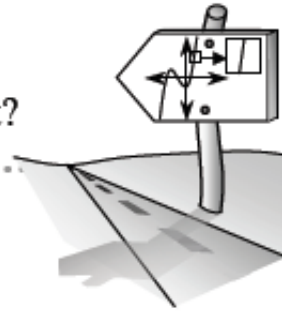


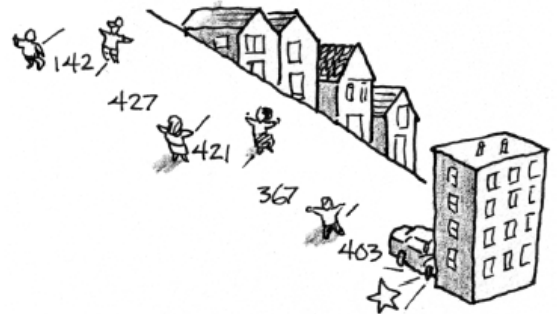
2.3.2 How fast was the car traveling on impact?

Sudden Impact



2-112. SUDDEN IMPACT, Part Two

Ms. Dietiker still needs to find the velocity her car was traveling down the hill when it slammed into the building so she can fill out her insurance report. Since she didn't see the accident herself, she had to collect information from the students walking up the steep hill to school. (Fortunately, some of them were her calculus students who know the importance of collecting good data!) Note: Distances are in feet.



Here were their statements:

Note: Distances are in feet. Drawing is not to scale.

Eric: "I noticed the car start to roll at 7:54 and 46 seconds."

Joshua: "It almost killed me at 7:55 and 20 seconds."

Lisa: "It practically ran over me 7 seconds after it passed Kirt."

Samantha: "I'll mark the time 7:54 and 57 seconds forever in my memory as the moment I nearly died."

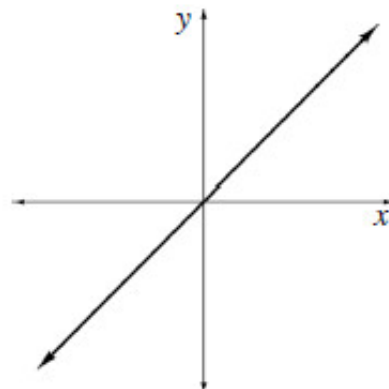
Kirt: "I noticed it took twice as long for the car to reach me as it did to reach Samantha."

- Determine at what time and distance the car passes each person. Then plot the data on a distance vs. time graph.
- These data points can be connected with a smooth "best fit" curve; describe the shape of this curve. Your teacher will instruct you on how to find the best-fit equation for the curve.
- According to the curve of best fit, how long did it take for Ms. Dietiker's car to slam into the building?
- Determine how fast the car was traveling when it slammed into the building. Will Ms. Dietiker be able to

collect on her insurance policy (see problem 2-102)?]

- e. Approximately when is the car traveling the fastest? How does the shape of the graph help you answer this question?

2-113. After Marlayna was playing with her graphing calculator, Sandy picked it up and saw the graph at right. Knowing her functions well, Sandy figured that Marlayna was examining a line. However, when Sandy looked at the function screen, the only equation in the calculator was $y = \sin x$! Now Sandy is very confused- this does not look like any trigonometric graph she has ever seen before.



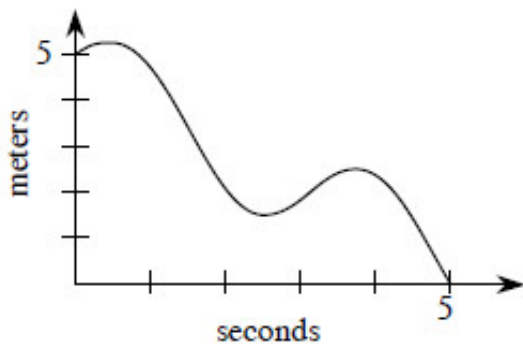
- What happened? Can you recreate this graph of $y = \sin x$ on your graphing calculator?
- Find three more functions that appear to be linear when zooming in on the calculator at $x = 0$.
- Challenge: Find a function that does not appear linear when "zooming in" on the calculator at $x = 0$.



2-114. Sketch a function $f(x)$ that satisfies all of the following conditions: [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

- $D = [2, +\infty)$
 $R = (0, 6]$
- $\lim_{x \rightarrow \infty} f(x) = 0$
- $f(2) = 3$
- $f(4) = 6$

2-115. While running in a straight line to class, Steven's distance from class (in meters) was recorded on the graph below. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)



- Estimate his velocity (in meters per second) at $t = 0, 1$, and 3 seconds.
- Did Steven ever stop and turn around? If so, when? How does the graph show this?
- Approximate the interval(s) of time when Steven was headed toward class.

