

(1)

MATHEMATICS

COURSE STRUCTURE CLASS-IX

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1. NUMBER SYSTEM

* Natural numbers: The counting numbers 1, 2, 3, 4, ... are known as natural numbers

Remarks (i) 1 is the smallest natural number.

(ii) There is no largest natural number.

(iii) If we go on adding 1 to each natural number, we get next natural number

* WHOLE NUMBERS: The number '0' together with the natural numbers 1, 2, 3, 4, ... are known as whole numbers

REMARKS (i) '0' is the smallest whole number

(ii) There is no largest whole number

(iii) Every natural number is a whole number but not the converse. i.e. Every whole number is not a natural number ex-'0'

* INTEGERS: All natural numbers 0 and negative of natural numbers are called integers

REMARKS (i) There is no smallest or greatest integer

(ii) Every whole number is an integer

* RATIONAL NUMBERS : A number of the form $\frac{p}{q}$ where p and q are integers and $q \neq 0$ is known as Rational number

$$\text{Ex } 2 = \frac{2}{1} \quad 0 = \frac{0}{1} \quad -3 = \frac{-3}{1}$$

* Equivalent Rational numbers

We know that

$$\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \dots = \frac{121}{242} = \dots$$

These are known as equivalent rational numbers

* SIMPLEST FORM OF A RATIONAL NUMBER

A rational number r of the form $\frac{p}{q}$ where p and q are integers and $q \neq 0$ is said to be in the standard form if p and q have no common factor other than 1 i.e. p and q are co-primes

Simplest form of $\frac{5}{15}$, $\frac{10}{30}$, $\frac{20}{60}$ etc is $\frac{1}{3}$

* INSERTING RATIONAL NUMBERS BETWEEN TWO GIVEN NUMBERS

I Let a and b be two rational numbers such that $a < b$ then $\frac{a+b}{2}$ is a rational number lying between a and b

Further a rational number between $\frac{a+b}{2}$ and c

$$= \frac{\frac{a+b}{2} + c}{2} \quad \text{and so on}$$

ALTERNATIVE METHOD : Consider two rational numbers

a and b and $a < b$

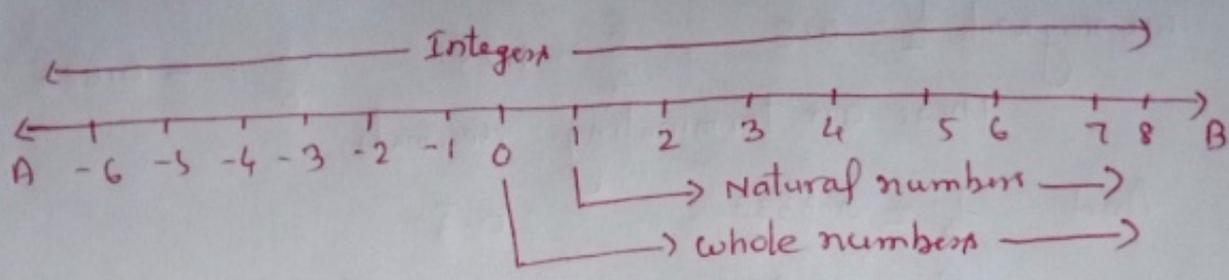
Suppose we want to put n rational numbers between a and

$$d = \frac{b-a}{n+1}$$

Then n rational numbers between a and b are

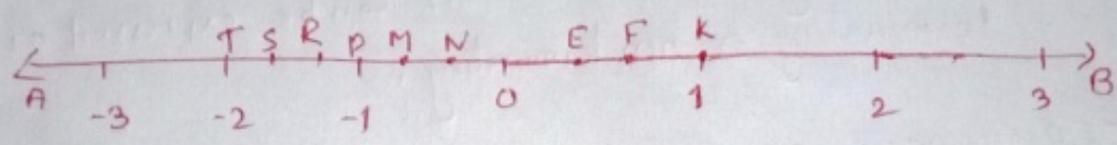
$$(a+d), (a+2d), (a+3d) \dots (a+nd)$$

* Representation of Natural numbers, whole numbers, integers and rational numbers on a number line



* Rational numbers can be represented as follows

Let we have to represent $\frac{1}{3}, \frac{2}{3}, -\frac{5}{3}$ on a number line
Draw a line AB



Step 1: Take a point O representing 0 (zero)

Let $OK = 1$ unit. Divide OK into 3 equal parts such that $OE = EF = FK$ i.e. $OE = \frac{1}{3}$ unit

Step 2: Divide $ON = MN = MP$, $ON = -\frac{1}{3}$, $OM = -\frac{2}{3}$
point M and N will represent $-\frac{2}{3}$ and $-\frac{1}{3}$

