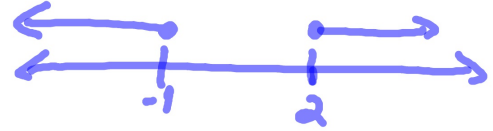


Review notation:
YOU NEED TO KNOW THIS!!!

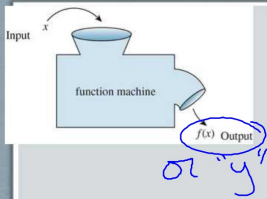


$$\{x \mid x \in \mathbb{Z}, -1 \leq x \leq 4\}$$

$$\{x \mid x \in \mathbb{Z}, -1 \leq x < 5\}$$



$$(-\infty, -1] \cup [2, \infty)$$



Functions Chapter 4

Mathematical Modelling

HOMEWORK:
Page 142-143-4C: all
Page 144-145-4D: all

Let's think about Math

1. Numbers and Numerical Expressions

$$2 + 3 \div 1 + 2^2 - (3 + 2)$$

You can "simplify" it or "evaluate", same thing.

In the end, you end up with a number.

The mathematical tool you are using is "order of operations or BEDMAS"

2. Variable and algebraic expressions:

$$2x^3 - 5x + x^3 + 2x + 7 + x$$

$$\rightarrow 3x^3 - 2x + 7$$

The tool you have used to simplify this expression is called: Like terms

$$\frac{-4x^4 y^2}{2(xy)^2} \Rightarrow -2x^2$$

The tool you have used to simplify this expression is called: exponents rules or index laws.

You can SIMPLIFY expressions. You can EVALUATE when a specific value of the variable is given. You can also FACTOR an expression. But NEVER, solve.



Let's think about Math

3. Equations

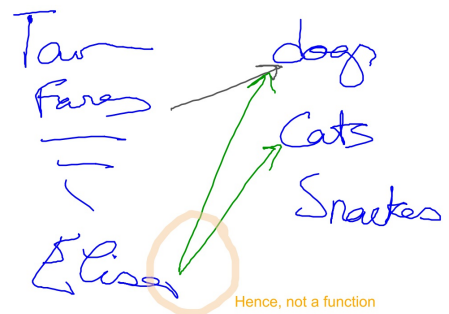
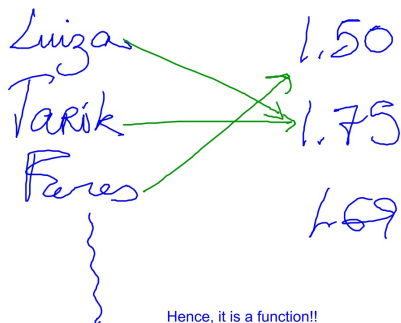
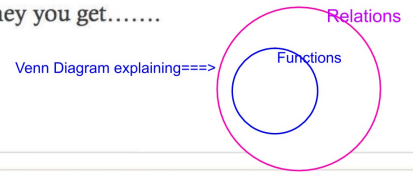
4. Functions

- a) Polynomial: $2x^3 + 2x^2 - x + 4 = 0 = y$
 $2x - 1 = 0 = y$
- b) Reciprocal: $\frac{2}{x} = 10 = y$
- c) Radical: $\sqrt{x-4} = 10 = y$
- d) Exponential: $2^{x+1} = 8 = y$
 $2^{x+1} = 2^3$
 $\therefore x+1 = 3$
- e) Trigonometric: $\sin 2x = \frac{1}{2} = y$

Where do functions come from?

RELATIONS: (patterns)

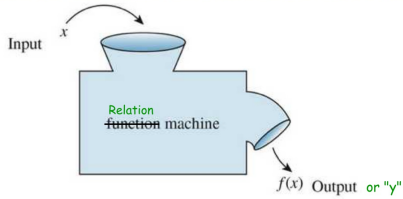
- Relationship between the time you parked your car and charges.
- Time the alarm clock goes and you get up.....
- How kind you are to your parents and how much pocket money you get.....



Where do they come from?

- A Relationship between two variables such that each value of the first variable is paired with one or **more values** of the second is called a RELATION

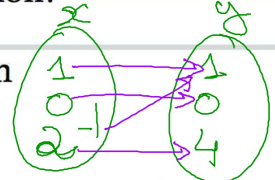
Every INPUT can have more than one OUTPUT



How do you represent a function or a relation?

