16. *Local Nonlinearity Problem:* Figure 3-2e shows the graph of

$$f(x) = x^2 + 0.1(x - 1)^{2/3}$$

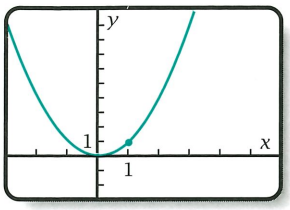


Figure 3-2e

a. Show that the point (1, 1) is on the graph of f. Does the graph seem to possess local linearity at that point? (See Problem 15.)

b. Zoom in on the point (1, 1) several times. Sketch what you see.

c. Explain why the graph of f does not have local linearity at $x = 1$.

d. Explain why f does not have a value for the derivative at $x = 1$.

17. Let f be the piecewise function

$$f(x) = \begin{cases} \dfrac{x^2 - x - 6}{x - 3}, & \text{if } x \neq 3 \\ 7, & \text{if } x = 3 \end{cases}$$

a. Plot the graph on your grapher, using a friendly window with $x = 3$ as a grid point. Sketch the result, showing clearly what happens at $x = 3$.

b. Write the difference quotient for $f'(3)$ and plot it on your grapher. (See if you can find a time-efficient way to enter the equation!) Sketch the result.

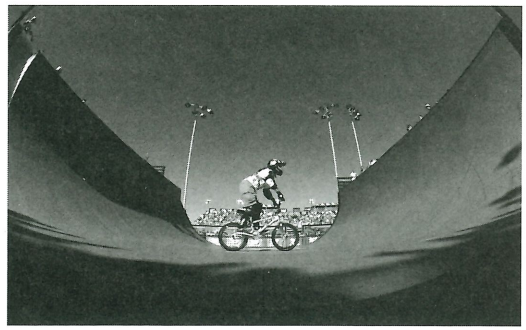
c. Make a short table of values of the difference quotient for values of x close to 3 on both sides of 3. Based on your work, explain why the function has no derivative at $x = 3$.

18. Let $s(x) = 2 + |\sin(x - 1)|$.

a. Plot the graph of s. Sketch the result.

b. Plot the difference quotient for $s'(1)$. Sketch the graph.

c. Explain why s does not have a value for the derivative at $x = 1$.



A line through the points where each tire touches the half-pipe is a secant line.

19. *Tangent Lines as Limits of Secant Lines:* Figure 3-2f shows the graph of

$$f(x) = 0.25x^2 - 2.5x + 7.25$$

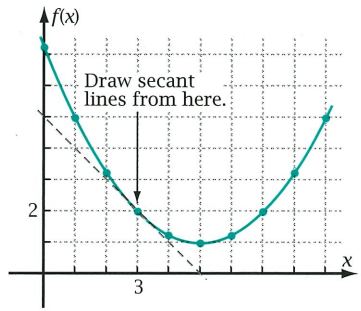


Figure 3-2f

a. Show that the tangent line on the diagram at $x = 3$ has slope equal to $f'(3)$.

b. Recall that a secant line intersects a curve at a minimum of two points. On a copy of Figure 3-2f, draw secant lines starting at the point (3, 2) and going through the points on the graph where $x = 9, 8, 7, 6, 5$, and 4. Describe what happens to the secant lines as the x-distance between those points and the point (3, 2) decreases.

c. Does the same thing happen with the secant lines from the point (3, 2) to the points on the graph where $x = 0, 1$, and 2?