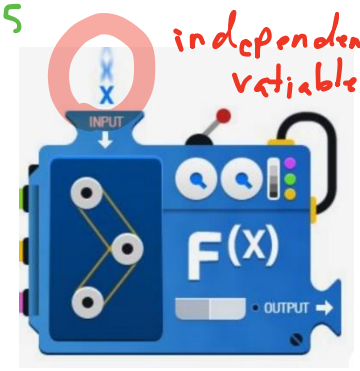
$y = 2x + 5$



independent variables

1.8 – Functions, Relations, Domain and Range

A **relation** is a **set of ordered pairs (x, y)**.

A **function** is a special type of relation. It can be represented in many ways:

i. as **a set of ordered pairs**

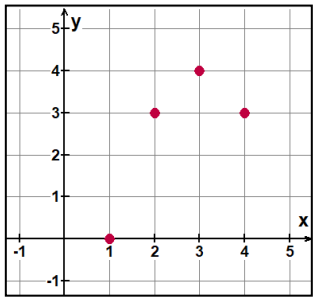
{ (1,0), (2,3), (3,4), (4,3) }

discrete

ii. as a **table of values**

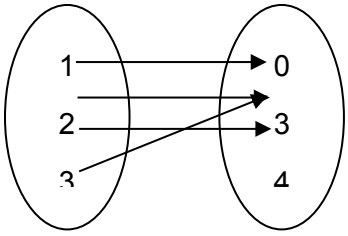
x	y
1	0
2	3
3	4

iii. as a **scatter plot/graph**



discrete

iv. as a **mapping** diagram



v. by an **equation**

$y = -(x - 3)^2 + 4$

Quardratic

vertex (3, 4)

vi. **in words**

Domain & Range

The **DOMAIN** is the set of first elements of the ordered pairs (the set of distinct **x values**)

* **all possible values of x** looking left to right on a graph
* **all possible input values** (usually x) which allows the function formula to work

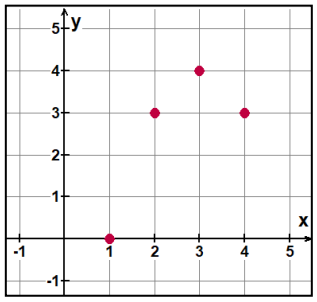
The **RANGE** is the set of second elements of the ordered pairs (the set of distinct **y values**)

* **all possible values of y** looking bottom to top on a graph
* all possible output values (usually y) which result from using the function formula

Discrete Relations (individual ordered pairs, not producing a continuous line/curve)

► Notation: Use { , , … , } and list all the unique values for each

Ex. 1 Consider the relation from above { (1,0), (2,3), (3,4), (4,3) }



Domain: $\{1, 2, 3, 4\}$

Range: $\{0, 3, 4\}$

Continuous Relations (ordered pairs producing a continuous line/curve)

but x is not equal to 6

►Formal Notation: $\{ x \in R \mid x \neq 6 \}$ Informal Notation: $\{x \neq 6, x \in R\}$

such that

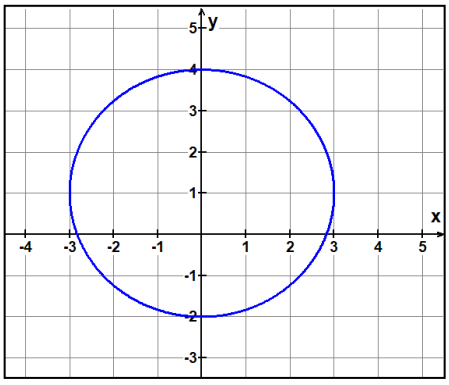
x is an element of the set of real numbers

The set notation above contains three important pieces of information, and is mathematical shorthand for "***the set of all x such that x is an element of the set of real numbers, and x is not equal to 6***."

Ex. 2 Consider the relations as defined by the graphs:

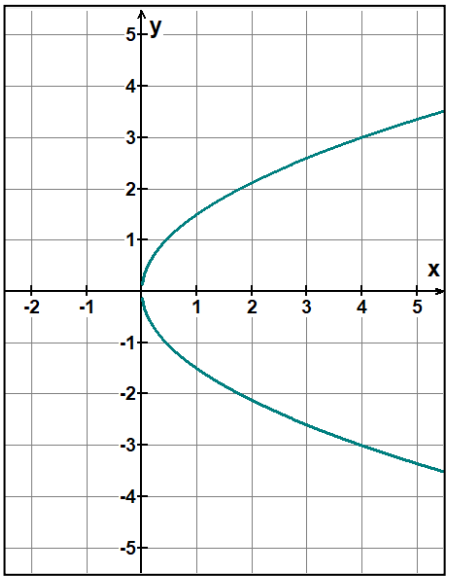
Domain: $\{x \in R \mid -3 \leq x \leq 3\}$

Range: $\{y \in R \mid -2 \leq y \leq 4\}$



$>$ $\geq$ $<$ $\leq$

↑ or equal to



Domain: $\{x \in R \mid x \geq 0\}$

Range: $\{y \in R\}$

ER = Element Real number

A **function** is a relation in which each value in the *domain* corresponds to exactly **ONE** element of *range*. It is a set of ordered pairs in which, **for every value of x, there is only one value of y.**

So, a relation is **NOT** a function if *one x value has 2 different y-values associated* with it.

