# Numbers and functions <br> Lesson \#1 

## MAT 1375 Precalculus

New York City College of Technology CUNY

## Number systems

Natural numbers $\mathbb{N}$ Examples:

## Number systems

Natural numbers $\mathbb{N}$
Examples: 7, 2, 5, 1003
$1,2,3,4,5, \ldots$

## Number systems

Natural numbers $\mathbb{N}$
Examples: 7, 2, 5, 1003
$1,2,3,4,5, \ldots$
Integers $\mathbb{Z}$
Examples:

## Number systems

Natural numbers $\mathbb{N}$
$1,2,3,4,5, \ldots$

Integers $\mathbb{Z}$

Examples: 7, 2, 5, 1003

Examples: $-3,7,2,5,0,1$
$\ldots,-3,-2,-1,0,1,2,3, \ldots$

## Number systems

Natural numbers $\mathbb{N}$
$1,2,3,4,5, \ldots$
Integers $\mathbb{Z}$
$\ldots,-3,-2,-1,0,1,2,3, \ldots$

## Rational numbers $\mathbb{Q}$

Examples: 7, 2, 5, 1003

Examples: -3, 7, 2, 5, 0, 1

Examples:

## Number systems

Natural numbers $\mathbb{N}$
$1,2,3,4,5, \ldots$
Integers $\mathbb{Z}$
$\ldots,-3,-2,-1,0,1,2,3, \ldots$

## Rational numbers $\mathbb{Q}$

Examples: 7, 2, 5, 1003

Examples: $-3,7,2,5,0,1$
fractions $\frac{\partial}{b}$ for integers $a, b$, and $b \neq 0$

Examples: $\frac{2}{3}, 7=\frac{7}{1},-3,0, \frac{-36}{17}$

## Number systems

Natural numbers $\mathbb{N}$
$1,2,3,4,5, \ldots$
Integers $\mathbb{Z}$
$\ldots,-3,-2,-1,0,1,2,3, \ldots$
Rational numbers $\mathbb{Q}$
fractions $\frac{a}{b}$ for integers $a, b$, and $b \neq 0$
Real numbers $\mathbb{R}$

Examples: 7, 2, 5, 1003

Examples: $-3,7,2,5,0,1$

Examples: $\frac{2}{3}, 7=\frac{7}{1},-3,0, \frac{-36}{17}$

Examples:

## Number systems

Natural numbers $\mathbb{N}$
$1,2,3,4,5, \ldots$
Integers $\mathbb{Z}$
$\ldots,-3,-2,-1,0,1,2,3, \ldots$
Rational numbers $\mathbb{Q}$
fractions $\frac{a}{b}$ for integers $a, b$, and $b \neq 0$

## Real numbers $\mathbb{R}$

numbers on the number line


Examples: 7, 2, 5, 1003

Examples: $-3,7,2,5,0,1$

Examples: $\frac{2}{3}, 7=\frac{7}{1},-3,0, \frac{-36}{17}$

Examples: $\frac{2}{3}, 7,-3,0, \frac{-36}{17}$

## Number systems

Natural numbers $\mathbb{N}$
$1,2,3,4,5, \ldots$
Integers $\mathbb{Z}$
$\ldots,-3,-2,-1,0,1,2,3, \ldots$
Rational numbers $\mathbb{Q}$
fractions $\frac{a}{b}$ for integers $a, b$, and $b \neq 0$

## Real numbers $\mathbb{R}$

numbers on the number line


Examples: 7, 2, 5, 1003

Examples: - 3, 7, 2, 5, 0, 1

Examples: $\frac{2}{3}, 7=\frac{7}{1},-3,0, \frac{-36}{17}$

Examples: $\frac{2}{3}, 7,-3,0, \frac{-36}{17}$
Examples of irrational numbers:

## Number systems

Natural numbers $\mathbb{N}$
$1,2,3,4,5, \ldots$
Integers $\mathbb{Z}$
$\ldots,-3,-2,-1,0,1,2,3, \ldots$
Rational numbers $\mathbb{Q}$
fractions $\frac{a}{b}$ for integers $a, b$, and $b \neq 0$

