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الرياضيات
الصف الثاني عشر العام

mathematics

12 general

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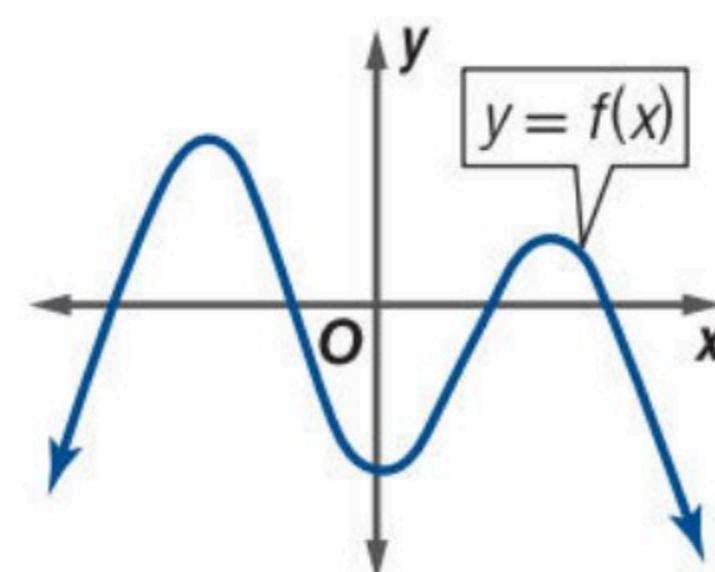
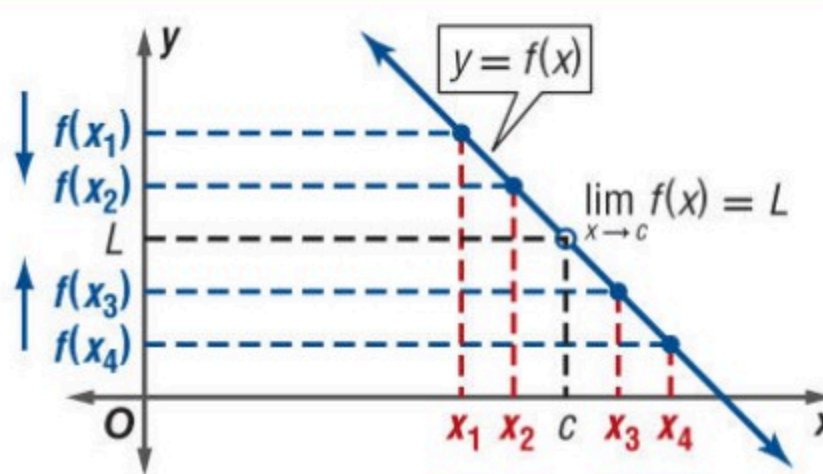
1-3

Continuity, End Behavior, and Limits

KeyConcept Limits

Words If the value of $f(x)$ approaches a unique value L as x approaches c from each side, then the limit of $f(x)$ as x approaches c is L .

Symbols $\lim_{x \rightarrow c} f(x) = L$, which is read *The limit of $f(x)$ as x approaches c is L .*

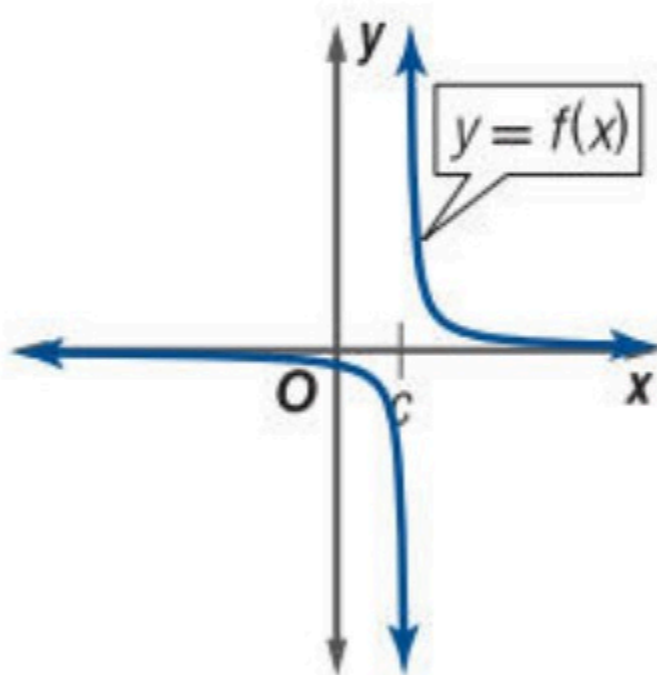


$f(x)$ is continuous for all x .

KeyConcept Types of Discontinuity

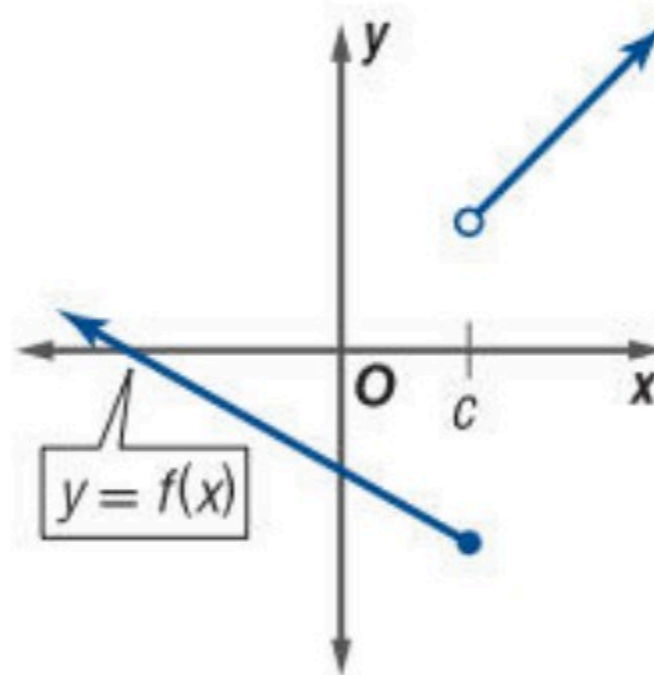
A function has an **infinite discontinuity** at $x = c$ if the function value increases or decreases indefinitely as x approaches c from the left and right.

