**Number Systems**

1. Numbers 1, 2, 3…….**, which are used for counting are called **natural numbers**. The collection of natural numbers is denoted by **N.** Therefore, N = {1, 2, 3, 4, 5, }.
2. When 0 is included with the natural numbers, then the new collection of numbers called is called **whole number**. The collection of whole numbers is denoted by **W**. Therefore, W = {0, 1, 2, 3, 4, 5, }.
3. The negative of natural numbers, 0 and the natural number together constitutes **integers**. The collection of integers is denoted by **I**. Therefore, I = {…, -3, -2, -1, 0, 1, 2, 3, …}.
4. The numbers which can be represented in the form of *p*/*q*, where *q*  0 and *p* and *q* are integers are

called **rational numbers**. Rational numbers are denoted by ***Q*.** If *p* and *q* are co-prime then the rational number is in its simplest form.

1. All-natural numbers, whole numbers and integer are rational number.
2. **Equivalent rational numbers** (or fractions) have same (equal) values when written in the simplest form.

# Rational number between two numbers *x* and *y* =

*x*  *y* **.**

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1. There are infinitely many rational numbers between any two given rational numbers.
2. The numbers which are not of the form of *p*/ *q*, where *q*  0

**irrational numbers**. For example: 2, 7,**, etc.

and *p* and *q* are integers are called

1. Rational and irrational numbers together constitute are called **real numbers**. The collection of real numbers is denoted by ***R*.**

# Irrational number between two numbers x and y

 *xy* , if

 *xy* , if





 *xy* , if



*x* and *y* both are irrational numbers

*x* is rational number and *y* is irrational number

*x*  *y* is not a perfect square and *x*, *y* both are rational numbers

1. **Terminating fractions** are the fractions which leaves remainder 0 on division.
2. **Recurring fractions** are the fractions which never leave a remainder 0 on division.
3. The decimal expansion of **rational** number is **either terminating or non-terminating recurring**. Also, a number whose decimal expansion is terminating or non-terminating recurring is rational.
4. The decimal expansion of an **irrational** number is **non-terminating non-recurring**. Also, a number whose decimal expansion is non-terminating non-recurring is irrational.
5. Every real number is represented by a unique point on the number line. Also, every point on the number line represents a unique real number.
6. The process of visualization of numbers on the number line through a magnifying glass is known as the process of **successive magnification.** This technique is used to represent a real number with non-terminating recurring decimal expansion.
7. Irrational numbers like 2, 3 ,

by using Pythagoras theorem.

1. If a > 0 is a real number, then

… *n* , for any positive integer *n* can be represented on number line

= b means b2 = a and b > 0.



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*a*

1. For any positive real number x, we have:

 *x*  12  *x*  12

*x*   2    2 

   

1. For every positive real number x, following steps:



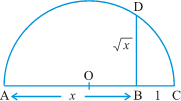
*x*

can be represented by a point on the number line using the

* 1. Obtain the positive real number, say x.
  2. Draw a line and mark a point A on it.
  3. Mark a point B on the line such that AB = x units.
  4. From B, mark a distance of 1 unit on extended AB and name the new point as C.
  5. Find the mid-point of AC and name that point as O.
  6. Draw a semi-circle with centre O and radius OC.
  7. Draw a line perpendicular to AC passing through B and intersecting the semi-circle at D.
  8. Length BD is equal to .



*x*



# Properties of irrational numbers:

* 1. The sum, difference, product and quotient of two irrational numbers need not always be an irrational number.
  2. Negative of an irrational number is an irrational number.
  3. Sum of a rational and an irrational number is irrational.
  4. Product and quotient of a non-zero rational and irrational number is always irrational.

1. Let a > 0 be a real number and n be a positive integer. Then The symbol '  ' is called the **radical sign**.



*n a*

= b, if bn = a and b > 0.

1. For real numbers a > 0 and b > 0:
   1.  *a* 



*ab*



*b*

*a*

*b*



*a*

*b*

* 1. 
  2. (



*a*

 *b* )(

* *b* )  *a*  *b*
  1. ( *a* 



*a*

*b* )(

 *d* ) 

*ac*   

* 1. (*a* 



*c*



*bc*

*ad*

*bd*

*b* )(*a* 

*b* )  *a*2  *b*

vi. (  *b* )2  *a*  *b*  2



*a*



*ab*

1. The process of removing the radical sign from the denominator of an expression to convert it to an equivalent expression whose denominator is a rational number is called **rationalising the denominator**.
2. The multiplicating factor used for rationalising the denominator is called the **rationalising factor**.
3. If a and b are positive real numbers, then
   1. Rationalising factor of 1 is



*a*



*a*

* 1. Rationalising factor of
  2. Rationalising factor of

1 is *a*

1 is



*a*  *b*



*b*



*a*  *b*



*a b*

1. The **exponent** is the number of times the base is multiplied by itself.
2. In the exponential representation am , a is called the **base** and m is called the **exponent or power**.
3. **Laws of exponents**: If a, b are positive real numbers and m, n are rational numbers, then

i.

ii.

*am*  *an*  *am**n am*  *an*  *am**n*

iii. *am* *n*  *amn*

iv.

*a* *n*  1

*an*

v. *ab**n*  *anbn*

vi.

 *a* *n*

 

*b*

 

 *an*

*bn*

1. *am* / *n*  *am* 1/ *n*  *a*1/ *n* *m* or *am* / *n*   *n a* *m*

*n am*

1. *a*0  1