## Real numbers $\mathbb{R}$

numbers on the number line


Examples: 7, 2, 5, 1003

Examples: - 3, 7, 2, 5, 0, 1

Examples: $\frac{2}{3}, 7=\frac{7}{1},-3,0, \frac{-36}{17}$

Examples: $\frac{2}{3}, 7,-3,0, \frac{-36}{17}$
Examples of irrational numbers:
$\pi, \sqrt{2}, \sqrt[3]{7}$

## Number systems

Natural numbers $\mathbb{N}$
$1,2,3,4,5, \ldots$
Integers $\mathbb{Z}$
$\ldots,-3,-2,-1,0,1,2,3, \ldots$
Rational numbers $\mathbb{Q}$
fractions $\frac{a}{b}$ for integers $a, b$, and $b \neq 0$

## Real numbers $\mathbb{R}$

numbers on the number line


Complex numbers $\mathbb{C}$

## Number systems

Natural numbers $\mathbb{N}$
$1,2,3,4,5, \ldots$
Integers $\mathbb{Z}$
$\ldots,-3,-2,-1,0,1,2,3, \ldots$
Rational numbers $\mathbb{Q}$
fractions $\frac{a}{b}$ for integers $a, b$, and $b \neq 0$

## Real numbers $\mathbb{R}$

numbers on the number line


Complex numbers $\mathbb{C}$
$a+b i$, for real numbers $a, b$

## Interval notation - review

3 ways to express an interval
(1) On the number line:

(2) Inequality notation:

$$
2 \leq x \leq 5
$$

(3) Interval notation:
$[2,5]$

## Interval notation - exercises

|  | Inequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) |  |  |  |
| (b) | $2<x<5$ |  |  |
| (c) |  |  |  |
| (d) |  |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ |  |  |
| (f) | $2 \leq x$ |  |  |
| (g) |  |  | $(-\infty, 5]$ |
| (h) | $-\pi<x$ |  |  |
| (i) | $5 \leq x \leq 2$ |  |  |
| (j) |  |  |  |

## Interval notation - exercises

|  | Inequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) | $1 \leq x \leq 6$ |  | $[1,6]$ |
| (b) | $2<x<5$ | $\begin{array}{llllllllll} 1 & 1 & 1 & 1 & & 1 & & & 1 & 1 \\ -3-2-1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \end{array}$ |  |
| (c) |  | $\begin{array}{llllllllll}  \\ \hline & & & & & & \mathbf{O} & \mathbf{l} & \mathbf{l} \\ -5 & -4 & -3 & -2 & 0 & 1 & 2 & 3 & 4 & 5 \\ \hline \end{array}$ |  |
| (d) |  |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ |  |  |
| (f) | $2 \leq x$ | $\begin{array}{lllllllllll} + & 1 & & & & & & & & & \\ \hline-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \end{array}$ |  |
| (g) |  | $\begin{array}{lllllllllll} \hline & 1 & 1 & 1 & 1 & 1 & & 1 & & 1 & 1 \\ -2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ \hline \end{array}$ | $(-\infty, 5]$ |
| (h) | $-\pi<x$ | $\begin{array}{l\|ccccccccc} \hline & 1 & 1 & 1 & 1 & 1 & & 1 & 1 & \mathbf{1} \\ -5 & -4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\ 5 \end{array}$ |  |
| (i) | $5 \leq x \leq 2$ | $\begin{array}{lllllllllll} \hline & & & & & & & 1 & & & \\ \hline-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ \hline \end{array}$ |  |
| (j) |  |  |  |