Example



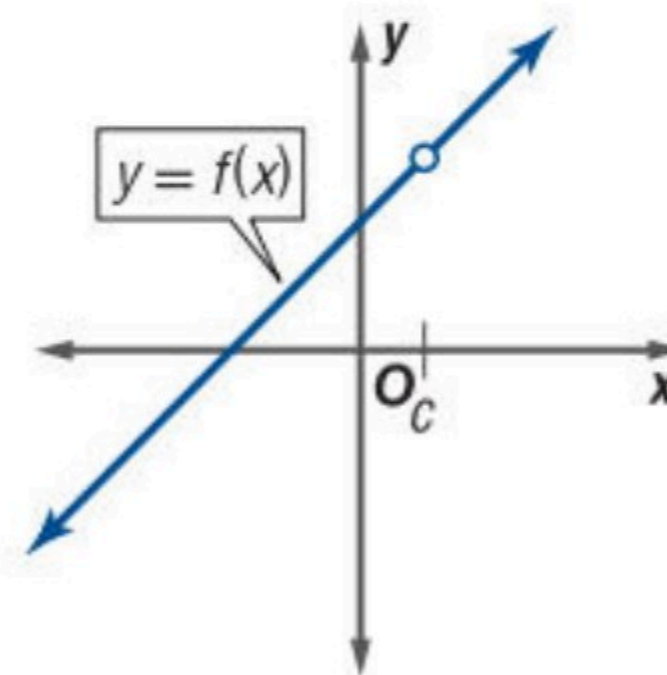
A function has a **jump discontinuity** at $x = c$ if the limits of the function as x approaches c from the left and right exist but have two distinct values.

Example



A function has a **removable discontinuity** if the function is continuous everywhere except for a hole at $x = c$.

Example



Identify a Point of Continuity

Determine whether $f(x) = 2x^2 - 3x - 1$ is continuous at $x = 2$. Justify using the continuity test.

x							
$f(x)$							



Determine whether each function is continuous at $x = 0$. Justify using the continuity test.

$$f(x) = \begin{cases} \frac{1}{x} & \text{if } x < 0 \\ x & \text{if } x \geq 0 \end{cases}$$

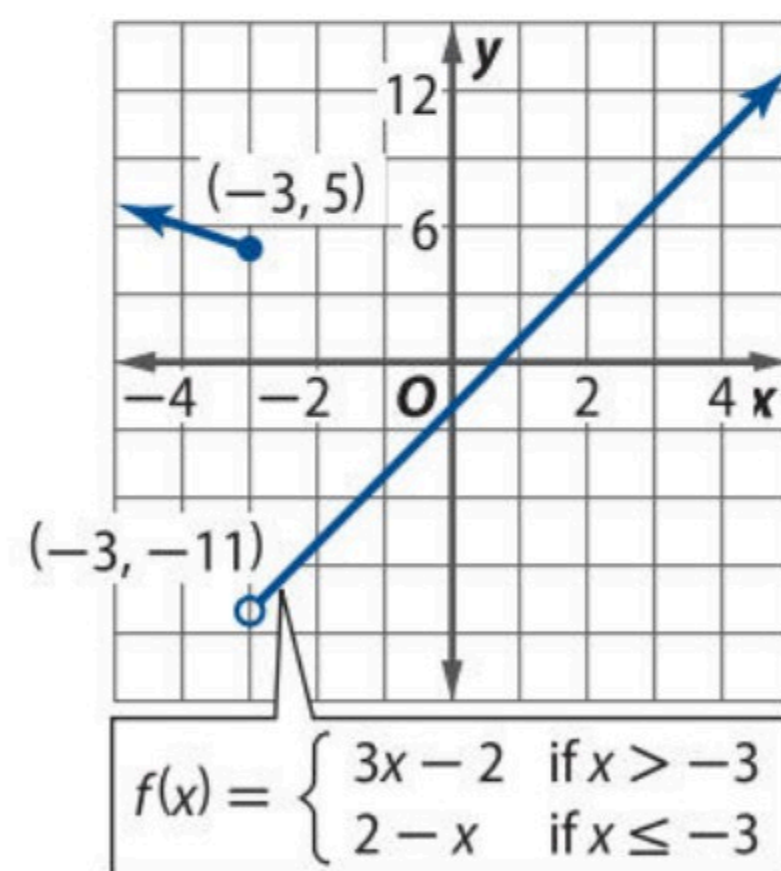
x							
$f(x)$							



Determine whether each function is continuous at the given x -value(s). Justify using the continuity test. If discontinuous, identify the type of discontinuity as *infinite*, *jump*, or *removable*.

