**REAL NUMBERS**

**Basic key concepts:**

* The counting numbers are called as Natural numbers.
* The set of Natural numbers is represented by ‘N’.
* N = {1,2,3,4,……}
* Natural numbers together with ‘0’ are called as whole numbers.
* The set of whole numbers is represented by ‘w’.
* W = {0,1,2,3,4, …….}
* The whole numbers together with negative numbers are called as Integers.
* The set of integers is represented by ‘Z’.
* Z = {…..,-3,-2,-1,0,1,2,3,4, …… }
* The numbers which are having only two factors 1 and itself are called prime numbers
* The number which have more than two factors is called co.
* The numbers having no common factors except 1 are called as ‘Co-prime numbers’ or ‘Relative prime numbers’ .

Ex: (9,10), (15,16),(21,44),……

* All prime numbers are co-prime numbers but convers is not true.
* Any two consecutive numbers are co-primes.
* Decimal numbers are two types. They are

1) terminating decimal

2) non terminating decimal

* If we can count the number of digits in the decimal part then the decimal is “Terminating decimal”.

Ex: 23.45907

* If we can’t count the number of digits in the decimal part then the decimal is called as “Non terminating decimal”.
* The nonterminating decimals are two types. They are

1) non terminating repeating decimal

Ex: 34.5676767…….

2) non terminating non repeating decimal.

Ex: 34.5674583982961……….

* Division algorithm is

Dividend = Divisor × quotient + remainder.

**Euclid’s division lemma**

* Given two positive integers a and b, there exists unique pair of integers q and r satisfying a = bq + r, 0 ≤ r < b. This is called Euclid’s division lemma.
* By using Euclid’s division lemma, we can find the H.C.F of two numbers.

**The fundamental theorem of Arithmetic**

* Every composite number can be expressed as a product of primes and this factorization is unique, apart from the order in which the prime factors occur.

Ex: 66 = 2 × 3 × 11

24 = 2 × 2 × 2 × 3

* In general, given a composite number ‘x’, we factorize it as

X = p1.p2.p3………pn where p1,p2,p3,………,pn are primes and written in ascending order. If we combine the equal primes, we will get power of primes. Once we have decided that the order will be ascending then the way the number is factorized, is unique.

Ex: 8232 = 2 × 2 × 2 × 3 × 7 × 7 × 7

= 23 × 3 × 73

* If a number was written as the product of prime factors that means the given number is a *composite number*.
* If 2 is a prime factor of a number then the given number is an *even number*.
* If 5 is a prime factor of a number then the number ends with 5.
* If 2 and 5 are prime factors of a number then the number ends with ‘0’.

**H.C.F and L.C.M**

* We can find H.C.F and L.C.M of two positive numbers using fundamental theorem of Arithmetic. This method is called “*prime factorization method*”.
* The H.C.F of two numbers is product of the smallest powers of **each common prime factors** of the numbers.
* The L.C.M of two numbers is product of the greatest power of **each prime factors** of the numbers.

Ex: if a = 22 × 3 × 52 and b= 2 × 32

H.C.F (a, b) = 2 × 3 = 6

L.C.M (a, b) = 22 × 32 × 52

= 4 × 9 × 25

= 900

* If H.C.F and L.C.M of the numbers ‘a’ and ‘b’ are H and L then the relation between them is

**a × b = H × L**

* If ‘a’ and ‘b’ are co-primes then

L.C.M (a, b) = a × b

H.C.F (a, b) = 1

* If ‘a’ is a factor of ‘b’ then

L.C.M (a, b) = b

H.C.F (a, b) = a

* If ‘a’ is a multiple of ‘b’ then

L.C.M (a, b) = a

H.C.F (a, b) = b

* If r =0 in a = bq + r then

1) H.C.F (a, b) = b

2) ‘b’ is a factor of ‘a’

3) ‘q’ is also a factor of ‘a’

**RATIONAL NUMBERS**

* The numbers which can be written in p/q form where p and q are integers and q ≠ 0 are called “Rational numbers”.
* Rational numbers are also called as “Quotient numbers”.
* The set of rational numbers is represented by ‘Q’.
* The rational number between ‘a’ and ‘b’ is .
* Every terminating decimal and nonterminating repeating decimal can be express in p/q form. So, they are rational numbers.

