

LESSON PLAN (CONSOLIDATED)

SUBJECT: MATHEMATICS

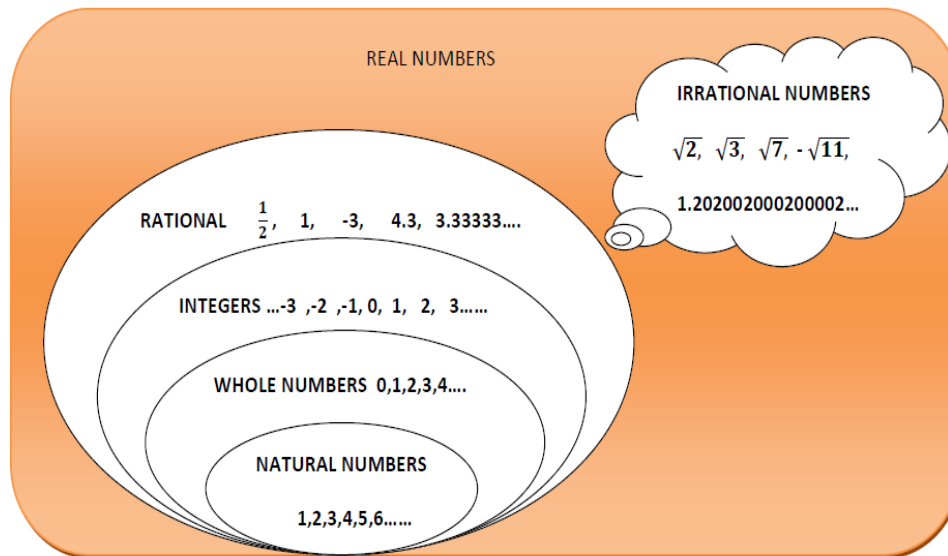
GRADE: IX

Chapter Number and Title of Chapter	1.NUMBER SYSTEM
No. of Periods	Total: 4 periods (approx. 40 min each)
Learning Objectives	This Chapter will enable the learner to •describe the different types of numbers, •identify the rational and irrational numbers amongst the real numbers, •represent the real numbers on number line, •describe the decimal representation of rational and irrational numbers, •state and apply the laws of radicals, •carry out fundamental operations like addition, subtraction, multiplication and division on radicals, •solve problems involving the rationalization of real numbers. •state and apply the laws of exponents for real numbers.
Teaching Aids / Resources	1) Videos (Teaching and Explanation) 2) PPT related to the number system and its concepts. 3) Concept Map of concepts used in this chapter 4) Additional Resources : NCERT BOOK AND NCERT EXAMPLER
Previous Knowledge/ Curiosity Questions	This lesson requires 1.Basic knowledge of different numbers like •How can we count the different objects?  •Define counting numbers? •Which numbers help us to measure the temperature below zero degree? 2. Knowledge of how to locate a point on the number line

Announcement of topic	Now today topic is NUMBER SYSTEM.
Teaching Methodology/ Strategy	Transaction would proceed in the following manner- Suggestive Methodologies: Brain Storming / Curiosity Questioning: The class would start with a discussion on what the students have already learnt in the previous classes about rational numbers and hence what is it that they would learn now. They would also be told the significance of the topic that they would be studying. Active learning-Students will try to understand the concept of number system along with some example. Group learning-students will give the real life examples of different types of number where we can use in daily life after discussing with peer group. Questioning- To address the diverse nature of the classroom HOTS QUESTIONS will be given to the gifted students. Question/answer technique will be used for recapitulation and assessment. Guided practice followed by Independent Practice- NCERT questions to be discussed in the classroom.
Content Obligatory Vocabulary (Keywords)	Number system, Natural numbers, Whole numbers, Integers, Rational, Irrational numbers and Real numbers, Terminating decimal expansions , repeating decimal expansions and non – terminating non repeating, Successive magnification and radicals and rationalization,