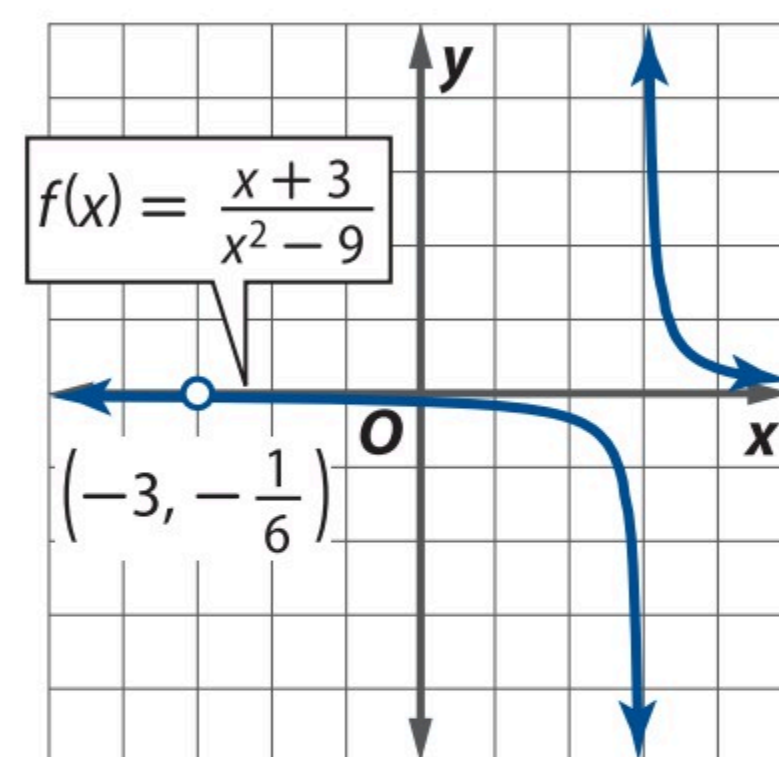
$$f(x) = \begin{cases} 3x - 2 & \text{if } x > -3 \\ 2 - x & \text{if } x \leq -3 \end{cases}; \text{ at } x = -3$$

x							
$f(x)$							



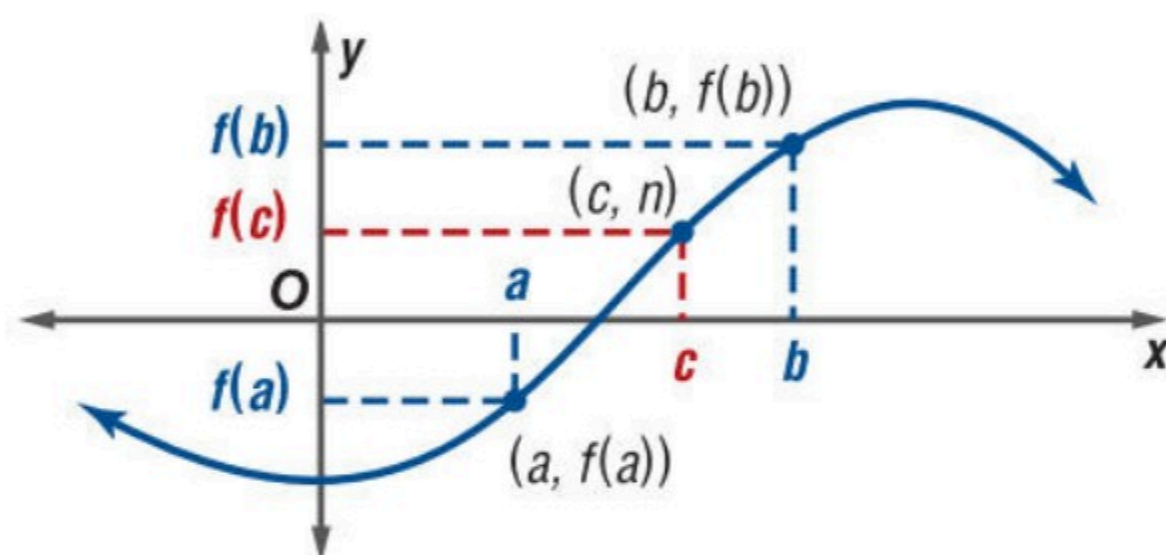
$$f(x) = \frac{x+3}{x^2-9}; \text{ at } x = -3$$

x							
$f(x)$							



KeyConcept Intermediate Value Theorem

If $f(x)$ is a continuous function and $a < b$ and there is a value n such that n is between $f(a)$ and $f(b)$, then there is a number c , such that $a < c < b$ and $f(c) = n$.

