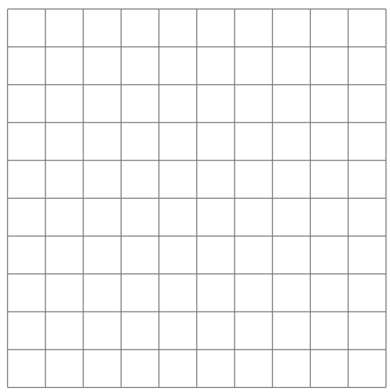
1. Find $\lim\limits_{x\to 4} \dfrac{2-\sqrt{x}}{x-4}$.

2. Sketch a graph of an example of a function f with the following properties:
   (a) f is defined on the interval $[-5, 5]$,
   (b) $\lim\limits_{x\to -3^-} f(x) = 2$,
   (c) $\lim\limits_{x\to -3^+} f(x) = -3$,
   (d) $f(0) = 0$,
   (e) $\lim\limits_{x\to 2^-} f(x) = 4$,
   (f) f is discontinuous at $x = 2$.



3. Find the numbers at which the function

$$f(x) = \begin{cases} x^2 & \text{if } x < 0 \\ x-1 & \text{if } x \geq 0. \end{cases}$$

   is discontinuous. At which of these points is f continuous from the right, from the left, or neither?

4. Using the definition of a derivative, find a formula for $f'(x)$ if $f(x) = \dfrac{6}{x}$. What is the domain of $f'(x)$?

5. Differentiate the following functions using differentiation rules, *not* by using the definition of a derivative. Be sure to simplify in part (d).
   (a) $f(x) = 4x^5 - 3x^3 + \sqrt{x}$
   (b) $g(x) = 3\sin(x) - 2\cos(x)$
   (c) $p(x) = x\sin(x)$
   (d) $q(x) = \dfrac{x+2}{x^2+1}$

6. Find $\lim_{x\to-\infty} \frac{1-x-x^2}{4+x+x^2}$. What does this tell you about the graph of the function

$$f(x) = \frac{1-x-x^2}{4+x+x^2}?$$

Your answer only has to be one sentence.

Concept Questions

7. Curious Cal, a left-handed calculus student, noticed that the definition

$$f'(a) = \lim_{h\to 0} \frac{f(a+h)-f(a)}{h}$$

involved taking secant lines to the right of the point a. So he thought, why not a definition using secant lines to the left? So Curious Cal's proposition is to define the derivative as

$$f'(a) = \lim_{h\to 0} \frac{f(a-h)-f(a)}{h}.$$

What do you think of Cal's idea? Will it work?

8. Discuss the following limits:

$$\lim_{x\to-\infty} \sin\left(\frac{1}{x}\right), \qquad \lim_{x\to 0} \sin\left(\frac{1}{x}\right), \qquad \lim_{x\to\infty} \sin\left(\frac{1}{x}\right).$$

9. One of the formal Limit Laws in your book says the following. If $\lim_{x\to a} f(x)$ and $\lim_{x\to a} g(x)$ exist, then

$$\lim_{x\to a}[f(x)+g(x)] = \lim_{x\to a} f(x) + \lim_{x\to a} g(x).$$

Why do you need to assume the first two limits exist? Is it possible that $\lim_{x\to a} f(x)$ and $\lim_{x\to a} g(x)$ do *not* exist, but that $\lim_{x\to a}[f(x)+g(x)]$ *does* exist?