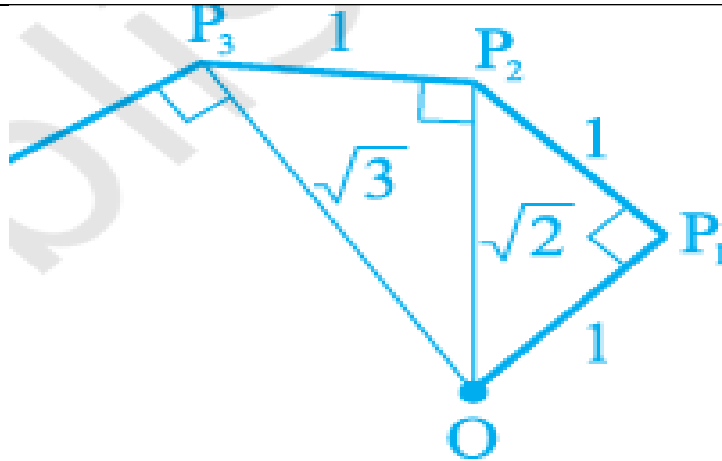
**Learning
Concepts/
Teaching Points**

- Introduce the number system by discussing the following classification: The first type of numbers are the counting numbers, also known as natural numbers, discovered when the need of counting arises. The natural numbers are as follows: 1, 2, 3, 4, 5, 6, ... The next type are the whole numbers, which are the natural numbers together with zero. Whole numbers are: 0, 1, 2, 3, 4, 5, 6, Whole numbers were discovered when we started with the subtraction of equal natural numbers. Then comes the integers, which includes the whole numbers, and the negatives of the natural numbers. Integers are: ... , -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6,... The next type is the rational numbers, which are ratios (divisions) of integers. In other words, a rational number is formed by dividing one integer by another integer. Rational numbers can be written as terminating (ending) or repeating decimals (such as 0.5, 0.76, or 0.333333...). On the other hand, all those numbers which are non-repeating, non-terminating decimals are not rational, so they are known as the "irrational numbers".
- Discuss the number system interactively using the model of number line.
- The rational and irrationals are totally different set of number and there is no overlap so clearly distinguish between two. Discuss examples on the identification of rational and irrational numbers.
- Use the following diagram to define the set of real numbers R and stress that each type of new numbers consists of the previous numbers within it



- Stress on the point that every real number is represented by a unique point on the number line and vice versa. For this reason we call the number line, the real number line.
- Representation of irrational numbers like etc. on the number line using Pythagoras theorem needs special attention.
- Encourage the students to perform the class room activity to create a 'square root spiral' to reinforce the concept of the representation of irrational numbers on the number line.
- Discuss with several examples simplest form of rational numbers as number of the form p/q (q not equal to 0), where p and q are co-prime integers.
- Discuss that every rational number can be expressed in decimal form. The decimal representation of rational number is either terminating or non-terminating repeating. Encourage students to analyse and conclude the condition for a rational number to terminate.
- Discuss the following useful short cut to convert a recurring decimal numbers to the form

Hard Spots/ Focus Spots	Basic number system and its meaning. Why: Students struggle in comprehending the concept of real numbers and their parts as they get confused among the different properties of the whole numbers, integers, irrational numbers and natural numbers. RESULT: Students will face difficulty in differentiating rational, irrational numbers, integers and natural numbers
Experiential Content	<u>CONSTRUCTING THE “SQUARE ROOT SPIRAL”</u> Objective: To create a square root spiral . Pre-requisite Knowledge: 1) Knowledge of drawing a perpendicular to a given line through a point on it. 2) Knowledge of applying Pythagoras Theorem. Materials Required: 1) Rectangular sheet of paper 2) Ruler and a pencil Procedure:



- Take a large sheet of paper and construct the ‘square root spiral’ in the following fashion.
- Start with a point O and draw a line segment OP₁ of unit length.
- Draw a line segment P₁P₂ perpendicular to OP₁ of unit length
- Now draw a line segment P₂P₃ perpendicular to OP₂.
- Then draw a line segment P₃P₄ perpendicular to OP₃. Continuing in this manner, you can get the line segment P_n–1P_n by drawing a line segment of unit length perpendicular to OP_n–1.
- In this manner, you will have created the points P₂, P₃,..., P_n,... , and joined them to create a beautiful spiral depicting , $\sqrt{2}$, $\sqrt{3}$, $\sqrt{4}$, $\sqrt{5}$..