## Interval notation - exercises

|  | Inequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) | $1 \leq x \leq 6$ |  | [1, 6] |
| (b) | $2<x<5$ |  | $(2,5)$ |
| (c) |  | $\begin{array}{llllllllll}  \\ \hline & & & & & & \mathbf{O} & \mathbf{l} & \mathbf{l} \\ -5 & -4 & -3 & -2 & 0 & 1 & 2 & 3 & 4 & 5 \\ \hline \end{array}$ |  |
| (d) |  |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ |  |  |
| (f) | $2 \leq x$ | $\begin{array}{lllllllllll} + & 1 & & & & & & & & & \\ \hline-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \end{array}$ |  |
| (g) |  | $\begin{array}{lllllllllll} \hline & 1 & 1 & 1 & 1 & 1 & & 1 & & 1 & 1 \\ -2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ \hline \end{array}$ | $(-\infty, 5]$ |
| (h) | $-\pi<x$ | $\begin{array}{cccccccccc} + & 1 & 1 & 1 & 1 & 1 & & 1 & 1 & 1 \\ -5 & -4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \end{array}$ |  |
| (i) | $5 \leq x \leq 2$ | $\begin{array}{lllllllllll} \hline & & & & & & & 1 & & & \\ \hline-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ \hline \end{array}$ |  |
| (j) |  |  |  |

## Interval notation - exercises

|  | nequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) | $1 \leq x \leq 6$ |  | [1, 6] |
| (b) | $2<x<5$ | $\begin{array}{lllllllll} \hline 1 & 1 & 1 & \mathbf{O} & & & \mathbf{0} & & \\ \hline-3 & 1 \\ -3 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ \hline \end{array}$ | $(2,5)$ |
| (c) | $-3 \leq x<2$ | $\begin{array}{llllllll} \hline & & & & & & \mathbf{O} & \\ \hline-5-4 & & & \mathbf{l} \\ \hline-3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $[-3,2)$ |
| (d) |  |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ |  |  |
| (f) | $2 \leq x$ |  |  |
| (g) |  | $\begin{array}{l\|llllllllll} 1 & 1 & 1 & 1 & 1 & 1 & & 1 \end{array}$ | $(-\infty, 5]$ |
| (h) | $-\pi<x$ | $\begin{array}{llllllllll} \hline 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ \hline-5-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 \\ \hline \end{array}$ |  |
| (i) | $5 \leq x \leq 2$ | $\begin{array}{llllllllllll} \hline & & & & 1 & & & & 1 & & l \end{array}$ |  |
| (j) |  |  |  |

## Interval notation - exercises

|  | nequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) | $1 \leq x \leq 6$ | $\begin{array}{llllllllllllll}  \\ \hline-3-2-1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \end{array}$ | [1, 6] |
| (b) | $2<x<5$ |  | $(2,5)$ |
| (c) | $-3 \leq x<2$ | $\begin{array}{lllllllll} \hline \\ \hline-\quad & & & & & \mathbf{O} & & & \\ \hline-5-4-3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 \\ \hline \end{array}$ | $[-3,2)$ |
| (d) | $-5<x \leq-2$ |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ |  |  |
| (f) | $2 \leq x$ | $\begin{array}{lllllllllll} +1 & 1 & & 1 & & & & 1 & & 1 \\ \hline-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline \end{array}$ |  |
| (g) |  | $\begin{array}{llllllllllll} \hline 1 & 1 & 1 & & 1 & 1 & 1 & & 1 & 1 \\ \hline-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \end{array}$ | $(-\infty, 5]$ |
| (h) | $-\pi<x$ | $\begin{array}{llllllllll} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ -5-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 \\ \hline \end{array}$ |  |
| (i) | $5 \leq x \leq 2$ | $\begin{array}{llllllllll} \hline & 1 & 1 & 1 & & A & 1 & \\ \hline-2-1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ \hline \end{array}$ |  |
| (j) |  |  |  |

## Interval notation - exercises

|  | nequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) | $1 \leq x \leq 6$ | 1   | [1, 6] |
| (b) | $2<x<5$ |  | $(2,5)$ |
| (c) | $-3 \leq x<2$ | $\begin{array}{llllllll} \hline & - \\ \hline-5-4-3 & -2 & -1 & 0 & 1 & 2 & & \\ \hline \end{array}$ | $[-3,2)$ |
| (d) | $-5<x \leq-2$ |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ |  | $[-1.5, \sqrt{5})$ |
| (f) | $2 \leq x$ | $\begin{aligned} & 1 \\ & \hline-2 \end{aligned}$ |  |
| (g) |  | $\begin{array}{lllllllllll} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & \\ \hline-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ \hline \end{array}$ | $(-\infty, 5]$ |
| (h) | $-\pi<x$ | $\begin{array}{llllllllll} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ -5-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 \\ \hline \end{array}$ |  |
| (i) | $5 \leq x \leq 2$ | $\begin{array}{llllllllll} \hline & 1 & 1 & 1 & & A & 1 & \\ \hline-2-1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ \hline \end{array}$ |  |
| (j) |  |  |  |

