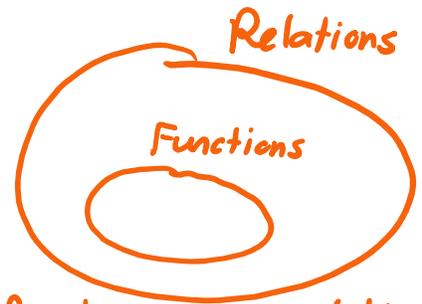


Lesson 4: Introduction to Functions

Relations and Functions

- ordered pair (x, y)
↑ ↑
input output
- a relation is a set of ordered pairs
- the domain is the set of all inputs (all x-values)
- the range is the set of all outputs (all y-values)

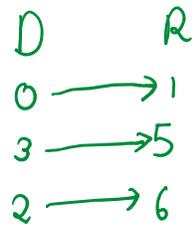
When is a relation a function?
Function: Each input has exactly one output
NOT a function: If an input has more than one output



All functions are relations BUT not all relations are functions.

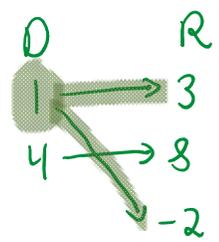
Ex 1: Are the following relations functions?

- (a) $\{(0, 1), (3, 5), (2, 6)\}$
 Domain: $\{0, 3, 2\}$
 Range: $\{1, 5, 6\}$



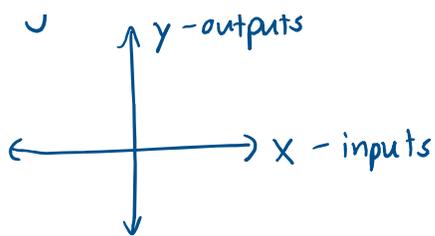
Yes it's a function
 b/c no one in the domain has 2 arrows coming out of it

- (b) $\{(1, 3), (4, 8), (1, -2)\}$
 Domain: $\{1, 4\}$
 Range: $\{3, 8, -2\}$

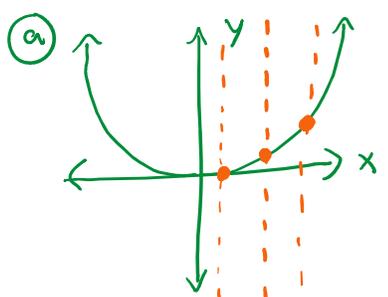


Not a function!

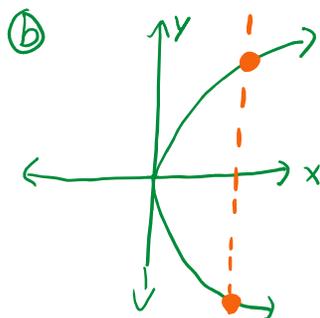
- Plotting relations
↑
y-outputs



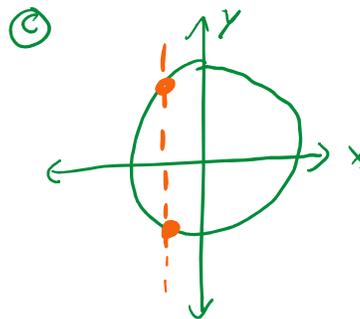
Ex 2: Determine if a function



Yes is a function



No it's a function



Not a function

Vertical Line Test:

- If there is a vertical line that intersects the graph more than once it is not a function.
- If every vertical line intersects the graph at most once, it is a function.

• Function notation: $y = f(x)$ $x \rightarrow \boxed{f} \rightarrow y$

↑ output
↑ input

Think of f as a set of instructions with a given input and f tells me which operations to do to get the out.

ex. $f(x) = 2x + 1$ x is input
 First double x (b/c $2x$)
 Then add 1 (b/c $2x + 1$)
 That # we get is the output

Working with Functions

Ex 3: Find $f(-7)$ given that $f(x) = \sqrt{x^2 + 51}$

$$\begin{aligned}f(-7) &= \sqrt{(-7)^2 + 51} \\&= \sqrt{49 + 51} \\&= \sqrt{100} \\&= 10\end{aligned}$$

Ex 4: If $g(x) = 5x^2 - 3x + 8$, find $g(x+2)$ and simplify

$$g(x+2) = 5(x+2)^2 - 3(x+2) + 8$$

$$(a+b)^2 = a^2 + 2ab + b^2$$

$$= 5(x^2 + 2(x)(2) + 2^2) - 3(x+2) + 8$$

$$= 5(x^2 + 4x + 4) - 3(x+2) + 8$$

$$= 5x^2 + 20x + 20 - 3x - 6 + 8$$

$$= 5x^2 + 17x + 22$$

Ex 5: Let $f(x) = 4x + 21$. Solve $f(x) = 3$,

Idea: Find the x -input so that f gives us 3.

$$3 = f(x) = 4x + 21$$

$$3 = 4x + 21$$

$$\begin{array}{r} -21 \quad -21 \\ \hline -18 = 4x \end{array}$$

$$-18 = 4x$$

$$\frac{-18}{4} = x$$

$$x = -\frac{9}{2}$$

Ex 6: Given $v(t) = t^2 + 3t - 5$ and solve $v(t) = 13$,

$$t^2 + 3t - 5 = 13$$

$$t^2 + 3t - 18 = 0$$

$$\begin{array}{r} -18 \\ \wedge \\ -2 + 9 = 7 \end{array}$$

$$t^2 + 3t - 18 = 0$$

$$t^2 - 3t + 6t - 18 = 0$$

$$t(t-3) + 6(t-3) = 0$$

$$(t+6)(t-3) = 0$$

$$t+6=0 \quad | \quad t-3=0$$

$$t=-6 \quad | \quad t=3$$

So $t = -6, 3$

$$-18$$

$$\wedge$$

$$-2+9 = 7$$

$$\underline{-3+6 = 3}$$