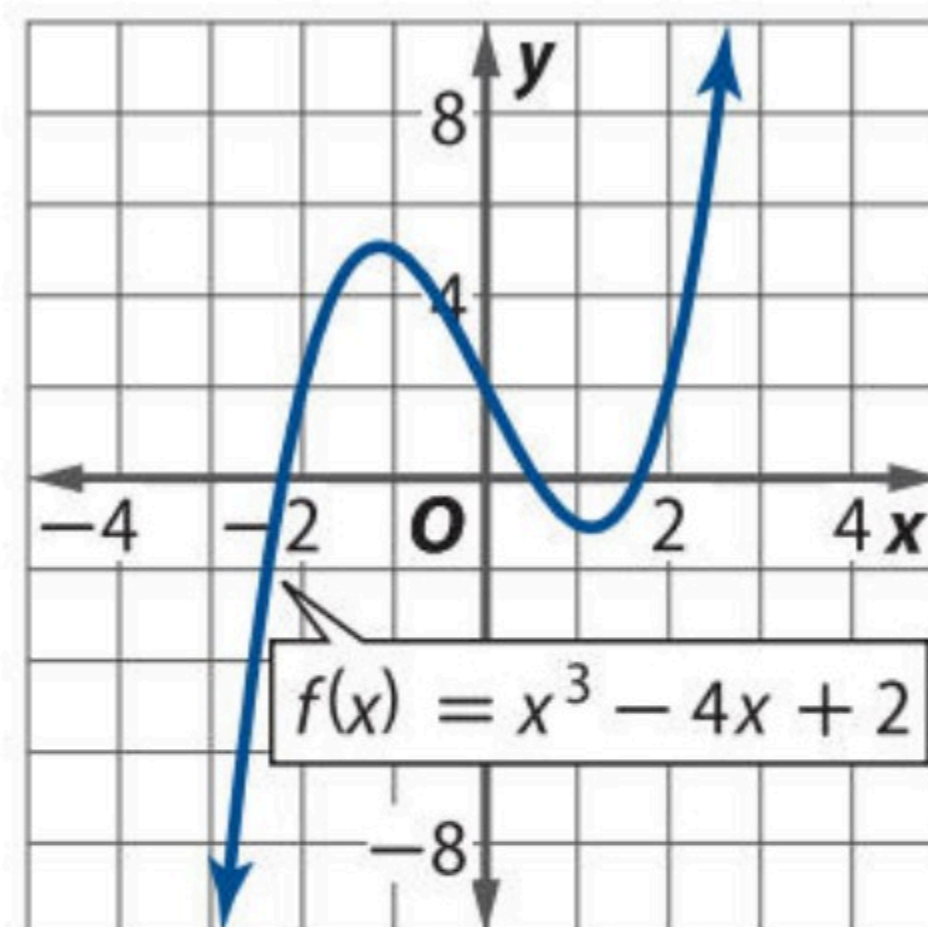


Corollary: The Location Principle If $f(x)$ is a continuous function and $f(a)$ and $f(b)$ have opposite signs, then there exists at least one value c , such that $a < c < b$ and $f(c) = 0$. That is, there is a zero between a and b .

Determine between which consecutive integers the real zeros of each function are located on the given interval.

