2.3.1 Can I approximate velocity?

Ramp Lab

2-102. SUDDEN IMPACT, Part One

One morning, because Ms. Dietiker was late to school, she decided to park in front of school. Unfortunately, in the rush, she forgot to engage her parking brake!! As the car rolled down the hill, students dove left and right to avoid being struck. The car rolled unimpeded until it reached the bottom of the hill, where it slammed into a building and stopped.

When filing for damages with her insurance company, Ms. Dietiker discovered that she would be ineligible for coverage if her car were traveling above the speed limit (55 mph) at the instant of impact. She needs your help! How fast was her car traveling when it hit the building?

a. What information do you need in order to answer this question?

b. What assumptions should we make to simplify the problem?

Note: We will begin with an investigation of an object rolling down a hill. Ms. Dietiker's problem will be solved in the next lesson.

2-103. RAMP LAB

Using a simplified ramp and a ball, measure the distance the ball travels over time. Take measurements for time $t = 0, 1, 2, 3, 4$, and 5 seconds. Try to collect data as accurately as possible.

a. Plot the data on your graphing calculator. Decide with your team what curve would best fit this data and then use your calculator to find a function of best fit.

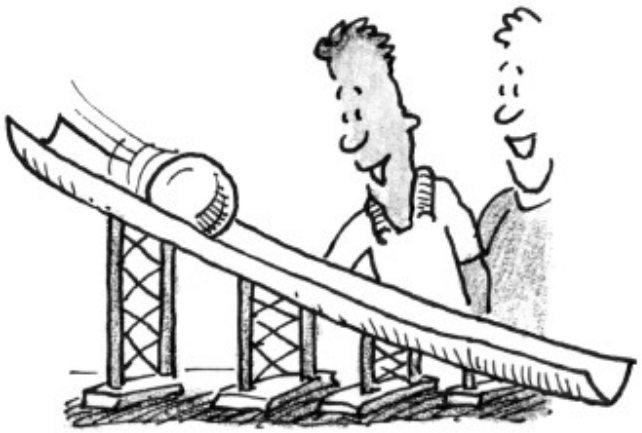
b. On graph paper, create a table of data and carefully plot the points. Use the points to sketch your curve of best fit. Choose an appropriate scale for the axes.

c. Examine the graph of your data. What happens to the ball's velocity as time increases? Why?

d. The ball did not travel at a constant speed throughout the experiment. How does the shape of the graph support this statement?

e. Since the ball does not travel at a constant speed, use the graph to decide when the ball is traveling slowest and fastest. What happens to the curve when the ball is traveling faster? Slower?

f. Estimate how fast the ball is traveling at $t = 4$ seconds. Discuss with your team how to best and *most accurately* do this. Prepare a presentation to explain how you decided to find this velocity.



2-104. During his 30-minute trip to work, Mr. Molinari travels with a velocity of $v(t) = 35 + 30t$ where t is measured in hours and $v(t)$ in miles per hour. Help (Html5)⇔Help (Java)

a. Sketch a graph of this scenario.

b. What are his maximum and minimum rates?

c. How far from work does Mr. Molinari live?

2-105. Without your graphing calculator, determine if the following functions are even, odd, or neither. Explain how you determined your choice. Then, *check* your answer with your graphing calculator. Help (Html5)⇔Help (Java)

a. $y = \cos(3x)$

b. $y = -|2x|$

2-106. Given $f(x) = 2x + 1$ and $g(x) = \sqrt{x-3} + 2$, find expressions for the following functions: Help (Html5)⇔Help (Java)

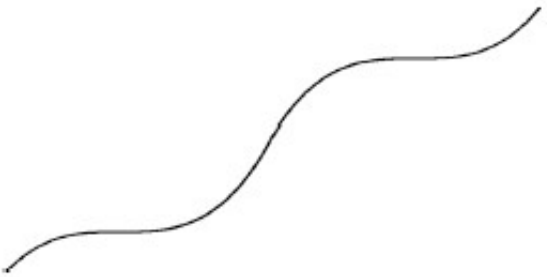
a. $f^{-1}(x)$

b. $g^{-1}(x)$

c. $g^{-1}(f(x))$

2-107. Write a complete slope statement from left to right for the curve drawn below. Help (Html5)⇔Help

(Java)



2-108. Given: $h(x) = \left|x^2 - 1\right|$ Help (Html5)⇔Help (Java)

a. Rewrite $h(x)$ as a piecewise function.

b. Using set notation, state the domain and range of $h(x)$.

c. Estimate $A(h, -1 \le x \le 3)$ by any method.

d. Write a Riemann sum to approximate $A(h, -1 \le x \le 3)$ with 24 rectangles of equal width and evaluate the sum.

2-109. The sigma notation below represents Riemann sums that find $A(f, a \le x \le b)$ for $n$rectangles of equal width. Determine a, b, and$n$. Help (Html5)⇔Help (Java)

a. $\sum_{i=0}^{17} \frac{1}{3} f\left(-6 + \frac{1}{3} i\right)$

b. $\sum_{i=0}^{9} \frac{1}{10} f\left(4 + \frac{1}{10} i\right)$

2-110. Lena loves limits! She wants to find a shortcut for limits so she can predict a function's value without graphing. Use the following limits to look for a shortcut and explain to Lena how she can find $\lim_{x \to \infty} \frac{p(x)}{r(x)}$ without graphing. (Be careful! The expressions below are all slightly different.) Help (Html5)⇔Help (Java)

a. $\lim_{x \to \infty} \left(\frac{x^2 - 7x + 6}{x^3 + 9x - 2}\right)$

b. $\lim_{x\to\infty}\left(\frac{x^2-7x+6}{x^2+9x-2}\right)$

c. $\lim_{x\to\infty}\left(\frac{x^3-7x+6}{x^2+9x-2}\right)$

2-111. Given $f(x) = 2x + 1$ and $g(x) = \sqrt{x-3}+2$, find expressions for the following functions and state the domain of each composition. Help (Html5)⇔Help (Java)

a. $h(x) = g(f(x))$

b. $k(x) = f(f(x))$