Ex: 2.157 =

1. 3333….. =

* The rational number p/q has a *terminating decimal* expansion if the prime factorization of the denominator ‘q’ is in the form 2m × 5n where m and n are nonnegative integers.
* The rational number p/q has a *nonterminating repeating decimal* expansion if the denominator ‘q’ has any other prime factor other than 2 or 5.

Ex: ---- terminating decimal

---- nonterminating repeating decimal.

* The square root of a perfect square number is also a rational number.

Ex: √4, √49, √169 …..

* If ‘a’ is a positive real number and can’t written nth power of any rational number then is also a rational number.

Ex: , …..

* Rational numbers satisfy closure property under the four fundamental operations. Mean sum, difference, product and quotient of two rational numbers is a rational number.
* Rational numbers satisfy densitive property. Means we can insert infinitely many numbers between any two rational numbers.

**Irrational numbers**

* The numbers which can’t be written in p/q form where p and q are integers and q ≠ 0 are called as “Irrational numbers”.
* The set of irrational numbers is represented by Q’ or S.
* The nonterminating non repeating decimals are irrational numbers.

Ex: 3.485297……….

* The irrational number between ‘a’ and ‘b’ is where ‘ab’ is not a perfect square number.
* We can insert infinitely many irrational numbers between two numbers.
* π is an irrational number.
* If ‘p’ is not a perfect square number then √p is an irrational number.

Ex: √2, √3, √5, ……

* If ‘a’ is a positive rational number and can’t written nth power of any other rational number then is an irrational number.

Ex; , ….

* If √a is an irrational number then -√a and also irrational numbers.
* If ‘p’ is a prime number then √p is an irrational number.

Ex: √11, √41,……

* The sum of two irrational numbers need not be irrational.

Ex: 1) √2 + √3 -- irrational number.

2) √2 + (-√2) = 0 -- rational number.

* The difference of two irrational numbers need not be irrational.

Ex: 1) √2 - √3 irrational number.

2) √2 - √2 rational number.

* The product of two irrational numbers need not be irrational.

Ex: 1) √2 × √3 = √6 irrational number

2) √2 × √8 = √16 rational number.

* The quotient of two irrational numbers need not be irrational.

Ex:1) = √3 irrational number

2) = √4 rational number.,

* If ‘p’ and ‘q’ are prime numbers then √p + √q is an irrational number.

**REAL NUMBERS**

* The rational numbers together with irrational numbers are called “*Real numbers*”.
* The set of real numbers is represented by ‘R’.
* The sum or difference of a rational number and an irrational number is an irrational.

Ex: √3 + 8, √5 – 3 are irrational.

* The product or quotient of a rational number and an irrational number is an irrational.

Ex: 2√5, are irrational.

* If ‘p’ be a prime number and ‘p’ divides a2 then ‘p’ divides ‘a’.
* The sum, difference, product and quotient of two real numbers is also real number.

**LOGARITHMS**

* If ax = N then x = log a N where a>0, a≠1, N>0 and a,N € R.
* Logarithms are defined only for positive real numbers.

log 0 is not define

log (-4) is not define.

* Logarithm of a number to the base 10 is called *common logarithm.*
* Father of logarithms is ***JOHN NAPIER***
* Logarithm of a number to different bases is different.

Ex: log 2 64 = 6

log 4 64 = 3

log 8 64 = 2

* Logarithm of a number to the same base is 1.

Ex: log 5 5 = 1

log a a = 1

* Logarithm of 1 to any base is 0.

Ex: log 5 1 = 0

log a 1 = 0

* Laws of logarithms

1. log a xy = log a x + log a y
2. log a = log a x – log a y
3. log a xn = n.log a x
4. log an x = log a x
5. alog a x = x

* log 10 = 1
* log 100 = 2.