## Interval notation - exercises

|  | nequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) | $1 \leq x \leq 6$ | $\begin{array}{lllllllllllll} \hline & \\ \hline-3-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline \end{array}$ | [1, 6] |
| (b) | $2<x<5$ |  | $(2,5)$ |
| (c) | $-3 \leq x<2$ | $\begin{array}{llllllll}  \\ \hline & - & & & & & 0 & \\ \hline-5-4-3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $[-3,2)$ |
| (d) | $-5<x \leq-2$ |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ | $\begin{array}{lllllllll}  \\ \hline & & & & & & & 0 & 0 \end{array}$ | $[-1.5, \sqrt{5})$ |
| (f) | $2 \leq x$ |  | $[2, \infty)$ |
| (g) |  | $\begin{array}{lllllllllll} 1 & 1 & 1 & 1 & 1 & & & 1 & 1 \\ \hline-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \end{array}$ | $(-\infty, 5]$ |
| (h) | $-\pi<x$ | $\begin{array}{llllllllll} 1 & 1 & 1 & 1 & 1 & 1 & 1 & \\ \hline-5 & -4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ |  |
| (i) | $5 \leq x \leq 2$ | $\begin{array}{lllllllllllll}  & & & & 1 & & 1 & 1 & & \\ \hline-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ \hline \end{array}$ |  |
| (j) |  | $\begin{array}{lllllllllllll} \hline & & & & & & & -0 & & & & & \\ \hline-1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ \hline \end{array}$ |  |

## Interval notation - exercises

|  | Inequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) | $1 \leq x \leq 6$ |  | [1, 6] |
| (b) | $2<x<5$ | $\begin{array}{lllllllll} \hline 1 & 1 & 1 & \mathbf{O} & & & \mathbf{0} & & \\ \hline-3 & 1 \\ -3 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ \hline \end{array}$ | $(2,5)$ |
| (c) | $-3 \leq x<2$ |  | $[-3,2)$ |
| (d) | $-5<x \leq-2$ |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ | $\begin{array}{llllllllll} \hline & & & & & & 0 & 0 & & \\ \hline-5-4-3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $[-1.5, \sqrt{5})$ |
| (f) | $2 \leq x$ |  | $[2, \infty)$ |
| (g) | $x \leq 5$ |  | $(-\infty, 5]$ |
| (h) | $-\pi<x$ | $\begin{array}{lllllllll} 1 & 1 & 1 & 1 & 1 & 1 & & 1 \\ -5-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ |  |
| (i) | $5 \leq x \leq 2$ | $\begin{array}{lllllllllll} \hline & 1 & & 1 & & 1 & & 1 & & \\ \hline-2-1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline \end{array}$ |  |
| (j) |  |  |  |

## Interval notation - exercises

|  | nequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) | $1 \leq x \leq 6$ | $\begin{array}{lllllllllllll} \hline & \\ \hline-3-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline \end{array}$ | [1, 6] |
| (b) | $2<x<5$ | $\begin{array}{llllllllll} +1 & 1 & 1 & \mathbf{1} & & & & 0 & & \\ \hline-3 & 1 \\ -3 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline \end{array}$ | $(2,5)$ |
| (c) | $-3 \leq x<2$ | $\begin{array}{llllllll}  \\ \hline & - & & & & & 0 & \\ -5-4-3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $[-3,2)$ |
| (d) | $-5<x \leq-2$ |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ | $\begin{array}{lllllllll}  \\ \hline & & & & & & \mathbf{O} & \mathbf{O} & \\ \hline-5-4-3-2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 \end{array}$ | $[-1.5, \sqrt{5})$ |
| (f) | $2 \leq x$ |  | $[2, \infty)$ |
| (g) | $x \leq 5$ |  | $(-\infty, 5]$ |
| (h) | $-\pi<x$ |  | $(-\pi, \infty)$ |
| (i) | $5 \leq x \leq 2$ | $\begin{array}{lllllllllll} \hline & 1 & & 1 & & 1 & & 1 & & \\ \hline-2-1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline \end{array}$ |  |
| (j) |  | $\begin{array}{lllllllllllll} \hline & & & & & & & -0 & & & & & \\ \hline-1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ \hline \end{array}$ |  |