1. Mapping diagram

$(1, 1); (-1, 1)$



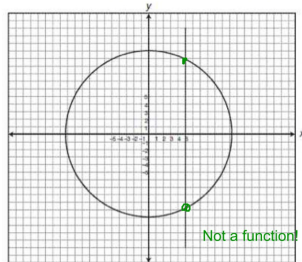
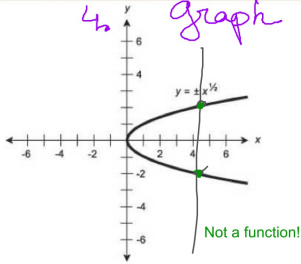
2. Table (vertical or horizontal)

x	1	5	8	9	6	5
y	2	3	4	5	2	4
x	1	5	8	9	6	5
y	2	3	4	5	4	3

Handwritten notes: x/y on the left, x/y on the right, and a vertical line with $1, 5, \dots$ on the right side.

3. Pairs (points) $(1, 2); (5, 3); (8, 4)$

4. Graph

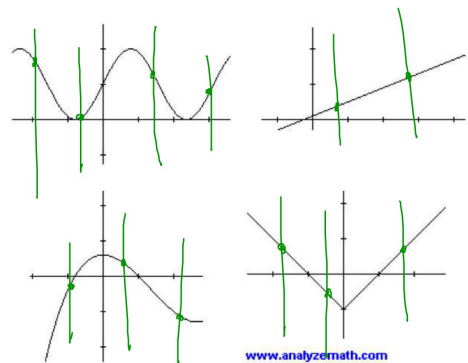


5. The equation of the function/relation

$$y = 2x + 1$$

4. Graph

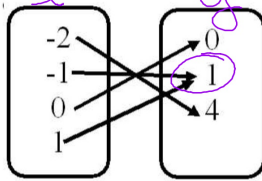
There are all functions!!!



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What is it?

- It is a relation between two sets of numerical elements. Provided that every element in the domain (first variable) relates to **only one** element in the range (2nd variable)



- Have independent values (x values : **DOMAIN**) and dependent values (y values: **RANGE**)
- Can be infinite ordered pairs or finite order pairs.

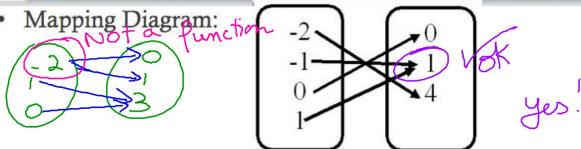
DOMAIN & RANGE.

Don't forget set notation (or interval notation)

- DOMAIN:** of a relation is the complete set of possible values of the independent variable.
 - In functions: we can say that DOMAIN is the set of permissible values of x which means the values of x that will make the function "work" and will output real y-values
- RANGE: (IMAGE):** of a relation is the complete set of possible values of the dependent variable.
 - In functions: we can say that RANGE is the set of permissible values of y.

How do we check if it is a function?

- Mapping Diagram:



- Table or Pairs (POINTS) *check table from previous slide*

X, Domain	3	4	3	4	5	6	52
Y, Range	-3.6	-3.6	4.2	4.2	10.7	12.1	52

not a funct.

X, Domain	1	2	3	4	5	6	52
Y, Range	-3.6	-3.6	4.2	4.2	10.7	12.1	52

yes!

Example with pairs.

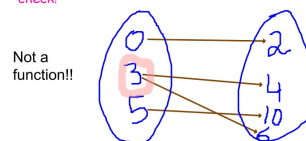
$(0, 2); (3, 4); (5, 10); (3, 6)$

Not a function!

$(2, 3); (3, 4); (4, 5); (5, 6)$

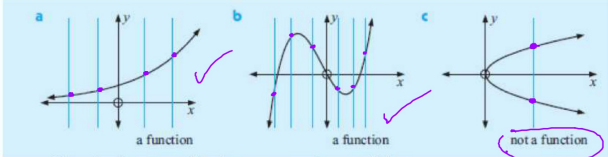
It is a function!

Note: if you are not sure, you can quickly draw the map (or mapping diagram) and check!



How do we check if it is a function?

- Graph: **THE VERTICAL LINE TEST.**



Check the graphs from previous slide

- Equation: A bit more challenging

$y = \sqrt{x}$ Not a function

$y = x^2$ It is a function

2-Notations

$f: x \mapsto \dots$ Or $f(x) = \dots$

$f: x \mapsto x^2$

$f(x) = x^2$

$f(x) = y$
 $y = \dots$

$y = x + 2$

$y = x^2 - x + 1$

Now, what do we do with functions?