Step 3 $-\frac{5}{3} = -(1 + \frac{2}{3})$

Divide $PR = RS = ST$
point R, S will represent $-(1 + \frac{1}{3}) = -\frac{4}{3}$
and $-(1 + \frac{2}{3}) = -\frac{5}{3}$

Questions given to solve

1. Represent each of the following rational numbers on the number line :- $\frac{1}{5}, \frac{3}{5}, -\frac{3}{5}, -\frac{8}{5}$

2. Find 5 rational numbers between

(i) $-\frac{3}{4}$ and $-\frac{2}{5}$ (ii) -2 and $-\frac{3}{2}$

(iii) $-\frac{3}{4}$ and $-\frac{1}{2}$ (iv) $\frac{3}{5}$ and $\frac{4}{5}$

(4)

* DECIMAL REPRESENTATION OF RATIONAL NUMBERS

Let us observe

we may write $\frac{1}{2} = 0.5$, $\frac{5}{4} = 1.25$ $-\frac{5}{8} = -0.625$

These are terminating decimals

And $\frac{1}{3} = 0.3333 \dots = 0.\bar{3}$

$\frac{4}{11} = 0.363636 \dots = 0.\bar{36}$

$\frac{1}{3}$, $\frac{4}{11}$ are nonterminating and repeating (recurring) decimals

Thus every rational number can be expressed as a decimal terminating or nonterminating.

TERMINATING DECIMALS: If a rational number $\frac{p}{q}$ terminates (comes to end) then the decimal so obtained is said to be terminating decimal. EX $\frac{7}{2} = 3.5$, $\frac{15}{4} = 3.75$

AN IMPORTANT NOTE: A rational number $\frac{p}{q}$ is a terminating decimal only when prime factors of q are 2 and/or 5
ie $q = 2^m \times 5^n$

$\frac{7}{2}$, $\frac{9}{4}$, $\frac{15}{8}$ are terminating decimals

$\frac{7}{3}$, $\frac{9}{7}$, $\frac{15}{6}$ are nonterminating decimals

RECURRING (REPEATING) DECIMALS: - A decimal in which a digit or a set of finite number of digits repeats periodically is called a recurring or repeating decimal. In a recurring decimal a bar is placed over the first block of repeating digits and other repeating blocks are omitted.

EX (i) $\frac{5}{3} = 1.6666 \dots = 1.\bar{6}$

(ii) $\frac{7}{11} = 0.636363 \dots = 0.\bar{63}$

(iii) $\frac{1}{999} = 0.001001001 \dots = 0.\overline{001}$

(iv) $\frac{111}{900} = 0.12333 \dots = 0.12\bar{3}$

* IRRATIONAL NUMBERS: The number which can neither be expressed as a terminating decimal nor as a recurring decimal is called an irrational number

OR
Non terminating non recurring decimals are called an irrational number

ex, $\sqrt{2}$, $\sqrt{3}$
 $0.010010001 \dots$

* π is approximately equal to $\frac{22}{7}$
So π is irrational and $\frac{22}{7}$ is rational

* There are infinitely many irrational between two irrationals

PROPERTIES of IRRATIONAL NUMBERS:

- (I) Negative of an irrational number is an irrational
- (II) The sum, difference, product and quotient of a rational and irrational number are irrational numbers
- (III) The sum difference, product and quotient of two irrational numbers are not necessarily an irrational number
- (IV) Irrational numbers satisfy the commutative, associative and distributive laws for addition and multiplication

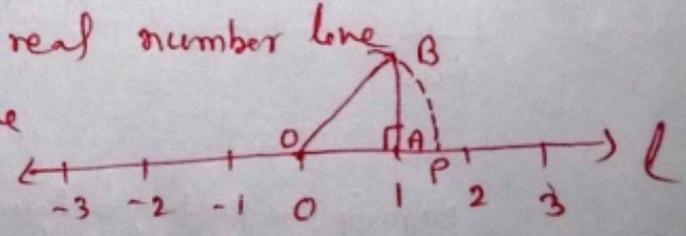
REAL NUMBER Rational numbers together with irrational numbers are said to be real numbers.

PROBLEM BASED ON REPRESENTING IRRATIONALS ON THE REAL NUMBER LINE

1. Represent $\sqrt{2}$ on the real number line

Soln Let l be real number line

and O be a point represents 0



take $OA = 1$ unit

Draw $AB \perp OA$ such that $AB = 1$ unit join OB

clearly $OB = \sqrt{OA^2 + AB^2} = \sqrt{1^2 + 1^2} = \sqrt{2}$ [By pythagoras theorem]

with O as centre and OB as radius draw an arc meeting line l at P then $OP = OB = \sqrt{2}$ units

Thus point P represents $\sqrt{2}$ on the real number line.