## Interval notation - exercises

|  | nequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) | $1 \leq x \leq 6$ | 1   | [1, 6] |
| (b) | $2<x<5$ |  | $(2,5)$ |
| (c) | $-3 \leq x<2$ |  | $[-3,2)$ |
| (d) | $-5<x \leq-2$ |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ | $\begin{array}{lllllllll}  \\ \hline & & & & & & & 0 & \\ \hline-5-4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $[-1.5, \sqrt{5})$ |
| (f) | $2 \leq x$ |  | $[2, \infty)$ |
| (g) | $x \leq 5$ |  | $(-\infty, 5]$ |
| (h) | $-\pi<x$ |  | $(-\pi, \infty)$ |
| (i) | $5 \leq x \leq 2$ |  | no such number |
| (j) |  |  |  |

## Interval notation - exercises

|  | Inequality notation | Number line | Interval notation |
| :---: | :---: | :---: | :---: |
| (a) | $1 \leq x \leq 6$ |  | [1, 6] |
| (b) | $2<x<5$ | $\begin{array}{llllllllll} \hline 1 & 1 & 1 & 0 & & & 0 & & 1 \end{array}$ | $(2,5)$ |
| (c) | $-3 \leq x<2$ |  | $[-3,2)$ |
| (d) | $-5<x \leq-2$ |  | $(-5,-2]$ |
| (e) | $-1.5 \leq x<\sqrt{5}$ |  | $[-1.5, \sqrt{5})$ |
| (f) | $2 \leq x$ |  | $[2, \infty)$ |
| (g) | $x \leq 5$ |  | $(-\infty, 5]$ |
| (h) | $-\pi<x$ |  | $(-\pi, \infty)$ |
| (i) | $5 \leq x \leq 2$ |  | no such number |
| (j) | $1 \leq x \leq 3$ or $5<x \leq 7$ |  | $[1,3] \cup(5,7]$ |

## Functions - definition

## Definition

A function is an assignment, which assign to each input $x$ exactly one output $y$.

## Functions - definition

## Definition

A function is an assignment, which assign to each input $x$ exactly one output $y$.

The set of all inputs is called the

## Functions - definition

## Definition

A function is an assignment, which assign to each input $x$ exactly one output $y$.

The set of all inputs is called the domain, denoted by $D$.

## Functions - definition

## Definition

A function is an assignment, which assign to each input $x$ exactly one output $y$.

The set of all inputs is called the domain, denoted by $D$.

The set of all outputs is called the

## Functions - definition

## Definition

A function is an assignment, which assign to each input $x$ exactly one output $y$.

The set of all inputs is called the domain, denoted by $D$.

The set of all outputs is called the range, denoted by $R$.

We write $f(x)=y$ or $f: x \mapsto y$, if $f$ assigns to the input $x$ the output $y$.

## Functions - definition

## Definition

A function is an assignment, which assign to each input $x$ exactly one output $y$.

The set of all inputs is called the domain, denoted by $D$.

The set of all outputs is called the range, denoted by $R$.

We write $f(x)=y$ or $f: x \mapsto y$, if $f$ assigns to the input $x$ the output $y$.
(1)


## Functions - definition

## Definition

A function is an assignment, which assign to each input $x$ exactly one output $y$.

The set of all inputs is called the domain, denoted by $D$.

The set of all outputs is called the range, denoted by $R$.