2-116. A local fast-food restaurant records data on the rate customers enter their establishment during a typical lunch hour. Using this data in the table below, predict the total number of customers served during this 30-minute period. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

Time (min)	0	4	9	15	19	26	30
Rate (cust/min)	12	13	17	23	19	14	6

2-117. If $h(x) = \frac{4}{5}x^3 - 2x + 5$, use sigma notation to write Riemann sums to approximate $A(h, 10 \leq x \leq 15)$ with 10, 20, and 100 left endpoint rectangles of equal width. Then, use your calculator to find these approximations. What happens as the number of rectangles increases? [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

2-118. Evaluate the following limits. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

a. $\lim_{x \rightarrow 3} \frac{x^2 - 9}{x - 3}$

b. $\lim_{x \rightarrow \infty} \sqrt{\frac{16x^2 - 1}{4x^2 - 1}}$

c. $\lim_{x \rightarrow \infty} \frac{2^{-x}}{2^x}$

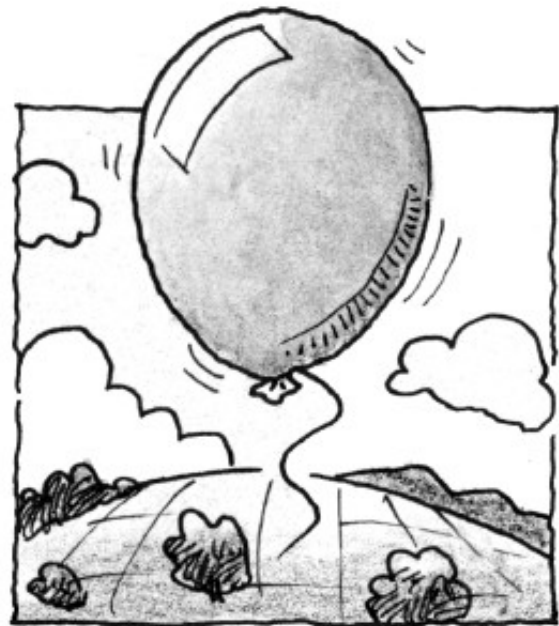
d. $\lim_{x \rightarrow \infty} \frac{2x^3 - x - 1}{12 - x - x^2}$

e. $\lim_{x \rightarrow \infty} \sin x$

f. $\lim_{x \rightarrow \infty} \frac{\sin x}{x}$

2-119. When the balloon in problem 2-81 reached 500 feet, it popped and started to fall back towards the ground. The height of the balloon as it falls is modeled by the function $h(t) = -16t^2 + 500$, where t is the number of seconds since the time it popped and $h(t)$ is the height of the balloon (in feet) above the ground. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

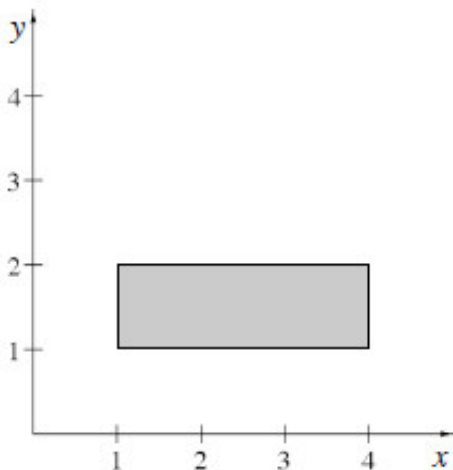
- According to $h(t)$, when will the balloon hit the ground?
- Approximate the balloon's velocity at $t = 5$ seconds.



2-120. For each part below, draw a graph of a function that meets the given conditions, if possible. If such a function is not possible, explain why. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

- $g(x)$ is discontinuous at $x = a$, but $\lim_{x \rightarrow a} g(x)$ exists.
- $g(x)$ is continuous at $x = a$, but $\lim_{x \rightarrow a} g(x)$ does not exist.
- $g(x)$ is discontinuous at $x = a$, and $\lim_{x \rightarrow a} g(x)$ does not exist.

2-121. We have found (or approximated) the volume of a rotated flag with various shapes. What if the axis of rotation (the "pole") is not attached directly to the flag?



In the graph above, there is a gap between the flag and the x -axis. Decide what will occur when this flag is rotated about the x -axis. Draw a sketch of the result and find the volume of the resulting solid. [Help](#)
(Html5) ⇌ [Help \(Java\)](#)