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Mathematics, Grade 9, Different Types of Numbers

The natural numbers

- The numbers that we use to count are called **natural numbers**:
  1 2 3 4 5 6 7 8 9 10 11 12 13 14

Natural numbers have the following properties:

- When you add two or more natural numbers, you get a natural number again.
- When you multiply two or more natural numbers, you get a natural number again.
- However, when a natural number is *subtracted* from another natural number, the answer is not always a natural number again. For example, there is no natural number that provides the answer to 5 – 20.
- Similarly, when a natural number is *divided* by another natural number, the answer is not always a natural number again. For example, there is no natural number that provides the answer to 10 ÷ 3.
- When subtraction or division is done with natural numbers, the answers are not always natural numbers.

The whole numbers

- Although we do not use 0 for counting, we need it to write numbers. Without 0, we would need a special symbol for 10, all multiples of 10 and some other numbers.
- For example, all the numbers that belong in the yellow cells below would need a special symbol.
- The natural numbers combined with 0 is called the system of **whole numbers**.

When working with natural numbers

- If you are working with natural numbers and you add two numbers, the answer will always be different from any of the two numbers added.
- For example: 21 + 25 = 46 and 24 + 1 = 25.
- If you are working with whole numbers, in other words including 0, this is not the case.
- When 0 is added to a number the answer is just the number you start with: 24 + 0 = 24.

Identity element

- For this reason, 0 is called the **identity element** for addition. In the set of natural numbers there is no identity element for addition.

The integers

- In the set of whole numbers, no answer is available when you subtract a number from a number smaller than itself.
- For example, there is no whole number that is the answer for 5 – 8. But there is an answer to this subtraction in the system of integers.
- For example: 5 – 8 = −3. The number –3 is read as “negative 3” or “minus 3”.

Whole numbers start with 0 and extend in one direction:

0 1 2 3 4 5 6 → → → ....

← ← ← −5 −4 −3 −2 −1 0 1 2 3 4 5 6 → → → .....

Whole numbers and integers

- **All whole numbers** are also **integers**.
- The set of whole numbers forms part of the set of integers.
- For each whole number, there is a negative number that corresponds with it.
- The negative number −5 corresponds to the whole number 5 and the negative number −120 corresponds to the whole number 120.

Within the set of numbers

- Within the set of integers, the sum of two numbers can be 0. For example 20 + (−20) = 0 and 135 + (−135) = 0.
- 20 and −20 are called **additive inverses** of each other.

Systems of integers

- The system of integers does not provide an answer for all possible division questions.
- For example, as we see above, the answer for 12 ÷ 5 is not an integer.
- To have answers for all possible division questions, we have to extend the number system to include fractions and negative fractions, in other words, numbers of the form integer/integer.
- This system of numbers is called **rational numbers**. We can represent rational numbers as common fractions or as decimal numbers.

Irrational numbers

- Rational numbers do not provide for all situations that may occur in Mathematics.
- For example, there is no rational number which will produce the answer 2 when it is multiplied by itself.
- (number) × (same number) = 2

- $2 \times 2 = 4$ and $1 \times 1 = 1$, so clearly, this number must be between 1 and 2.

No fraction answer

- But there is no number which can be expressed as a fraction, in either the common fraction or the decimal notation, which will solve this problem.
- Numbers like these are called **irrational numbers**.
- Here are some more examples of irrational numbers: 5 10 3 7 **π**

Estimation, rounding of and compensating

- To estimate, when working with numbers, means to try to get close to an answer without actually doing the calculations.
- However, you can do other, simpler calculations to estimate.
- When the goal is not to get an accurate answer, numbers may be rounded off.
- For example, the cost of 51 chickens at R38 each may be **approximated** by calculating 50×40.
- This is clearly much easier than calculating $51 \times$ R38.