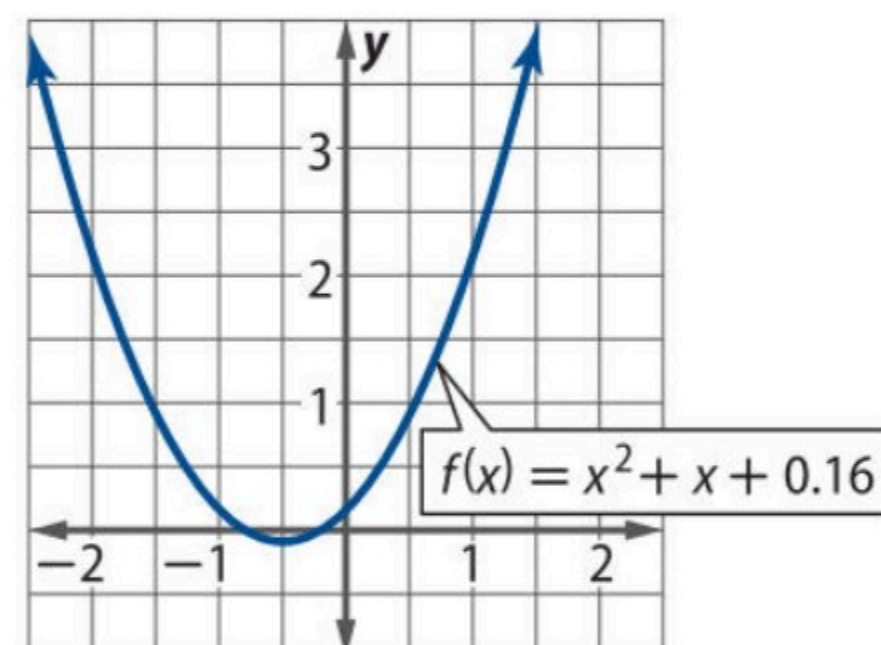
$$f(x) = x^3 - 4x + 2; [-4, 4]$$

x							
$f(x)$							



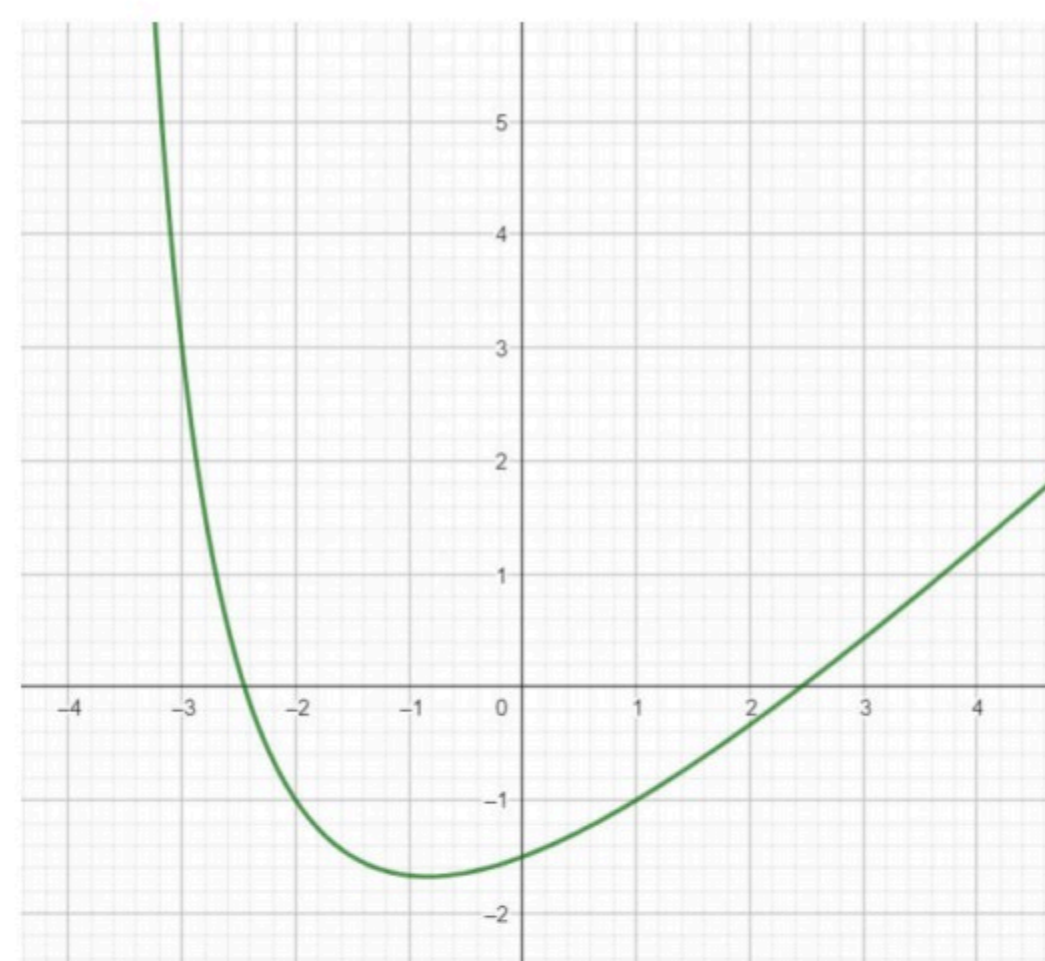
$$f(x) = x^2 + x + 0.16; [-3, 3]$$

x							
$f(x)$							



$$f(x) = \frac{x^2 - 6}{x + 4}; [-3, 4]$$

x							
$f(x)$							



2 End Behavior The **end behavior** of a function describes how a function *behaves* at either *end* of the graph. That is, end behavior is what happens to the value of $f(x)$ as x increases or decreases without bound—becoming greater and greater or more and more negative. To describe the end behavior of a graph, you can use the concept of a limit.

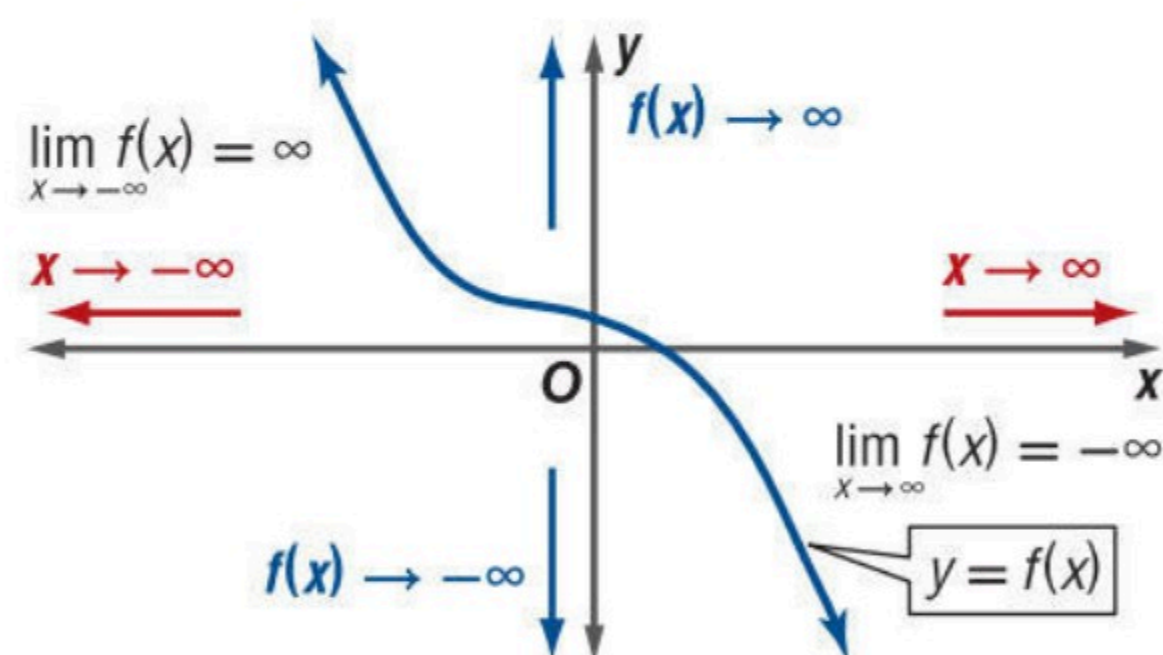
Left-End Behavior

$$\lim_{x \rightarrow -\infty} f(x)$$

One possibility for the end behavior of the graph of a function is for the value of $f(x)$ to increase or decrease without bound. This end behavior is described by saying that $f(x)$ approaches positive or negative infinity.