Verification:

Applying Pythagoras theorem,
calculate

$$OP_1 = \sqrt{1^2 + 1^2} = \sqrt{2}$$

$$\text{SIMILARLY, } OP_3 = \sqrt{3}$$

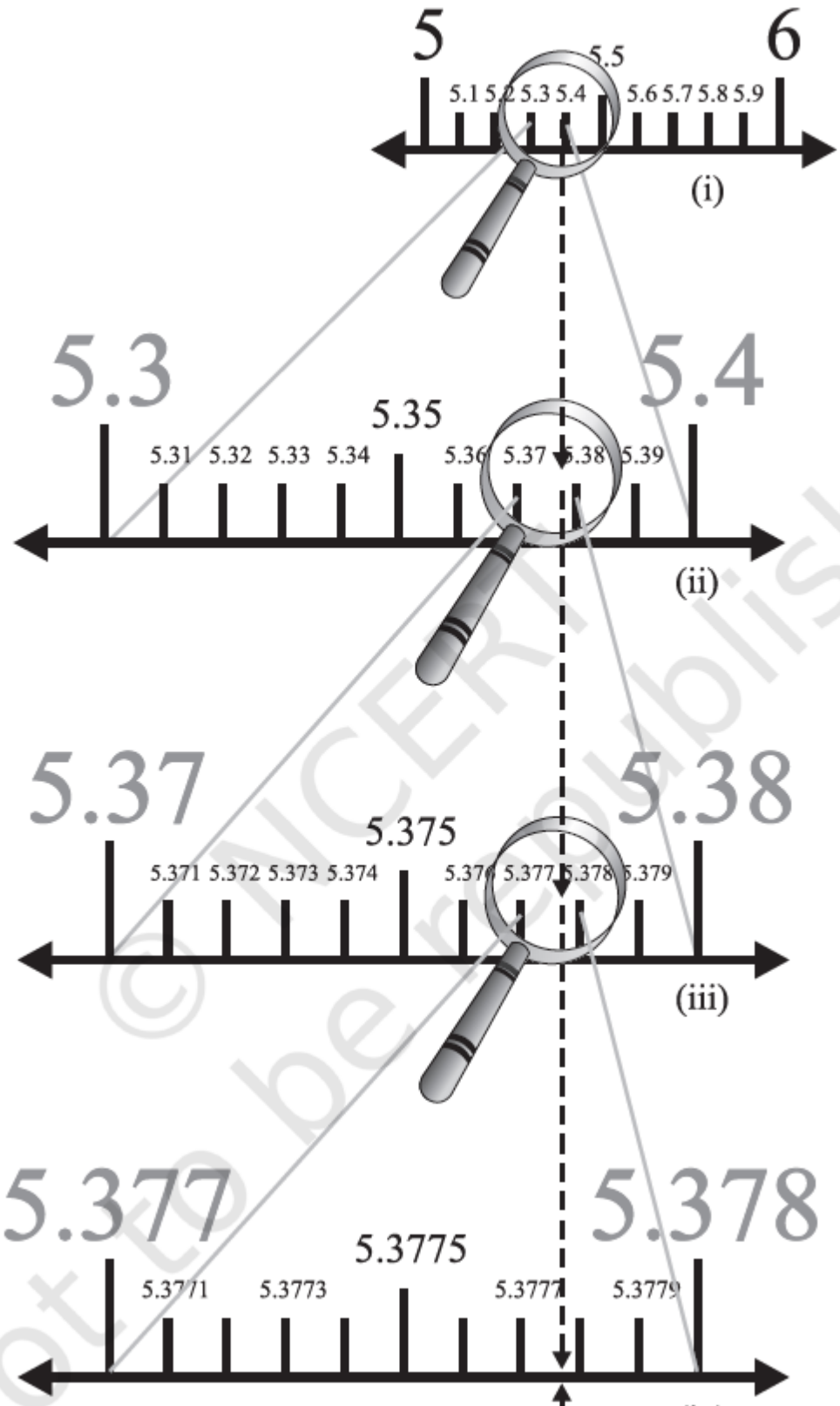
Observation:

The shape obtained is called a square root spiral.

**Subject
Enrichment
Activities for
Internal
Assessment**

Visualize the representation of $5.377777\ldots$ on the number line upto 5 decimal places .

By process of successive magnification



Recapitulation

QUESTIONS:

- 1) Is π , an irrational number? Why?
- 2) Is zero a rational Number?
- 3) $1/0$ is not defined. (true and false).

Multiple Choice Questions

Question 1.

Evaluate $\sqrt{4}$:

- (i) 2
- (ii) 3
- (iii) 16
- (iv) none of these

Question 2.

The square root of 5 is:

- (i) an irrational number
- (ii) a rational number
- (iii) an integer
- (iv) none of these

Question 3.