- ✓ Evaluate: (2, ?)
Eg: given a function $f(x) = x^2 + 2$, find $f(2)$ Same question as if I asked to solve for?
- ✓ Find intercepts (if any)
- ✓ Graph them in a Cartesian plane:
- ✓ Find Domain and Range
- ✓ Given the equation of the function, and one coordinate of a point on the curve, find the other coordinate.
(remember the dance :) if you have the x you can find the y...and if I have the y I can find the x...
- ✓ Real life situations. Such the cost of your taxi ride, depending on the distance travelled. Or the cost of renting a house, depending on months.

Domain and Range

You must master the concept whether I give you a table, a graph, a map, or the equation itself.

The domain of a relation is the set of permissible values that x may have.
The range of a relation is the set of permissible values that y may have.

EXAMPLE

Domain =

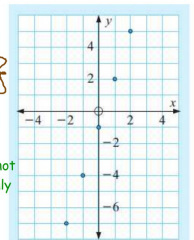
$\{-2, -1, 0, 1, 2\}$
 $\{x: -2 \leq x \leq 2, x \in \mathbb{Z}\}$

Range =

$\{-7, -1, 2, 5, -4\}$

x	-2	-1	0	1	2
$f(x)$	-7	-4	-1	2	5

For the range, you cannot describe it. You can only list...



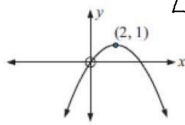
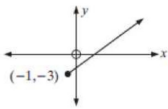
Examples

Example 2

For each of the following graphs state the domain and range:



a Domain is $\{x: x \leq 8\}$. Range is $\{y: y \geq -2\}$.
 b Domain is $\{x: x \geq -2\}$. Range is $\{y: y \geq -1\}$.



Be aware of limits!!

- Stop Signs!!!!
 - The point is not included
 - The point is included
- Vertices (plural of vertex) (or turning points)
 - These points are always included. → parabolas
 - V-function (abs value func)
- Asymptotes (vertical or horizontal asymptotes)

Asymptotes are lines that create a boundary where the curve is approaching, almost there, but never reaches.

These boundaries are lines, hence you should be able to give the equation of the asymptote.

If horizontal asymptote ($y=...$)

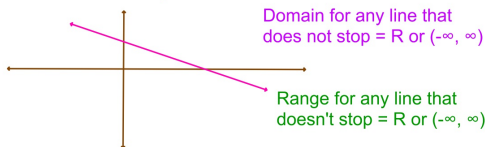
If Vertical asymptote ($x=...$)

→ exponential

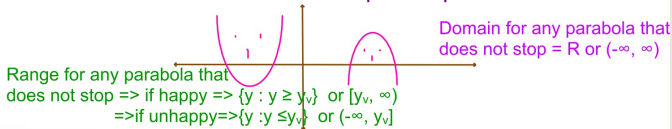
Note: Horizontal asymptotes affect the RANGE
 Vertical asymptotes affect the DOMAIN

Functions you already know

Linear Functions => the shape is a line.

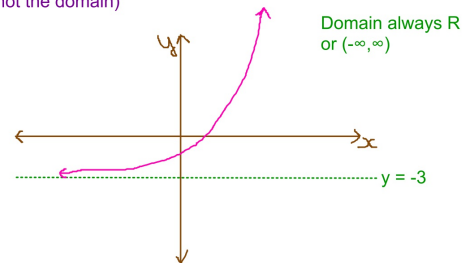


Quadratic Functions => the shape is a parabola



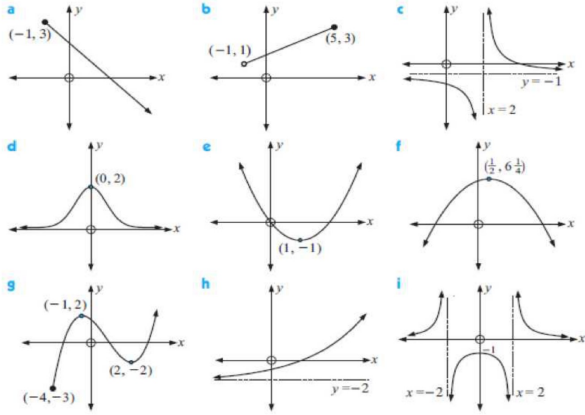
FUNCTIONS YOU ALREADY KNOW

Exponential (look for the Horizontal asymptote) Remember Horizontal asymptotes affects the range (not the domain)



Range:
 $\{y \mid y > -3\}$
 or
 $(-3, \infty)$

More examples



More examples