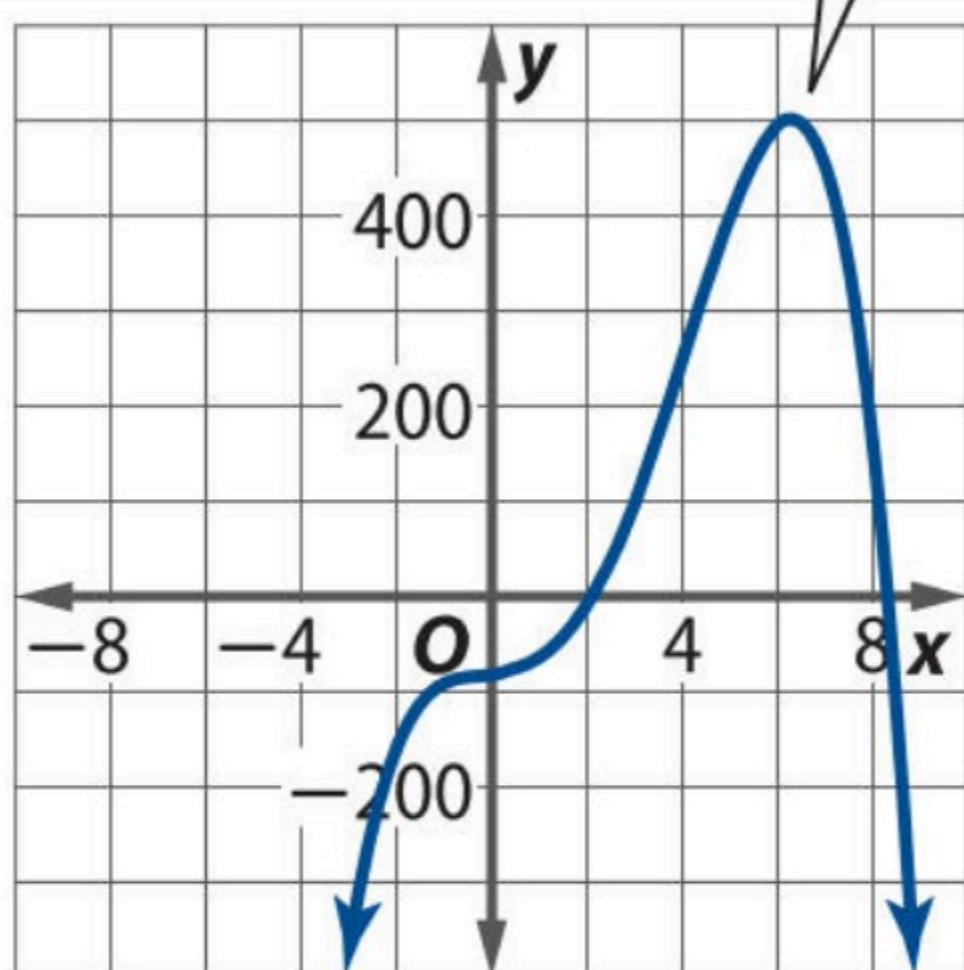
Right-End Behavior

$$\lim_{x \rightarrow \infty} f(x)$$



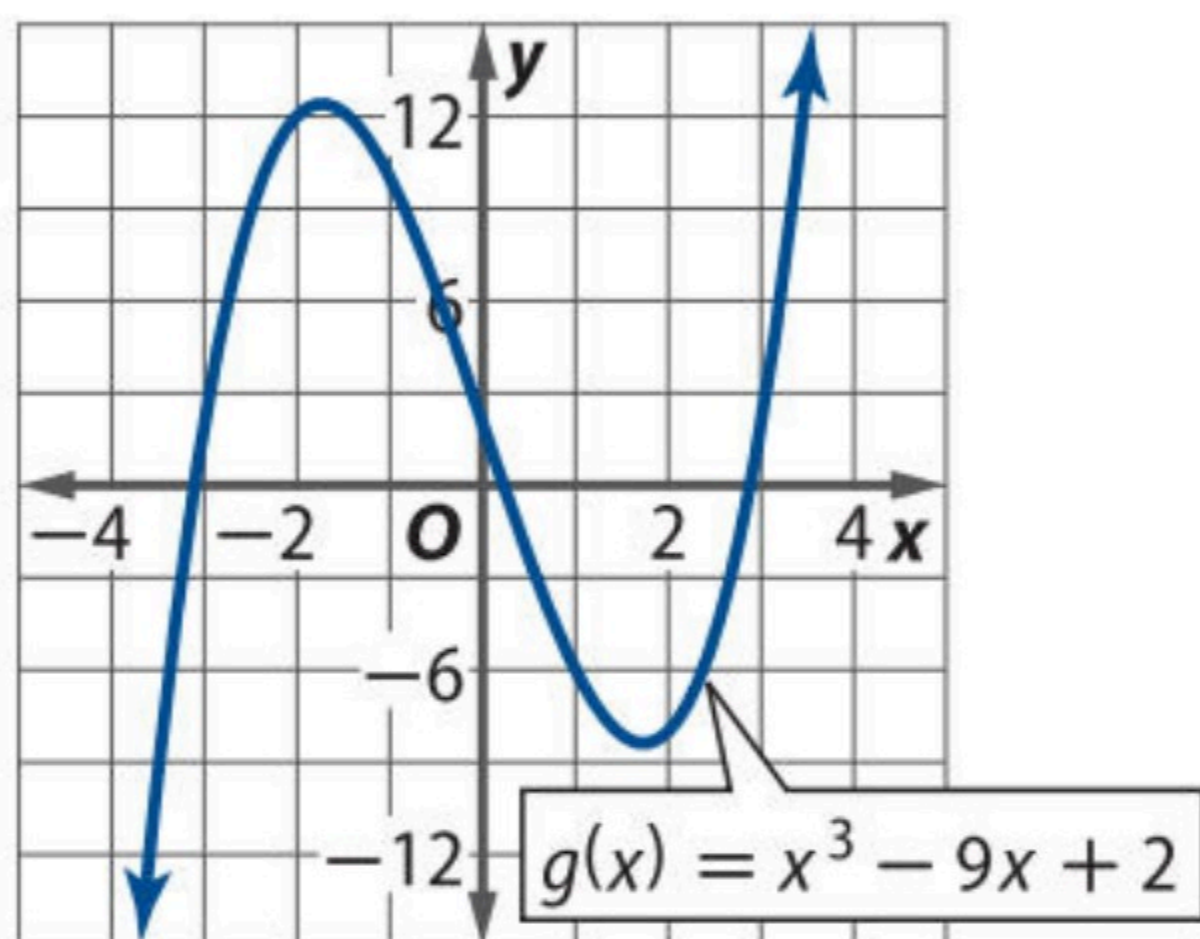
Use the graph of each function to describe its end behavior. Support the conjecture numerically.