Note: More than one *x*-value can correspond to the same *y*-value.

There are two ways in which to determine if a relation is a function or not.

1. **By looking at the ordered pairs → every x value can only have one y value**

Ex. 3 Referring back to the earlier examples of relations (on the first page), are these relations functions?

a) { (1,2), (5,3), (9,4), (7,1) } Function

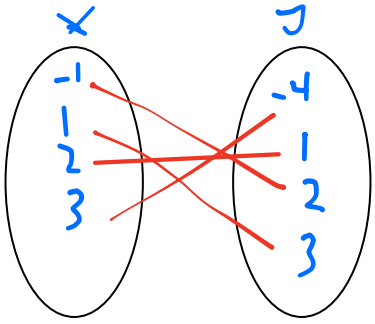
b) { (1,3), (4,2), (3,2), (6,5) } Function

c) { (1,4), (3,2), (5,4), (3,1) } Relation not a function

when x = 3 y is either 2 or 1.

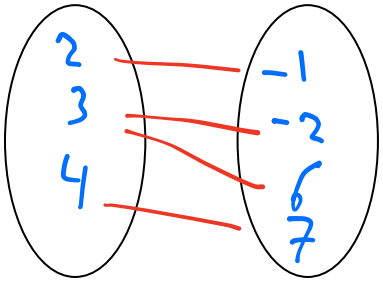
Ex. 4 Are the following relations functions? To help visualize your solution, create mapping diagrams for each.

a. {(2, 1), (3, -4), (-1, 2), (1, 3)}



function

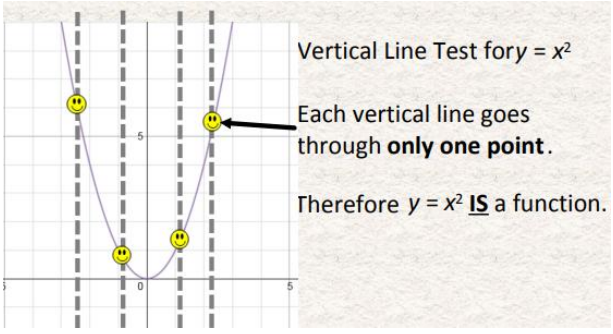
b. {(3, 6), (2, -1), (4, 7), (3, -2)}

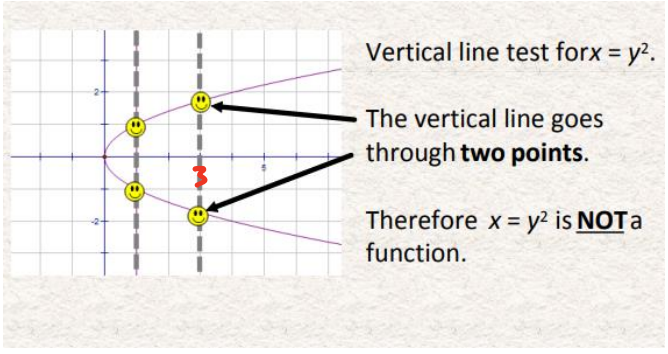


not a function
∴ Relation

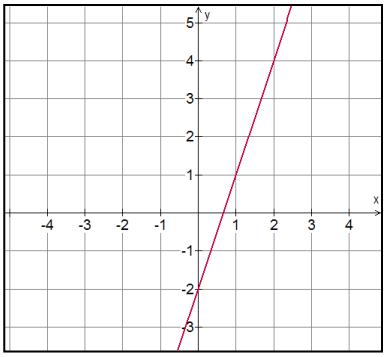
The **Vertical Line Test** on a graph. The Vertical Line Test states that a relation is a function if you can draw a vertical line through ONLY ONE point on the graph of the relation.