The mixed surd of $\sqrt{20}$ is :

- (i) $\sqrt{5}$
- (ii) $2\sqrt{5}$
- (iii) 74
- (iv) none of these

Question 4.

The rationalizing factor of $\sqrt{23}$ is:

- (i) 24
- (ii) 23
- (iii) $\sqrt{23}$
- (iv) none of these

Question 5.

The rationalizing factor of $2\sqrt{2}$ is:

- (i) 8
- (ii) $\sqrt{2}$
- (iii) $2\sqrt{2}$
- (iv) none of these

Question 3.

The mixed surd of $\sqrt{20}$ is :

- (i) $\sqrt{5}$

- (ii) $2\sqrt{5}$
- (iii) 74
- (iv) none of these

Question 4.

The rationalizing factor of $\sqrt{23}$ is:

- (i) 24
- (ii) 23
- (iii) $\sqrt{23}$
- (iv) none of these

Question 5.

The rationalizing factor of $2\sqrt{2}$ is:

- (i) 8
- (ii) $\sqrt{2}$
- (iii) $2\sqrt{2}$
- (iv) none of these

Question 6.

The rationalizing factor of $3 + \sqrt{5}$ is:

- (i) $3 - \sqrt{5}$
- (ii) $-3 - \sqrt{5}$
- (iii) $\sqrt{5}$
- (iv) none of these

Question 7.

The sum of $2 + \sqrt{7}$ and $2 - \sqrt{7}$ is:

- (i) 4
- (ii) 0
- (iii) $2\sqrt{7}$
- (iv) none of these

Question 8.

The product of $3\sqrt{5}$ and $3\sqrt{6}$ is :

- (i) $\sqrt{30}$
- (ii) $6\sqrt{30}$
- (iii) $9\sqrt{30}$
- (iv) none of these

Question 9.

The Pythagorean triplets for $\sqrt{2}$ is:

- (i) 1, $\sqrt{2}$, 3
- (ii) 1, 1, $\sqrt{2}$
- (iii) $\sqrt{2}$, 1, $\sqrt{2}$
- (iv) none of these

Question 10.

The set or collection of rational numbers and irrational numbers is known as :

- (i) integers
- (ii) real numbers
- (iii) whole numbers
- (iv) none of these

Answers

- 1. (i)
- 2. (i)
- 3. (ii)
- 4. (iii)
- 5. (ii)
- 6. (i)
- 7. (i)
- 8. (iii)
- 9. (ii)
- 10. (ii)

Assignment:

Q1 : Are the following statements true or false? Give reasons for your answers.

- (i) Every whole number is a natural number.
- (ii) Every integer is a rational number.
- (iii) Every rational number is an integer.

Solution : (i) False, because zero is a whole number but not a natural number.

(ii) True, because every integer m can be expressed in the form $1/m$, and so it is a rational number.

Q 2 : Find five rational numbers between 1 and 2.

We can approach this problem in at least two ways.

Solution : Recall that to find a rational number between r and

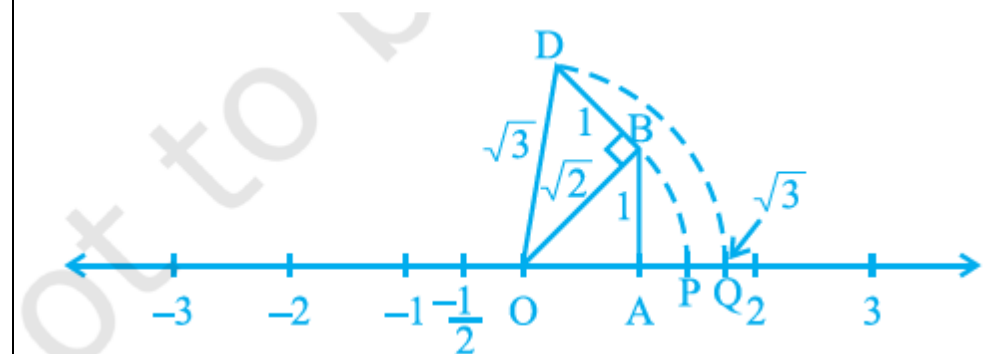
s, you can add r and s and divide the sum by 2, that is $r + s/2$ lies between r and s . So, $3/2$ is a number between 1 and 2. You can proceed in this manner to find four more rational numbers between 1 and 2. These four numbers are $5/4$, $11/8$, $13/8$, $7/4$. .