We write $f(x)=y$ or $f: x \mapsto y$, if $f$ assigns to the input $x$ the output $y$.
(1)


Function values: $f(\square)$ yellow $\quad f(\diamond)=$ green $\quad f(\Omega)=$ yellow $\ldots$

## Functions - definition

## Definition

A function is an assignment, which assign to each input $x$ exactly one output $y$.

The set of all inputs is called the domain, denoted by $D$.

The set of all outputs is called the range, denoted by $R$.

We write $f(x)=y$ or $f: x \mapsto y$, if $f$ assigns to the input $x$ the output $y$.
(1)


Function values: $f(\square)=$ yellow Domain $D=$

$$
f(\diamond)=\text { green } \quad f(\diamond)=\text { yellow } \quad \ldots
$$

Range $R=$

## Functions - definition

## Definition

A function is an assignment, which assign to each input $x$ exactly one output $y$.

The set of all inputs is called the domain, denoted by $D$.

The set of all outputs is called the range, denoted by $R$.

We write $f(x)=y$ or $f: x \mapsto y$, if $f$ assigns to the input $x$ the output $y$.
(1)


Function values: $f(\square)=$ yellow Domain $D=\{\triangle, \diamond, \bigcirc, \square, \odot\}$

$$
f(\diamond)=\text { green } \quad f(\Omega)=\text { yellow }
$$

Range $R=\{$ red, green, blue, yellow $\}$

## Functions - examples

(2)


Function values: $f(\triangle)=\quad f(\square)=$

## Functions - examples

(2)


Function values: $f(\triangle)=$ green $\quad f(\square)=$ ??? blue or yellow ???
$\Longrightarrow f$ is not a function $X$, since $\square$ has more than one output! ( $f$ is a relation.)

## Functions - examples

(2)


Function values: $f(\triangle)=$ green $f(\square)=$ ??? blue or yellow ???
$\Longrightarrow f$ is not a function $X$, since $\square$ has more than one output! ( $f$ is a relation.)
(3)


Is $f$ a function?

## Functions - examples

(2)


Function values: $f(\triangle)=$ green $f(\square)=$ ??? blue or yellow ???
$\Longrightarrow f$ is not a function $X$, since $\square$ has more than one output! ( $f$ is a relation.)
B


Is $f$ a function? Yes, $f$ is a function! $\sqrt{ }$
Domain $D=$
Range $R=$

Function values: $f(\square)=$

$$
f(\diamond)=\quad f(ৎ)=
$$

## Functions - examples

(2)


Function values: $f(\triangle)=$ green $\quad f(\square)=$ ??? blue or yellow ???
$\Longrightarrow f$ is not a function $X$, since $\square$ has more than one output! ( $f$ is a relation.)
©


Is $f$ a function? Yes, $f$ is a function!
Domain $D=\{\triangle, \diamond, \bigcirc, \square, \ominus\} \quad$ Range $R=\{$ green $\}$
Codomain $C=\{$ green, yellow, red, blue $\}$

- Notation: we write $f: D \rightarrow C$

Function values: $f(\square)=$ green

$$
f(\diamond)=\text { green } \quad f(\diamond)=\text { green }
$$

## Functions - word problems

(1) Consider the assignment which associates to each student the chair on which the student sits.

- Question: What is the domain?
- Question: What is the range?


## Functions - word problems

(1) Consider the assignment which associates to each student the chair on which the student sits.

- Question: What is the domain?

Answer: The domain is the set of all students in the classroom.

- Question: What is the range?


## Functions - word problems

(1) Consider the assignment which associates to each student the chair on which the student sits.

- Question: What is the domain?

Answer: The domain is the set of all students in the classroom.

- Question: What is the range?

Answer: The range is the set of all chairs in the classroom.

## Functions - word problems

(1) Consider the assignment which associates to each student the chair on which the student sits.

- Question: What is the domain?

Answer: The domain is the set of all students in the classroom.

- Question: What is the range?

Answer: The range is the set of all chairs in the classroom.

- Question: Does this assignment constitute a function?


## Functions - word problems

(1) Consider the assignment which associates to each student the chair on which the student sits.

