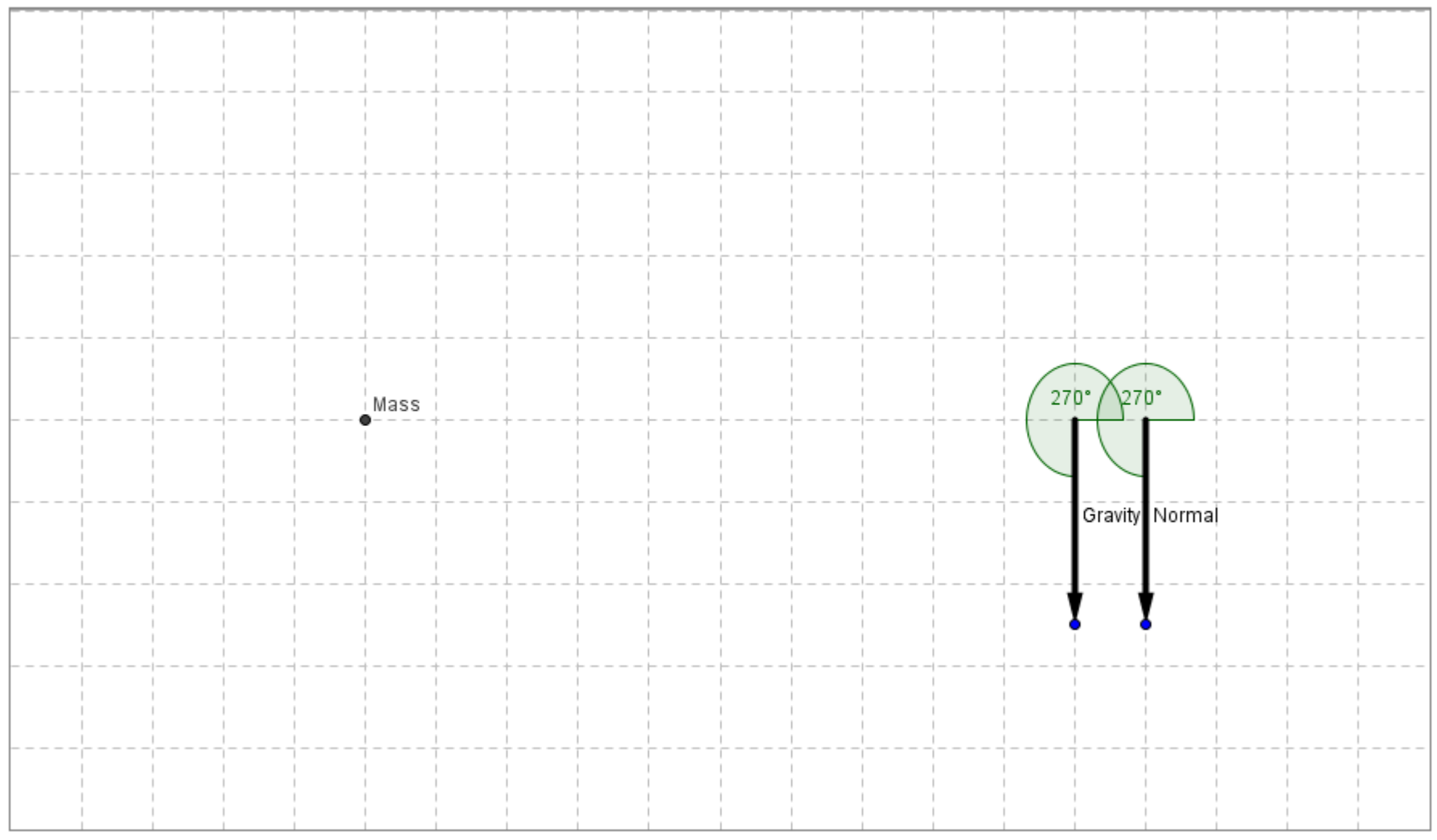
Creating FRP Problems

- Rules
  - Can check the value (or non-value) of each of these over any given (or open-ended) domain
    - Function value
    - First derivative
    - Second derivative
    - Integral
  - Also can define minimum & maximum lengths for domains and the level of accuracy required

Creating FRP Problems

- These problems are available now, but the templates are hidden.
- Interested in using or creating problems like these?
  - Check the LBCPhysicsLib folder on the MSU domain.
    - The problems are all from physics
    - Open XML
  - Ask me
  - Send me an e-mail (laverty1@msu.edu)