Q3 : Locate 3 on the number line.

Solution :

Construct BD of unit length perpendicular to OB (as in Fig. 1.8). Then using the Pythagoras theorem, we see that $OD =$

$$\sqrt{(\sqrt{2})^2 + 1^2} = \sqrt{3}.$$



Using a compass, with centre O and radius OD , draw an arc which intersects the number line at the point Q .

Then Q corresponds to $\sqrt{3}$

Q4 : Find the decimal expansions of $\frac{10}{3}$, $\frac{7}{8}$?

Solution :

$$\begin{array}{r}
 3 \overline{) 3.333...} \\
 \underline{3 } \\
 0 \\
 \underline{0 } \\
 0 \\
 \underline{0 } \\
 0 \\
 \underline{0 } \\
 0 \\
 \underline{0 } \\
 0 \\
 \underline{0 } \\
 0
 \end{array}$$

$$\begin{array}{r}
 8 \overline{) 0.875} \\
 \underline{8 } \\
 0 \\
 \underline{0 } \\
 0 \\
 \underline{0 } \\
 0 \\
 \underline{0 } \\
 0 \\
 \underline{0 } \\
 0 \\
 \underline{0 } \\
 0
 \end{array}$$

Q6 : Show that $0.3333... = \frac{1}{3}$. can be expressed in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

Solution : Since we do not know what $0.3333...$ is , let us call it 'x' and so

$$x = 0.3333...$$

Now here is where the trick comes in. Look at

$$10x = 10 \times (0.3333...) = 3.3333...$$

$$\text{Now, } 3.3333... = 3 + x, \text{ since } x = 0.3333...$$

$$\text{Therefore, } 10x = 3 + x$$

Solving for x, we get

$$9x = 3, \text{ i.e., } x = \frac{1}{3}$$

Q7. Visualise 3.765 on the number line, using successive magnification.

Q8: Add $2\sqrt{2} + 5\sqrt{3}$ and $\sqrt{2} - 3\sqrt{3}$.

$$\begin{aligned}
 \text{Solution : } & (2\sqrt{2} + 5\sqrt{3}) + (\sqrt{2} - 3\sqrt{3}) \\
 &= (2\sqrt{2} + \sqrt{2}) + (5\sqrt{3} - 3\sqrt{3}) \\
 &= (2 + 1)\sqrt{2} + (5 - 3)\sqrt{3} = 3\sqrt{2} + 2\sqrt{3}.
 \end{aligned}$$

Example 19 : Rationalise the denominator of $\frac{5}{\sqrt{3}-\sqrt{5}}$.

Solution : Here we use the Identity (iii) given earlier.

$$\text{So, } \frac{5}{\sqrt{3}-\sqrt{5}} = \frac{5}{\sqrt{3}-\sqrt{5}} \times \frac{\sqrt{3}+\sqrt{5}}{\sqrt{3}+\sqrt{5}} = \frac{5(\sqrt{3}+\sqrt{5})}{3-5} = \left(\frac{-5}{2}\right)(\sqrt{3}+\sqrt{5})$$

Example 21 : Simplify (i) $2^{\frac{2}{3}} \cdot 2^{\frac{1}{3}}$ (ii) $\left(3^{\frac{1}{5}}\right)^4$
(iii) $\frac{7^{\frac{1}{5}}}{7^{\frac{1}{3}}}$ (iv) $13^{\frac{1}{5}} \cdot 17^{\frac{1}{5}}$

Solution :

$$(i) \quad 2^{\frac{2}{3}} \cdot 2^{\frac{1}{3}} = 2^{\left(\frac{2}{3} + \frac{1}{3}\right)} = 2^{\frac{3}{3}} = 2^1 = 2 \quad (ii) \quad \left(3^{\frac{1}{5}}\right)^4 = 3^{\frac{4}{5}}$$

$$(iii) \quad \frac{7^{\frac{1}{5}}}{7^{\frac{1}{3}}} = 7^{\left(\frac{1}{5} - \frac{1}{3}\right)} = 7^{\frac{3-5}{15}} = 7^{\frac{-2}{15}} \quad (iv) \quad 13^{\frac{1}{5}} \cdot 17^{\frac{1}{5}} = (13 \times 17)^{\frac{1}{5}} = 221^{\frac{1}{5}}$$