$$f(x) = -x^4 + 8x^3 + 3x^2 + 6x - 80$$

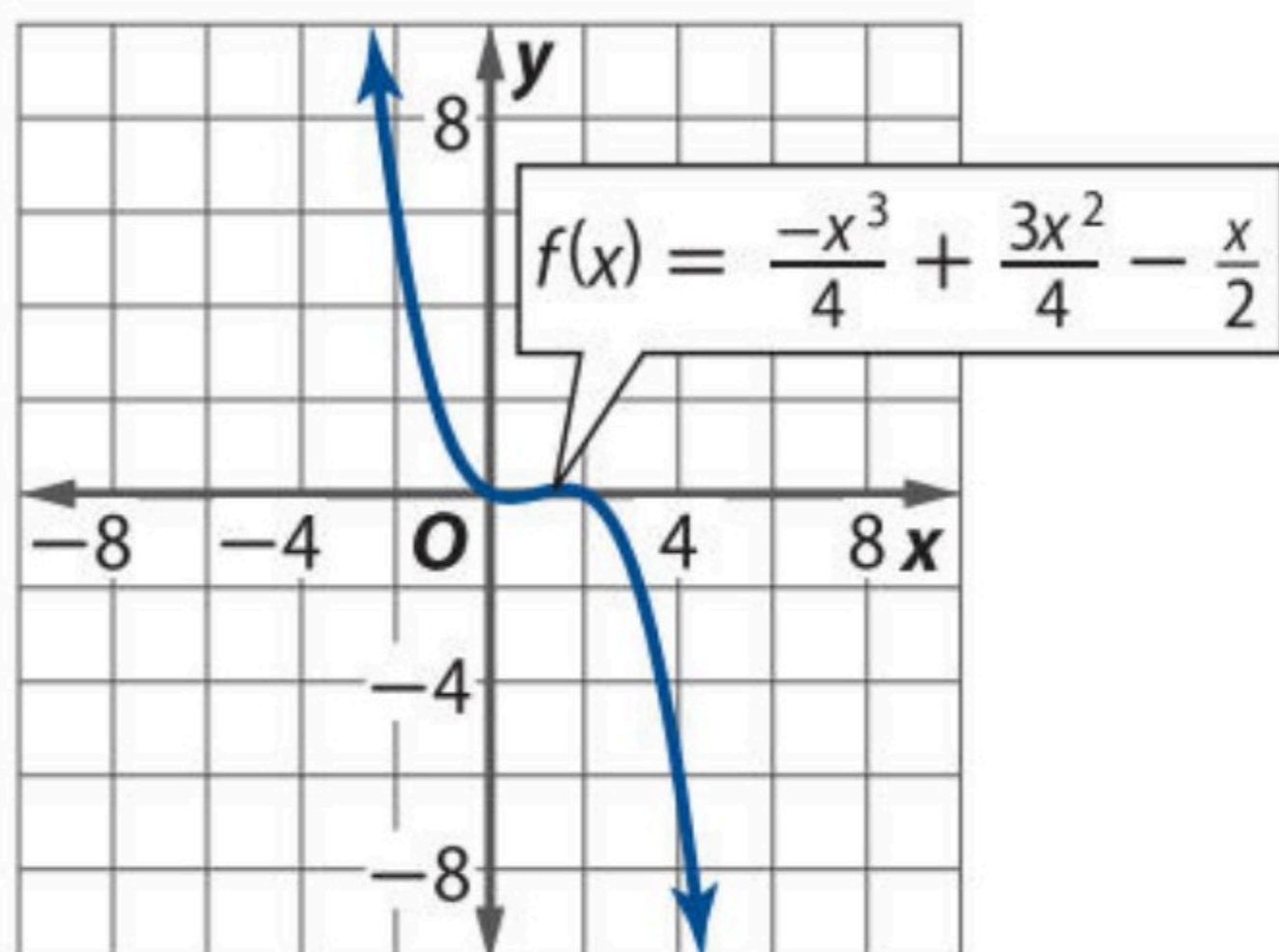


x							
$f(x)$							



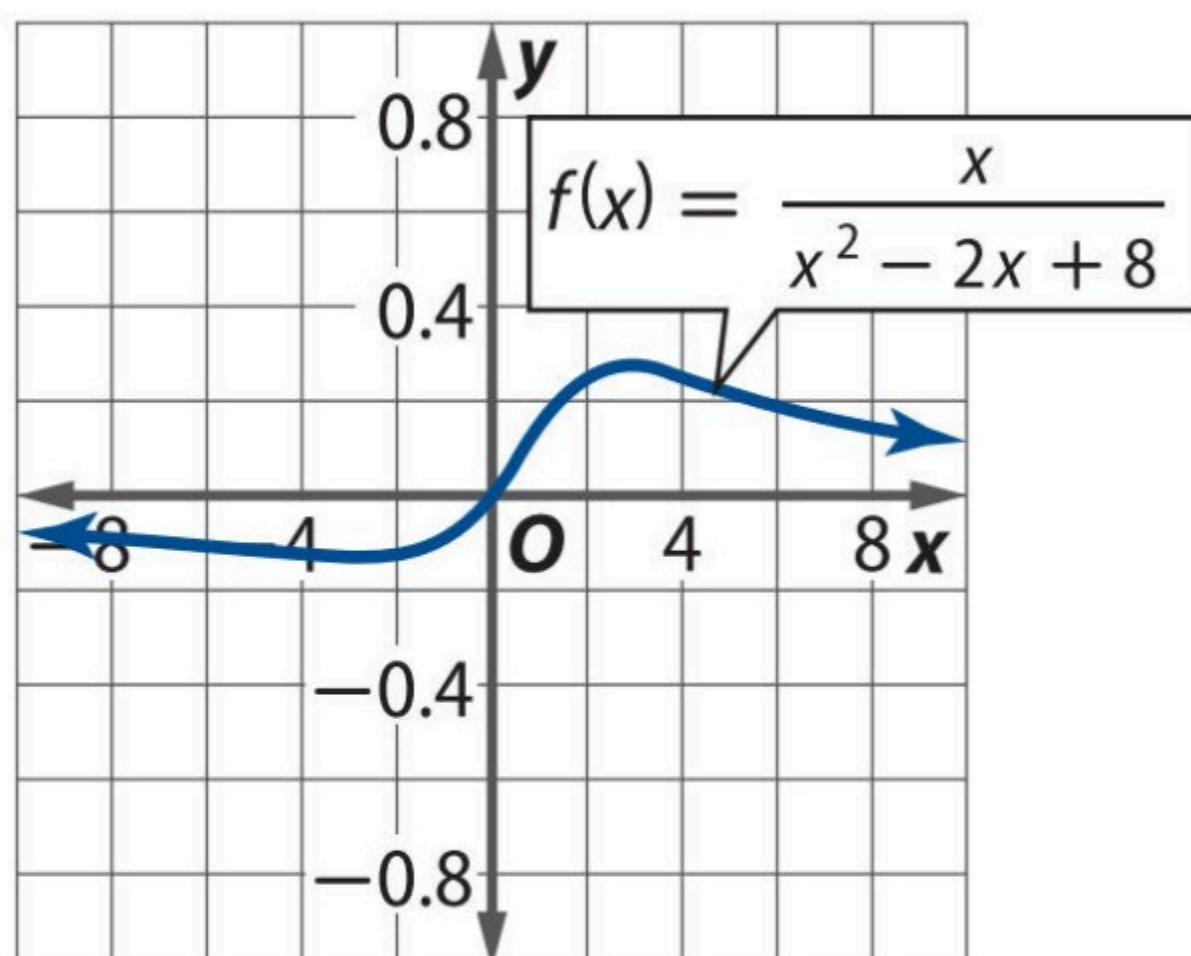