The Future - Vector Diagrams

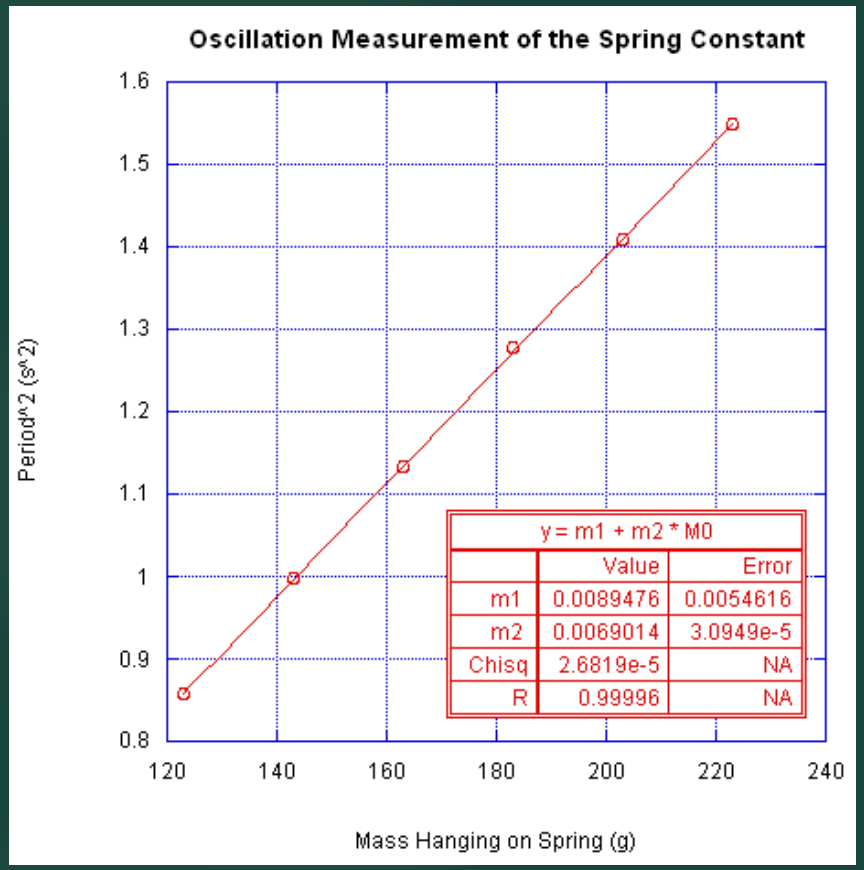


The Future - Vector Diagrams

Backup Slides

Connecting Formulas and Graphs

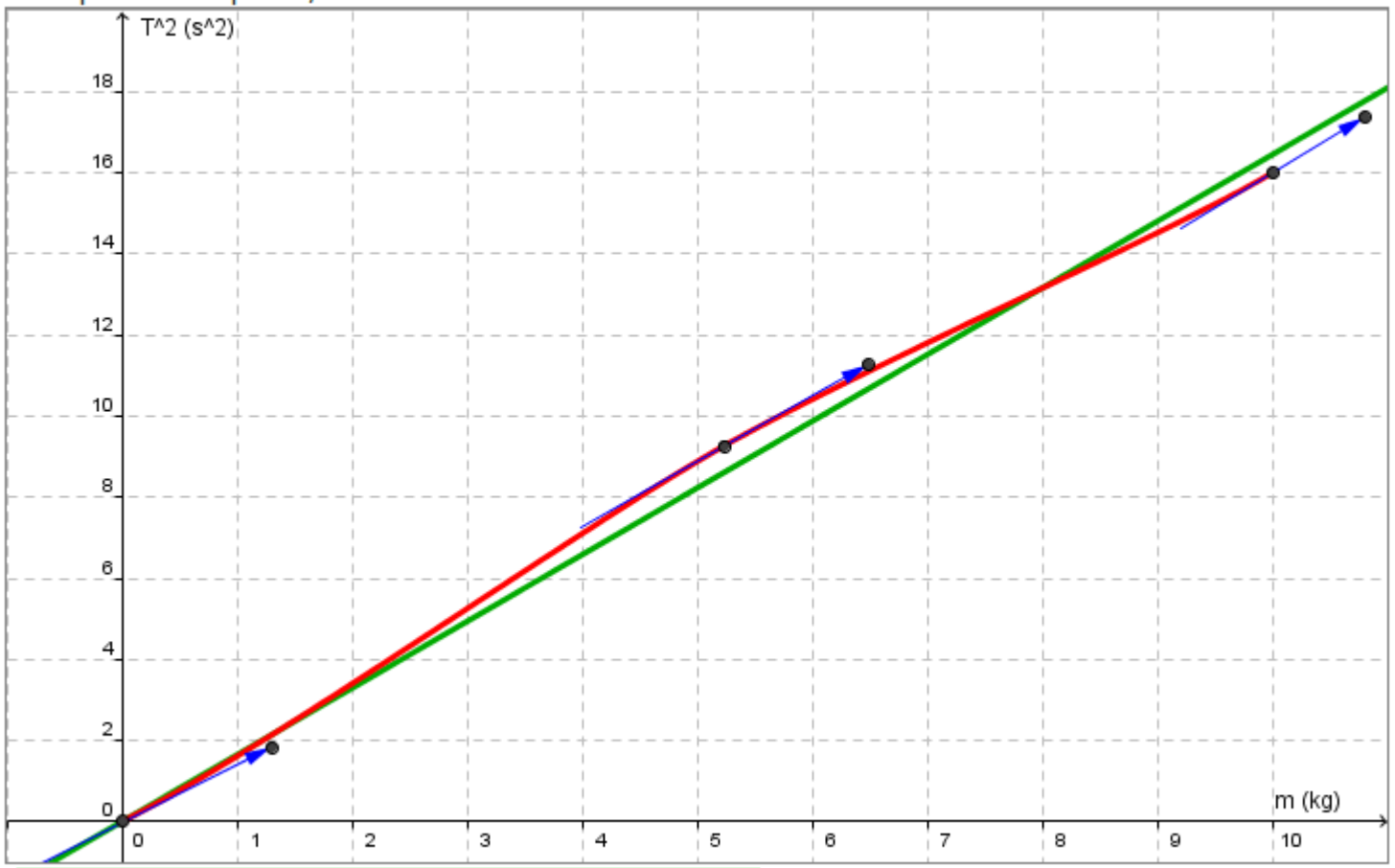
$$T^2 = \frac{4\tilde{a}^2 m}{k}$$



- In my personal experience, students in introductory labs often cannot identify the slope or y-intercept of this graph.

Connecting Formulas and Graphs

A spring has various masses ranging from 1 to 10 kg. It is then set in an oscillating motion and it's period is measured. The spring constant for this particular spring is 24 kg/s^2. Draw a graph (the red curve) to show the trend between the square of it's period, and the mass added to the end of it.



You are correct. Computer's answer now shown above. Previous Tries