- Question: What is the domain?

Answer: The domain is the set of all students in the classroom.

- Question: What is the range?

Answer: The range is the set of all chairs in the classroom.

- Question: Does this assignment constitute a function?

Answer: It is a function as long as each student sits on a chair.

## Functions - word problems

(1) Consider the assignment which associates to each student the chair on which the student sits.

- Question: What is the domain?

Answer: The domain is the set of all students in the classroom.

- Question: What is the range?

Answer: The range is the set of all chairs in the classroom.

- Question: Does this assignment constitute a function?

Answer: It is a function as long as each student sits on a chair.

- Pick a specific student.

Describe what the function assigns to this student in your own words!

## Functions - word problems

(1) Consider the assignment which associates to each student the chair on which the student sits.

- Question: What is the domain?

Answer: The domain is the set of all students in the classroom.

- Question: What is the range?

Answer: The range is the set of all chairs in the classroom.

- Question: Does this assignment constitute a function?

Answer: It is a function as long as each student sits on a chair.

- Pick a specific student.

Describe what the function assigns to this student in your own words!
(2) A gift card has been preloaded with a value of $\$ 30$. You want to use the gift card at a coffee shop, where your favorite cup of coffee costs $\$ 2$. The function $f(x)=30-2 x$ models the amount of money left on the card after purchasing $x$ many cups of coffee.

- Question: Interpret the meaning of $f(8)=14$.


## Functions - word problems

(1) Consider the assignment which associates to each student the chair on which the student sits.

- Question: What is the domain?

Answer: The domain is the set of all students in the classroom.

- Question: What is the range?

Answer: The range is the set of all chairs in the classroom.

- Question: Does this assignment constitute a function?

Answer: It is a function as long as each student sits on a chair.

- Pick a specific student.

Describe what the function assigns to this student in your own words!
(2) A gift card has been preloaded with a value of $\$ 30$. You want to use the gift card at a coffee shop, where your favorite cup of coffee costs $\$ 2$. The function $f(x)=30-2 x$ models the amount of money left on the card after purchasing $x$ many cups of coffee.

- Question: Interpret the meaning of $f(8)=14$.

Answer: After buying 8 cups of coffee, there is $\$ 14$ left on the card.

## Functions - word problems

(1) Consider the assignment which associates to each student the chair on which the student sits.

- Question: What is the domain?

Answer: The domain is the set of all students in the classroom.

- Question: What is the range?

Answer: The range is the set of all chairs in the classroom.

- Question: Does this assignment constitute a function?

Answer: It is a function as long as each student sits on a chair.

- Pick a specific student.

Describe what the function assigns to this student in your own words!
(2) A gift card has been preloaded with a value of $\$ 30$. You want to use the gift card at a coffee shop, where your favorite cup of coffee costs $\$ 2$. The function $f(x)=30-2 x$ models the amount of money left on the card after purchasing $x$ many cups of coffee.

- Question: Interpret the meaning of $f(8)=14$.

Answer: After buying 8 cups of coffee, there is $\$ 14$ left on the card.

- Question: Interpret the meaning of $f(x)>0$.


## Functions - word problems

(1) Consider the assignment which associates to each student the chair on which the student sits.

- Question: What is the domain?

Answer: The domain is the set of all students in the classroom.

- Question: What is the range?

Answer: The range is the set of all chairs in the classroom.

- Question: Does this assignment constitute a function?

Answer: It is a function as long as each student sits on a chair.

- Pick a specific student.

Describe what the function assigns to this student in your own words!
(2) A gift card has been preloaded with a value of $\$ 30$. You want to use the gift card at a coffee shop, where your favorite cup of coffee costs $\$ 2$. The function $f(x)=30-2 x$ models the amount of money left on the card after purchasing $x$ many cups of coffee.

- Question: Interpret the meaning of $f(8)=14$.

Answer: After buying 8 cups of coffee, there is $\$ 14$ left on the card.

- Question: Interpret the meaning of $f(x)>0$.

Answer: $f(x)>0$ means that after purchasing $x$ cups of coffee there is still some money left on the card.

