Lycée Des Arts	Mathematics	9^{th}-Grade
Name:	Notion about real numbers	A.S-1

1- Where do you see numbers in real life?

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2- Why do we use numbers?

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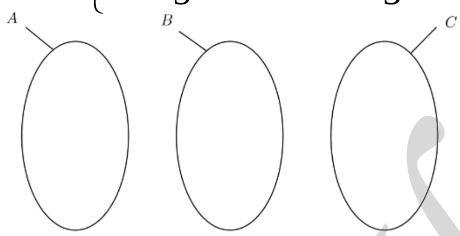
3- Consider the set of numbers: $P=\left\{-2,\ \frac{7}{5},\ -1,\ 3,\ 0,\ 1,\ \frac{1}{3},\sqrt{9+16},\ \left(\frac{1}{3}-\frac{12}{21}\right)\right\}$.



a. Sort the numbers of set P in the above diagram (a number can be used more than once).

b. What name can you give for each group.

………………………………………………………………………………………

Conclusions: Numbers are classified into ***sets*** (groups) according to their purpose.

1. *Natural numbers:*

Write down numbers that you use for counting the number of pages of a book or any other thing we use: ………………………………………………..

Ex1: Consider the set of numbers $\{1,2,3,4,5,\ ....\}$.

a) Trace a number line and place the above numbers on it.

……………………………………………………………………………..

b) What do you notice about the position of these numbers on the number line?

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Conclusions: The set of natural numbers is denoted by: $\mathbb{N}=\{0,1,2,3,4...\}$

Ex2: Consider the following equations: 1) $x+3=5$ 2) $2x+5=3$

a) Solve equation-1 for x in the set $\mathbb{N}$.

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b) If you are only familiar with the set of natural numbers, then can you find a value of x that satisfies equation-2? Show your work.

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c) What suggestions do you make to have a solution for equation-2?

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2. ***Integers***:

As you noticed, from the above example that some equations of the form $x+a=b$, where $a \& b$ belong to $\mathbb{N}$ cannot be solved in the set $\mathbb{N}$.

Ex3: What type of numbers would you use to represent the following situations?

- Temperature below zero. - Down slopes. - Value that verifies: $x+3=2$
- Places below ground floor - Loss.

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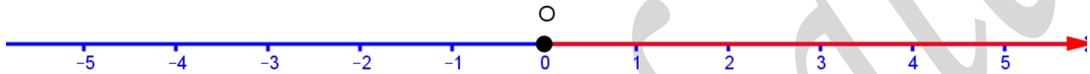
- So we will extend the set $\mathbb{N}$ to the set of integers $\mathbb{Z}$, which stands for ***Zahlen***.
- The set of integers consists of numbers such as:



Ex4: Describe the set of integers in terms of natural numbers.

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Conclusions:	1) The set of integers is denoted by: $\mathbb{Z}=\{...-3,-2,-1,0,1,2,3...\}$.
	2) Integers are natural numbers and their opposites.

Ex5: Solve the following equations in $\mathbb{Z}$:

- $x^2-4=0$ ……………………………………………………………………….
- $2x+3=0$ ……………………………………………………………………...

3. ***Rational numbers:***

$\mathbb{Z}$, is insufficient to solve some equations of the form $ax+b=0$, where $a \& b$ belong to $\mathbb{Z}$.

So, we will extend the set $\mathbb{Z}$ into the set of ***rational*** numbers.

The word rational is derived from ratio. So, we can deduce that any number that can be written in the ratio form, $\frac{a}{b}$, where $a \& b$ are integers such that $b \neq 0$ is said to be a rational number.

Example: $\frac{2}{3}, -\frac{4}{5}, \frac{2}{1}, \frac{1}{3}$, *are rational numbers.*

Conclusions:	1) The set of rational numbers is denoted by: $Q=\left\{...-\frac{1}{3},-\frac{1}{2},-1,0,\frac{1}{3},\frac{3}{2},\frac{35}{4}...\right\}$.
	2) A number is rational if that can be written in the ***ratio*** form, $\frac{a}{b}$, where $a \& b$ are ***integers*** such that $b \neq 0$.

A rational number can be written in decimal form.

Decimal form of a rational number:

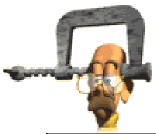
A number in decimal form is said to be rational if:

Its decimal part is

- Limited — $Ex_1: 3.45$ (Limited decimal part)

Or

- Unlimited but periodic — $Ex_2: 1.\overline{75}$ (Unlimited yet periodic)



How to express a rational number in decimal form in the form of a ratio?

Cases					
Limited decimal part			*Unlimited decimal part*		
	Course	**Application**		**Course**	**Application**
1^{st}	Eliminate the decimal point	3.45 $3 \quad \underset{decimal.part}{45}$	1^{st}	Separate integral part from the repeated decimal part by a "+" sign.	$1.\overline{75}$ $=1+75$
2^{nd}	Divide number by 10	$\frac{345}{10^{.....}}$	2^{nd}	Divide decimal part by equivalent number of 9's.	$1+\frac{75}{99}$
3^{rd}	Raise the 10 to a power equivalent to number of digits of the decimal part	$\frac{345}{10^2}$	3^{rd}	Add numbers.	$\frac{1\times 99}{99}+\frac{75}{99}$

Formal method

❖ Write $a = 3.\overline{72}$ in ratio form.