(If any vertical line passes through more than one point on the graph, then the relation is **not** a function)

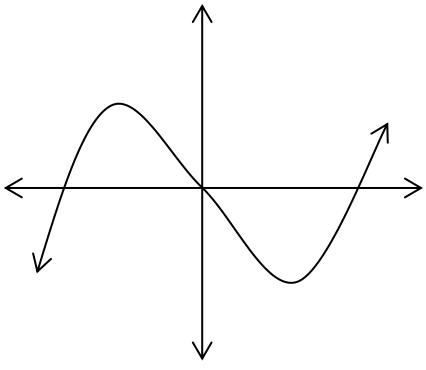




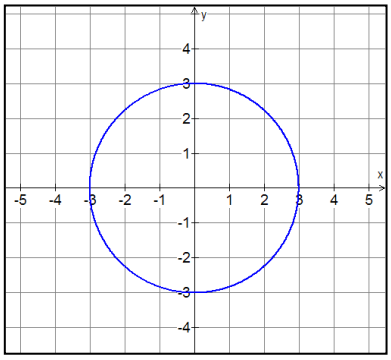
Ex. 4 Are the following relations functions? Do they pass the Vertical Line Test?



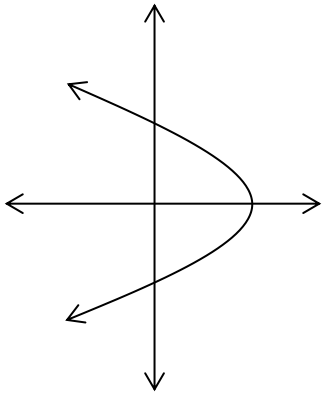
function



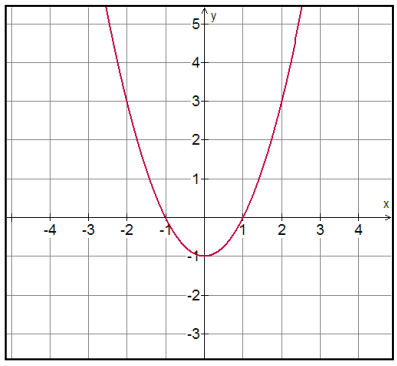
function



Relation
Not function



Not a function
↳ Relation

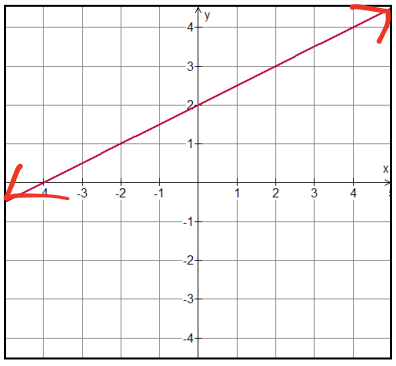


function

Functions & Relations ~ Worksheet

Given the following, state the domain and range of each relation and determine if the relation is a function.

a.

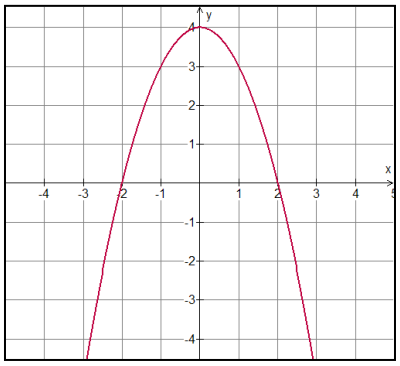


Domain: $\{x \in R\}$

Range: $\{y \in R\}$

Function ?: yes

b.

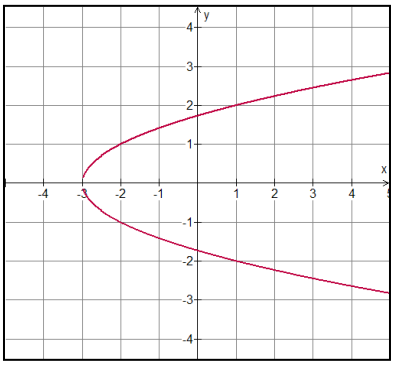


Domain: $\{x \in R\}$

Range: $\{y \in R | y \leq 4\}$

Function ?: yes

c.

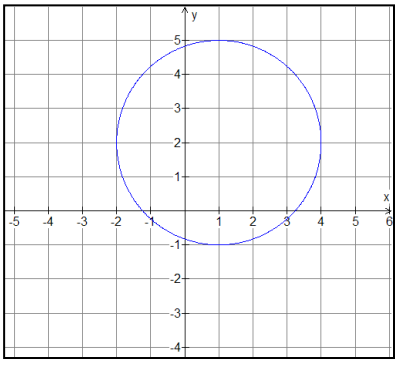


Domain: $\{x \in R | x \geq -3\}$

Range: $\{y \in R\}$

Function ?: Relation

d.



Domain: $(x \in R | -2 \leq x \leq 4)$

Range: $(y \in R | -1 \leq y \leq 5)$

Function ?: Relation

e. {(-2, -2), (-3, 3), (-4, 4), (- 3, 5), -1, 6)}

Domain: $\{-2, -3, -4, -1\}$

Range: $\{-2, 3, 4, 5, 6\}$

Function ?: Relation