# Unit: Limits and Continuity

## Lesson 2.1: Basic Limit Concepts

### Informal Method

↳ Idea of getting closer and closer to a value or location

Example: The area of a circle

### Formal Method

↳ Consider a function $f(x) = x^2 - 2x - 3$

**The Limit Question:**

What happens to the y-values as x "gets close to" a particular number?

### Numerically

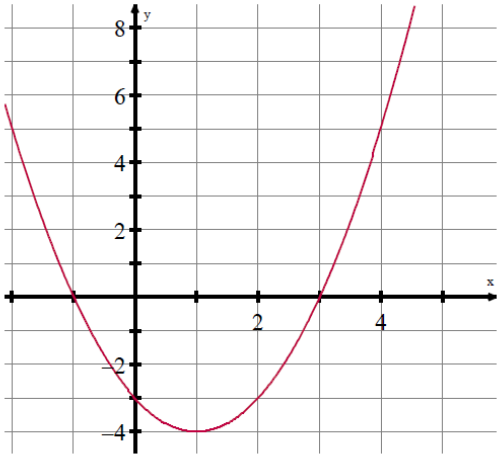
| X | Y1 |
|---|---|
| 3 | 0 |
| 3.5 | 2.25 |
| 3.8 | 3.84 |
| 3.9 | 4.41 |
| 3.95 | 4.7025 |
| 3.99 | 4.9401 |
| 3.999 | 4.994 |

Y1 = X²−2X−3

| X | Y1 |
|---|---|
| 5 | 12 |
| 4.5 | 8.25 |
| 4.2 | 6.24 |
| 4.1 | 5.61 |
| 4.05 | 5.3025 |
| 4.01 | 5.0601 |
| 4.001 | 5.006 |

Y1 = X²−2X−3

### Graphically



## Example 1

Determine the behavior of a rational function $f(x) = \frac{x^2 + 2x - 3}{x - 1}$ as $x \to 1$.

Are there any restrictions on the function?

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(i) Simplify the function.

(ii) Construct a table of values to observe the behavior of the function as *x* approaches 1 (from left and right)

| x | f(x) |
|---|---|
| 0.9 | |
| 0.99 | |
| 0.999 | |
| 1 | |
| 1.001 | |
| 1.01 | |
| 1.1 | |

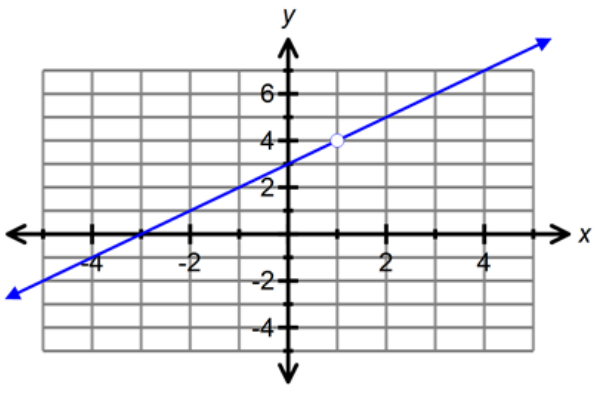
$f(x) = \frac{x^2 + 2x - 3}{x - 1}$

1

As $x \longrightarrow$ $f(x) \longrightarrow$

Notation:

(iii) Graph the function to verify the limit value.



## Example 2

i) What is the limit of $f(x)=\frac{1}{x}$ as $x \to \pm\infty$ ?

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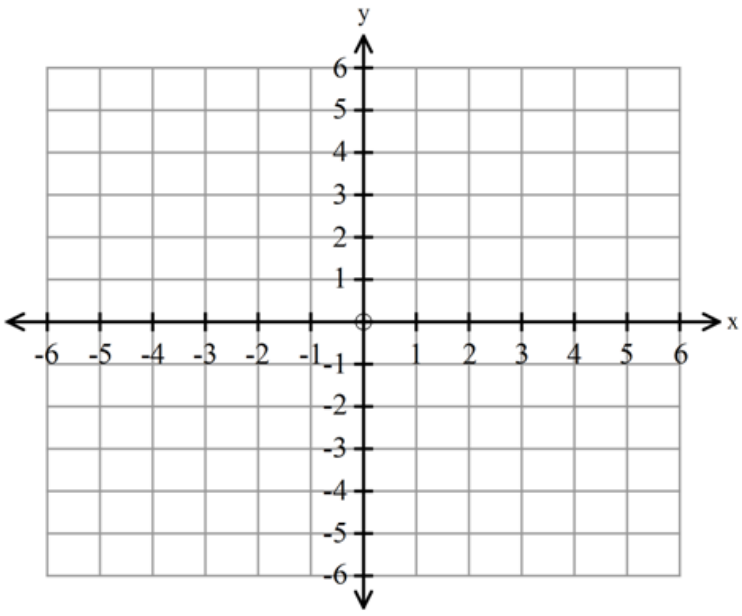
Construct a table of values and graph the function.

State the restriction on the domain of $f(x)=\frac{1}{x}$.

| x | -5 | -1 | $-\frac{1}{2}$ | $-\frac{1}{4}$ | 0 | $\frac{1}{4}$ | $\frac{1}{2}$ | 1 | 5 |
|---|---|---|---|---|---|---|---|---|---|
| f(x) | | | | | | | | | |

As $x \to \infty$ $f(x) \to$

As $x \to -\infty$ $f(x) \to$




Will the value of *f*(*x*) ever equal zero? Why or why not?

ii) What is the limit of $f(x)=\frac{1}{x}$ as $x \to 0$ ?