x							
$f(x)$							

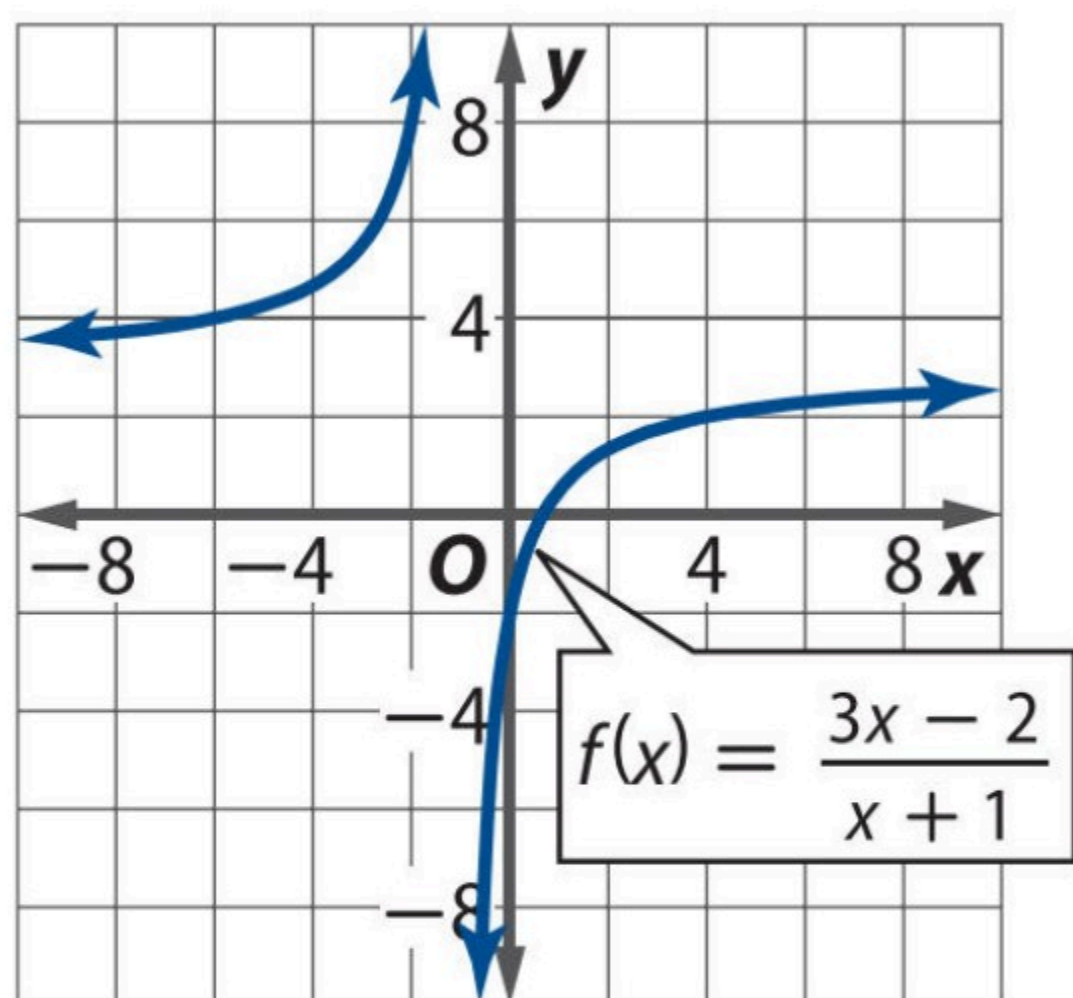


x							
$f(x)$							





x							
$f(x)$							



x							
$f(x)$							