* Questions given to solve

(1) Represent $\sqrt{3}$, $\sqrt{5}$, $\sqrt{17}$ on the real number line.

Represent $\sqrt{3.28}$ geometrically on the number line

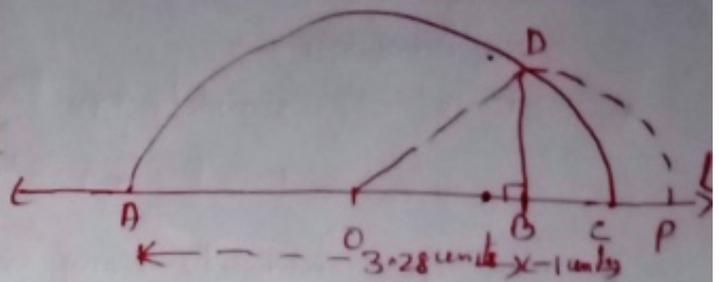
Soln Let l be the number line

Draw a line segment $AB = 3.28$ units
and $BC = 1$ unit find the mid point of AC

Draw a semi circle with centre O
and radius OA or OC

Draw $BD \perp AC$ intersecting the semi circle at D then $BD = \sqrt{3.28}$ units

Now with centre B and radius BD draw an arc intersecting the number line at P
Hence $BD = BP = \sqrt{3.28}$

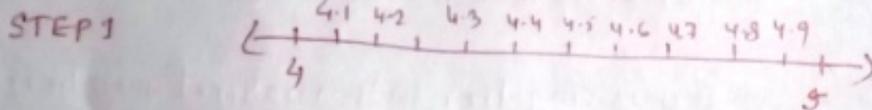


VISUALISE $4.\overline{26}$ on the number line upto 4 decimal places

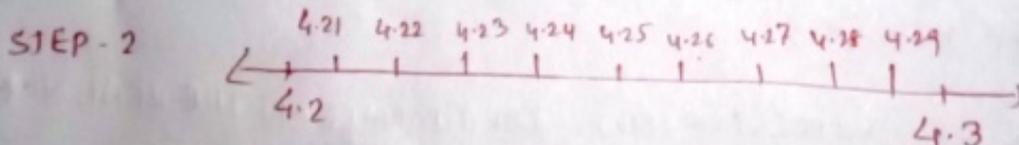
Soln: we may write $4.\overline{26} = 4.2626 \dots$

clearly $4.2626 \dots$ lies between 4.2 and 4.3

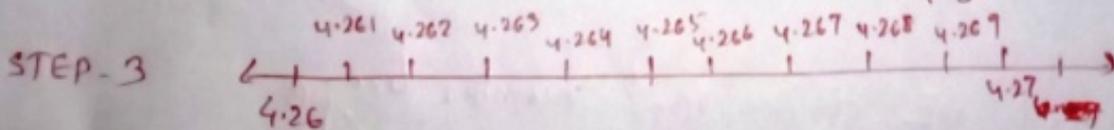
Let l be the number line



on the number line we take 4.2 and 4.3

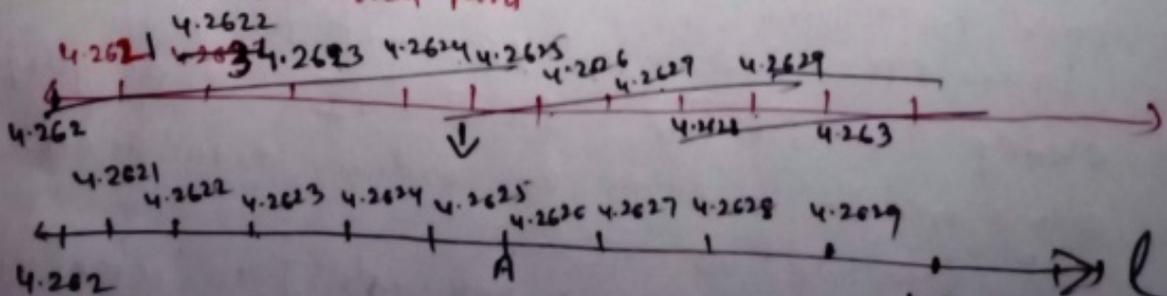


Magnify the position between 4.2 and 4.3



Magnify the position between 4.26 and 4.27

STEP-4 Magnify the position between 4.262 and 4.263 and divide it into 10 equal parts



Point A will represent 4.2626 on the number line