Solution	Steps	Statement
	$a = 3.727272...$	Write in expanded form
	$100a = 372.7272...$	Multiply both sides by a power of ten equal to the period
	$99a = 369$	Subtract previous equations to get rid of decimal part
	$a = \frac{369}{99}$	Divide both sides by 99 to get a fraction form

Irrational numbers: Are numbers that cannot be written in the form of a ratio

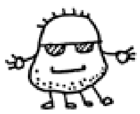
Common forms of irrational numbers:

- $\sqrt{2}, \sqrt{3}, \sqrt{5}, \sqrt{6}...$
- $\pi \approx 3.1415...$
- Numbers, in decimal form with infinite non periodic decimal part, $Ex: 7.9425721...$

4. ***Real numbers:***

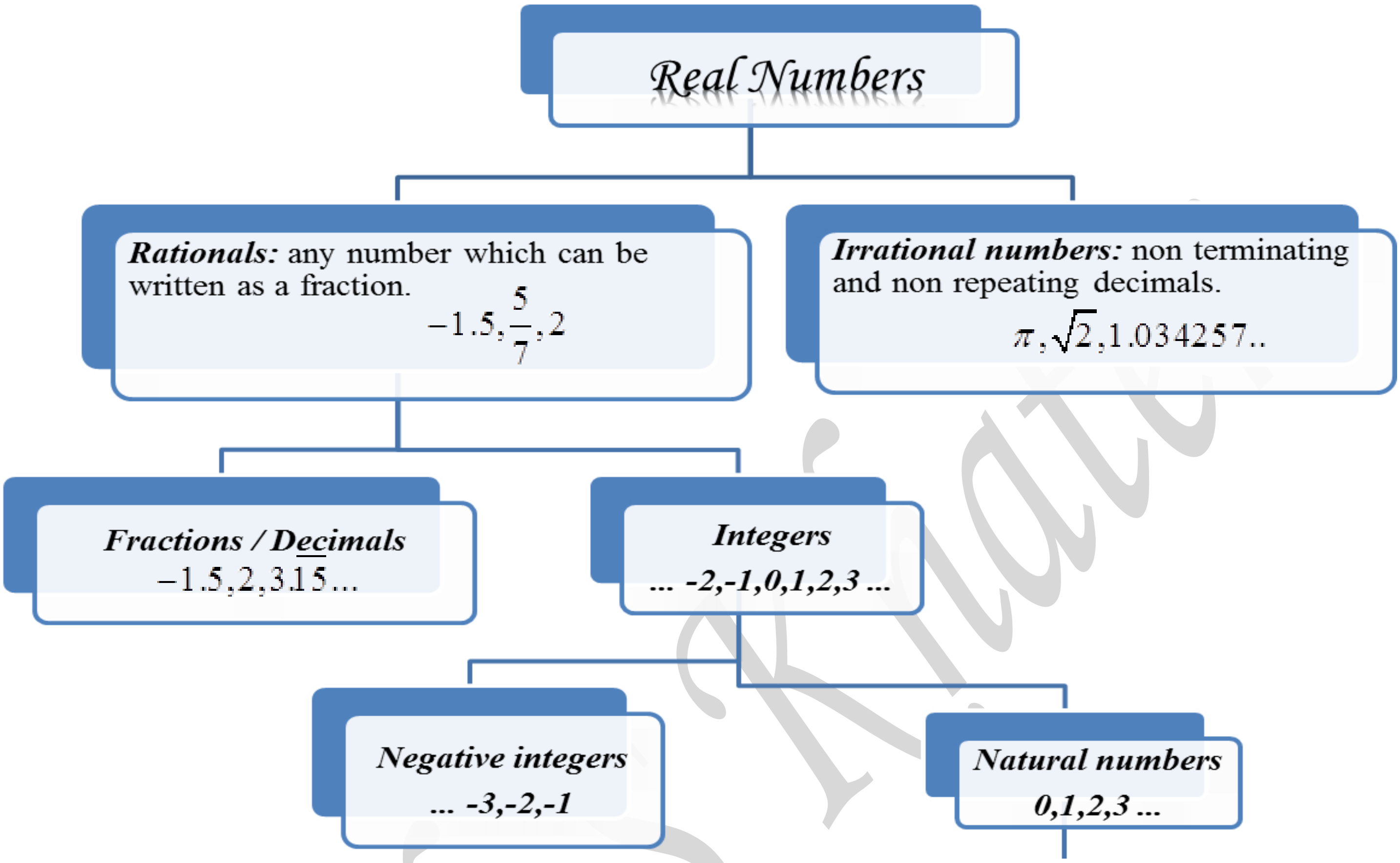
Is the set of all numbers, it includes all the above sets, $\mathbb{N}$, $\mathbb{Z}$, $\mathbb{Q}$ and the set of irrational numbers.

This set is denoted by: $\Re = \left\{...,-2,-\frac{1}{2},0,1,\sqrt{2},\pi,4.5...\right\}$



Summary of the lesson using:

Flow Chart:



Venn Diagram: