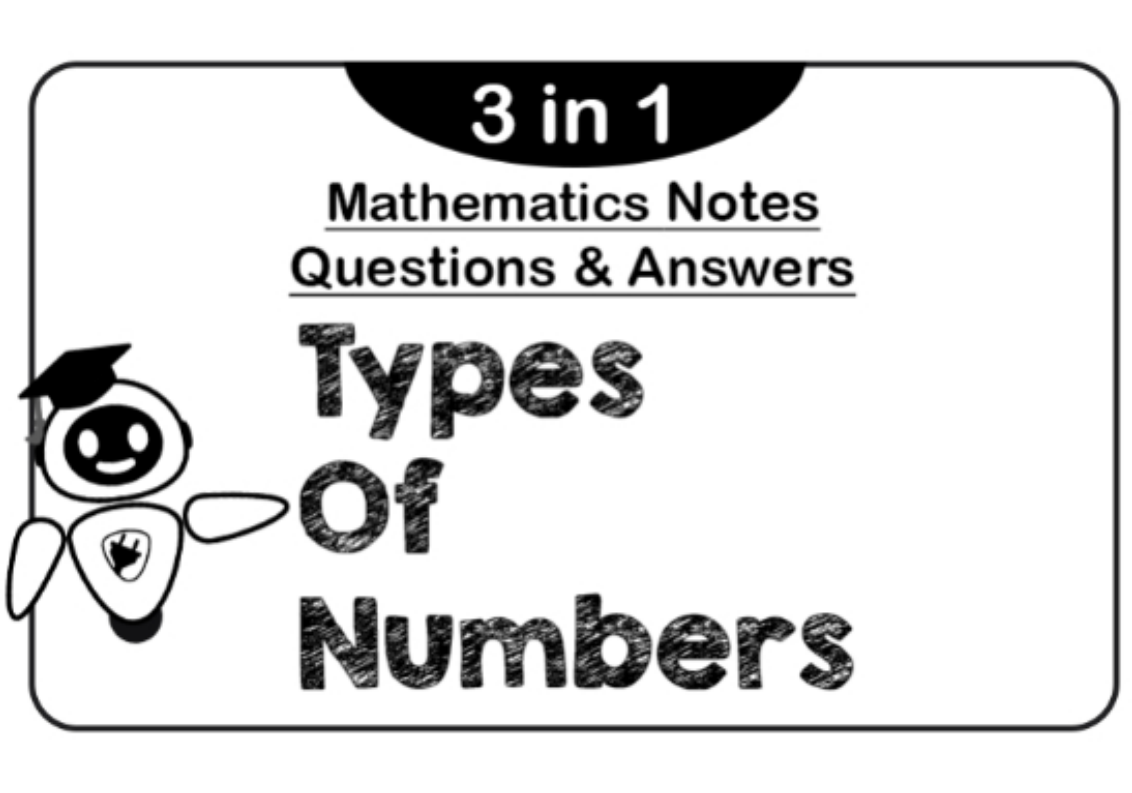

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About Types Of Numbers

In these notes you are going to be able to learn about **Types Of Numbers** and go through exercises to practice calculating and solving relevant questions. Make sure to go through all the notes, questions and answers so that you get used to solving questions of this topic.

Note that "**Types Of Numbers**" is a sub topic and you can also access more grade 10 notes, questions and answers under the main topic "**Numbers And Number Patterns**" which is one of the recommended learning topics in the **Grade 10 Mathematics Curriculum**.

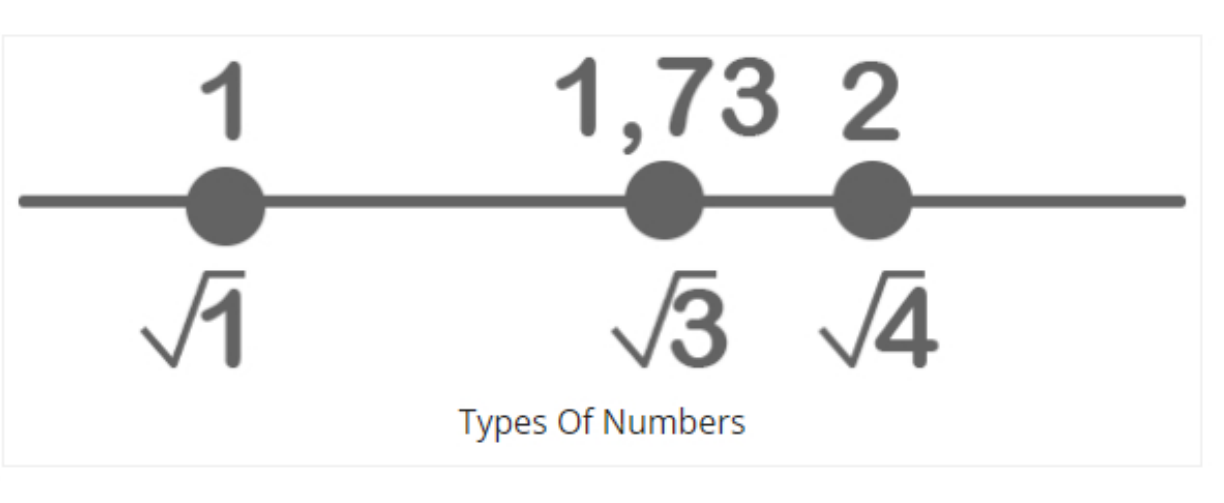
Introduction

In this topic it is important to keep in mind that numbers come in various forms: some are integers, others are fractions; some are positive, while others are negative.

$$NATURALNUMBERS : \mathbb{N} = \{1;2;3;\ldots\}$$
$$COUNTINGNUMBERS : No = \{0;1;2;3;\ldots\}$$
$$INTEGERS : Z = \{\ldots;-2;-1;0;1;2;3\ldots\}$$
$$Common\ fractions :$$
$$\frac{1}{2};1\frac{1}{4};-\frac{1}{5}$$
$$Decimal\ fractions :$$
$$0,5;\ 1,25;\ -0,2;\ldots$$

What does Irrational mean?

$$Since\ \sqrt{1}\ =\ 1\ and\ \sqrt{4}\ =\ 2$$
$$Therefore\ \sqrt{3}\ has\ a\ value\ between\ 1\ and\ 2\ thus,\ \sqrt{3} = 1\ldots$$
$$and\ 3\ being\ closer\ to\ 4\ than\ 1\ i.e\ \sqrt{3} = 1,7$$



Types Of Numbers

as on calculator
$\sqrt{3}$ = 1,732050808

correct to 2 decimal digits
1,73

This number is indeed ***real***! However, we can only determine its approximate value. You'll see that the digits after the decimal point don't follow any pattern and continue indefinitely.

$$And\ also\ for\ ins\tan ce\ \frac{2}{11} = 18181818$$
$$It\ also\ goes\ on\ and\ on,\ but,$$
$$there\ is\ a\ pattern\ so\ it\ is\ an\ infinite,\ RECURRING\ decimal$$
$$compared\ to\ \sqrt{3}\ =\ 1,732050808\ is\ an\ infinite,\ NON-RECURRING\ decimal.$$

Irrational numbers are decimals that go on forever without repeating or forming any predictable pattern.

Therefore, $\sqrt{3}$
is IRRATIONAL.

Other examples of irrational numbers

$$\sqrt{15}\ ;\ \sqrt[3]{10}\ ;\ \pi(3,141592654)$$
$$\pi = \frac{\text{the circumference of } \odot}{\text{the diameter of the} \odot}$$

Also note that

$$\frac{22}{7} = 3,142857\ 142857\ is\ \ Infinite\ and\ Recurring$$
$$and\ \frac{22}{7}\ and\ 3,14\ are\ both\ RATIONAL\ numbers$$
$$which\ are\ very\ useful\ as\ approximate\ values\ for\ \pi.$$
$$However,\ \pi\ is\ IRRATIONAL!$$

Before you continue check it out 👇

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Converting a repeating decimal into a fraction: A step-by-step guide

Example:

$$0,\dot{3}\ i.e.\ 0,333\ldots.$$
$$Let\ x\ =\ 0,333\ldots.(1)$$
$$10x\ =\ 3,3333\ldots.(2)$$
$$9x\ =\ 3$$
$$x = \frac{3}{9} = \frac{1}{3}$$
$$0,\dot{3}\ = \frac{1}{3}$$

Now try:

$$Now\ try :$$
$$(1)\ 0,\dot{4}$$
$$(2)\ 0,\dot{7}$$
$$(3)\ 0,\dot{3}\dot{1}$$
$$(4)\ 0,\dot{1}\dot{8}$$
$$(5)\ 0,\dot{9}\dot{3}$$

Answers:

(1)

$0,\dot{4}$ = 0,444 ...
let x = 0,444... (1)
10x = 4,444... (1)
9x = 4
$x = \frac{4}{9}$

Conjecture:

$0,\dot{1} = \frac{1}{9}$

$0,\dot{2} = \frac{2}{9}$

$0,\dot{3} = \frac{3}{9}$

etc

(2)

$0,\dot{7} = \frac{7}{9}$

(3)

$0,\dot{3}\dot{1} = 0,313131...$
Let $x = 0,313131...(1)$
Let $100x = 31,313131...(2)$
$(2)-(1): 99x = 31$
$x = \frac{31}{99}$

(4)

$0,\dot{1}\dot{8} = \frac{18}{99}$

(5)

$0,\dot{9}\dot{3} = \frac{93}{99}$

The key to turning infinite decimals into fractions lies in their recurring nature—specifically, the existence of a repeating pattern.

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Scientific Notation

It's a common practice to express extremely large or small numbers by placing a single digit before the decimal point. This is a widely accepted standard.

$$e.g.\ 12\ 038\ 524\ =\ 1,203\ 852\ 4\ x\ 10^{7}$$
$$0,000\ 00715\ =\ 7,15\ x\ 10^{-6}$$

What is a Rational Number?

A rational number is a number that can be expressed as a ratio or quotient of two integers.

$\frac{an\ integer}{an\ integer}\ or\ \frac{a}{b}$

where $a\ \&\ b\ \in \mathbb{Z};\ b \neq 0$

Example exercises

Can these numbers be expressed as fractions? Are they rational?
(Attempt to work through these examples on your own first.)

1. 5
2. -2
3. 4,1
4. $2\frac{1}{3}$
5. 3,14
6. $0,\dot{7}$
7. $\sqrt{9}$
8. $-\sqrt[3]{8}$
9. $\sqrt{10}$
10. $\sqrt{1\frac{9}{16}}$
11. $\sqrt{-9}$
12. $\sqrt[3]{9}$
13. $\frac{0}{5}$
14. $\frac{5}{0}$

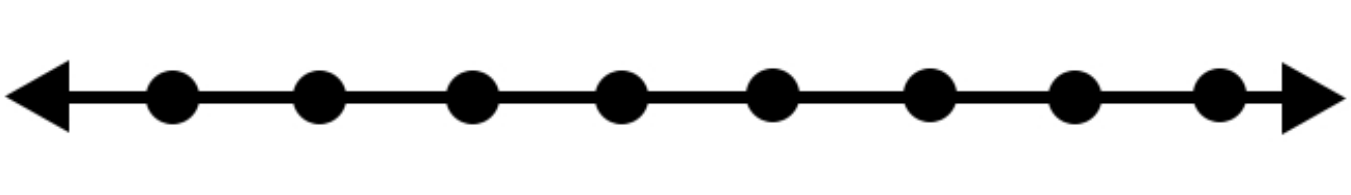
Answers

1. $5 = \frac{5}{1}$
2. $-2 = \frac{-2}{1}\quad = \frac{2}{-1}$
3. $4,1 = \frac{41}{10}$
4. $2\frac{1}{3} = \frac{7}{3}$
5. $3,14 = \frac{314}{100}$
6. $0,\dot{7} = \frac{7}{9}$
7. $\sqrt{9} = 3 = \frac{3}{1}$
8. $-\sqrt[3]{8} = -2 = \frac{-2}{1}$
9. $\sqrt{10}(=3,16\,227766...)$
10. $\sqrt{1\frac{9}{16}} = \sqrt{\frac{25}{16}} = \frac{5}{4} \neq 1\frac{3}{4}$
11. $\sqrt{-9}$ *is non – real x*
12. $\sqrt[3]{9}(=2,08008382...)$
13. $\frac{0}{5}$ *also* [= 0]
14. $\frac{5}{0}$ *is undefined x*

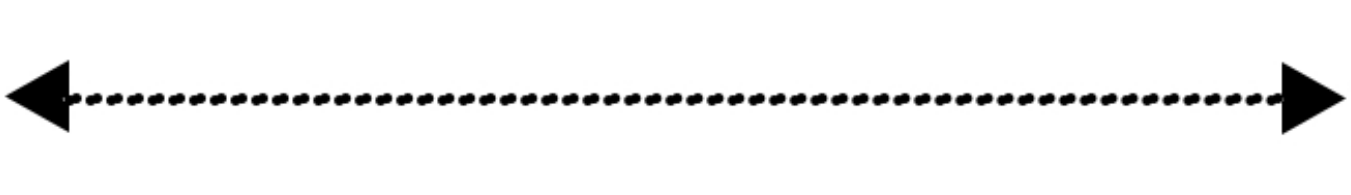
Based on the limited digits displayed on our calculator, no discernible pattern emerges; it appears to be infinite and non-repeating.

TYPES OF NUMBERS & THE NUMBER LINE

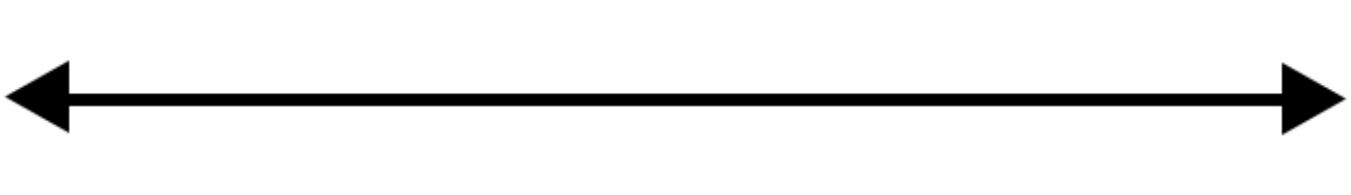
Imagine a line stretching infinitely in both directions, and now picture placing every whole number along this line.



Next, input all remaining rational numbers, such as fractions—both common and decimal forms. The spaces are reserved for irrational numbers.



Let's now introduce the irrational numbers:
With these, our number line becomes complete, representing the entire set of REAL numbers.



Is every number a real number?

Keeping in mind that Rational numbers + Irrational numbers = Real numbers

Is there a number that, when multiplied by itself, results in -16?
4^{2} = 16
and $(-4)^{2}\ =\ +16$ *also*

So therefore there's no number equal -16 when squared

Meaning $\sqrt{-16}$ *is not a real*
number – it is non – real.

And also Real numbers + Non-real numbers = Complex numbers

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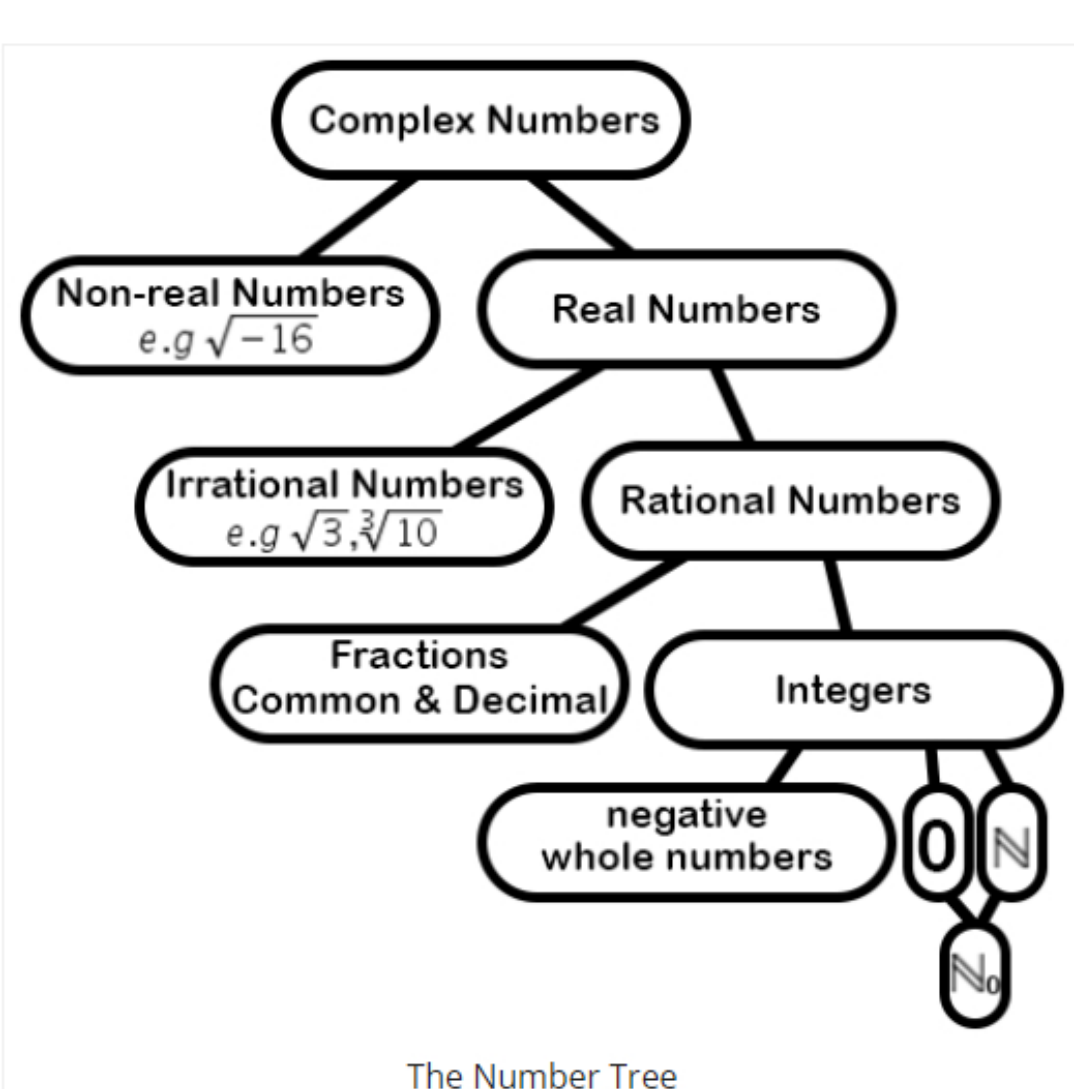
The Number Tree


Complex Numbers
Non-real Numbers e.g $\sqrt{-16}$
Real Numbers
Irrational Numbers e.g $\sqrt{3},\sqrt[3]{10}$
Rational Numbers
Fractions Common & Decimal
Integers
negative whole numbers
0
ℕ
ℕo

The Number Tree

No need to concern yourself with complex numbers right now—what's crucial is grasping the organization of the NUMBER SYSTEM.!

Lets also classify previous example exercise numbers

	Complex	Non-real	Real	Irrational	Rational	Integer	No	N
1	✓		✓		✓	✓	✓	✓
2	✓		✓		✓	✓		
3	✓		✓		✓			
4	✓		✓		✓			
5	✓		✓		✓			
6	✓		✓		✓			
7	✓		✓		✓	✓		
8	✓		✓		✓	✓		
9	✓		✓	✓				
10	✓		✓		✓			
11	✓	✓						
12	✓		✓	✓				
13	✓		✓		✓	✓	✓	
14		Division	by	zero	is	undefined		

Mixed Exercises

1.1 Convert the following to decimals:

1.1.1 $1\frac{1}{5}$

1.1.2 $4\frac{3}{8}$

1.1.3 $\frac{7}{11}$

1.2 Convert the following to common fractions

1.2.1 1,3

1.2.2 $0,\dot{6}$

1.2.3 $0,\dot{1}\dot{2}$

1.3 Rewrite the numbers in their expanded form.

i.e $1,\dot{2}\ =\ 1,222....$

1.3.1 $2,\dot{6}$

1.3.2 $0,\dot{5}\dot{1}$

1.3.3 $0,\dot{5}0\dot{1}$

1.3.4 $1,2\dot{3}$

1.4 Write these numbers in dot form:

1.4.1 0,111...
1.4.2 0,454545...
1.4.3 2,789789...
1.4.4 0,7212121...

2. Indicate whether each statement is accurate or not. If it is incorrect, provide the correct version.

2.1 Every irrational number belongs to the set of real numbers.
2.2 Every fraction is a rational number.
2.3 Not all integers are natural numbers.
2.4 When any number is divided by zero, the result is undefined.

Answers Without Explanations:

1.1.1 1,2

1.1.2 4,375

1.1.3 0,636363...

1.2.1

$$1\frac{3}{10}$$

1.2.2

$$\frac{2}{3}$$

1.2.3

$$\left(\frac{12}{99} =\right)\frac{4}{33}$$

1.3.1 2,666...

1.3.2 0,515151...

1.3.30,501 501 501...

1.3.41,2333...

1.4.1

$$0,\dot{1}$$

1.4.2

$$0,\dot{4}\dot{5}$$

1.4.3

$$2,\dot{7}8\dot{9}$$

1.4.4

$$0,7\dot{2}\dot{1}$$

2.1 True

2.2 True

2.3 False; All natural numbers are integers.

2.4 False; Division by zero is undefined

3.1

$$\sqrt{\frac{6}{2}}\,(=\sqrt{3})\ and\ \pi$$

3.2

$$\sqrt{-8}$$

3.3

$$\frac{5}{0}$$

3.4

$$-5,1\,;\sqrt[3]{-8}\,;\frac{-\sqrt{9}}{3}\,;\sqrt{\frac{0}{2}}\,;\frac{25}{20}\,;\sqrt{\frac{6}{2}}\,;\pi\,;4,\dot{1}$$

$$-5,1\,;-2\,;-1\,;0\,;1\frac{1}{4}\,;\ \sqrt{3}\,;3,14...\,;4,1111...$$

4.1

$$\sqrt{80}\ is\ between\ \sqrt{64}\ \&\ \sqrt{81}$$

$$i.e\ \sqrt{64} < \sqrt{80} < \sqrt{81}$$

$$\sqrt{80}\ \ lies\ between\ 8\ \&\ 9$$

$$i.e\ 8 < \sqrt{80} < 9$$

4.2

$$\sqrt{80} = 8,9$$

See Explanations For Answers