2026
EXAMINATION

CBSE

QUESTION & CONCEPT BANK

Chapter-wise & Topic-wise

CLASS 9

Chapter-wise
CONCEPT MAPS

Important Questions with Detailed Explanations
NCERT & EXEMPLAR

Handpicked & High yield from Renowned Schools
PYQs

Revision Blue Print & Solved Questions
COMPETENCY FOCUSED

As per Latest Pattern
MOCK TESTS

MATHEMATICS

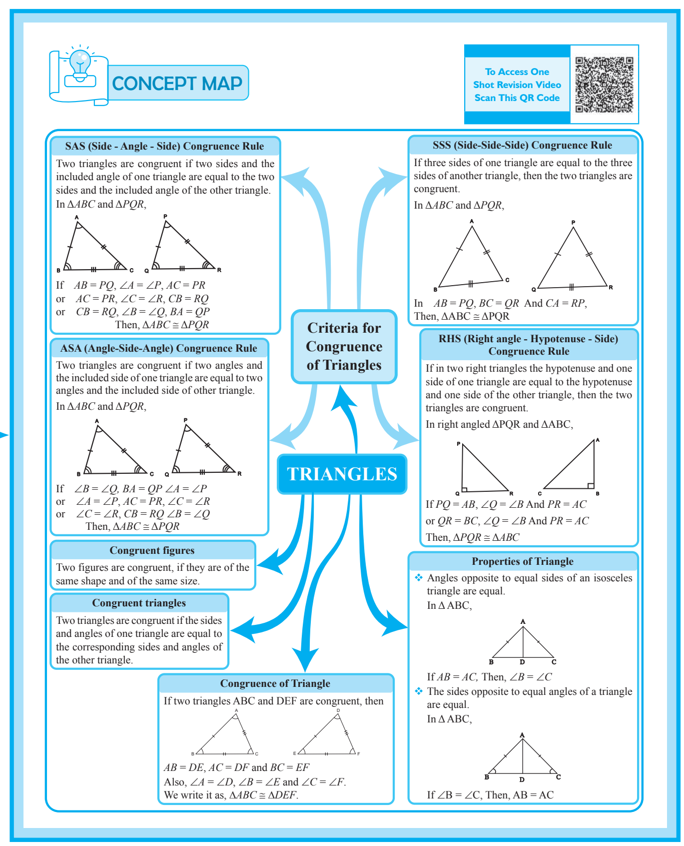
HOW TO USE THIS BOOK

This book is structured to support your learning journey of preparing for your board exams through a variety of engaging and informative elements. Here's how to make the most of it:

Preview

At the start of every chapter, you'll find a thoughtfully chosen image and a quote that captures the main idea and motivation of the topic. This approach aims to get your interest and give you a glimpse of the theme ahead.

Before diving into the details, we outline the syllabus and analyze the weightage given to each topic over the past five years. This helps you prioritize your study focus based on the significance of each section.



Concept Map with PYQs Tagging

The concept map with PYQs Tagging appears to be a comprehensive study aid that outlines key concepts in a structured format, featuring definitions, diagrams, and processes. For a student, it would serve as a visual summary, making complex ideas more accessible and aiding in revision and understanding of concept for their curriculum.

1 RATIONAL AND IRRATIONAL NUMBER AND ITS REPRESENTATION ON NUMBER LINE

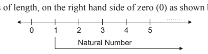
Important Terms

- **Natural Numbers:** The numbers used for counting objects are called natural numbers.
  These are 1, 2, 3, 4, 5, 6 ...... and so on. The collection of natural numbers is denoted by *N*.
  Note: 1 is the smallest natural number.
- **Whole Numbers:** The natural numbers together with zero are called the whole numbers. The whole numbers are denoted by *W*.
  Thus, W = {0, 1, 2, 3, 4, 5, 6 .....}
  Note: 0 is the smallest whole number.
- **Integers:** All natural numbers, 0 and negatives of natural numbers together are known as integers. The collection of integers is denoted by I or Z.
  Thus, I or Z = {.... –5, –4, –3, –2, –1, 0, 1, 2, 3, 4, 5, ...}

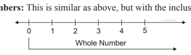
Important Concepts

- **Representation of Numbers on the Number Line:**
  - **Representation of Natural Numbers:** Draw a line and mark a point on it, which represents 0 (zero)

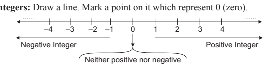
  Now mark point at equal intervals of length, on the right hand side of zero (0) as shown below.



  The above number line represents natural number. All the integer on the right-hand side of 0 represent the natural number, thus forming an infinite set of numbers.
  - **Representation of Whole Numbers:** This is similar as above, but with the inclusion of 0 in the numbers line as follows:



  - **Representation of Integers:** Draw a line. Mark a point on it which represent 0 (zero).



  Dots on either side show the continuation of integers indefinitely on each side.
- **Rational Numbers and Equivalent Rational Numbers:**

  A rational number is any number that can be expressed in the form of a fraction $\frac{p}{q}$, Where p and q are integers and $q \neq 0$.

  Examples: $\frac{3}{4}, \frac{-1}{2}, \frac{1}{3}$

  Note: There are infinitely many rational numbers between any two given rational numbers.

  Equivalent rational numbers are different fractions that represent the same value or the same point on the number line, even though they may look different.

  Example: The numbers $\frac{1}{2}, \frac{2}{4}, \frac{10}{20}, \frac{25}{50}, \frac{47}{94}$ are equivalent rational numbers as all these numbers represent the same value 0.5.

  Note: Two rational numbers $\frac{a}{b}$ and $\frac{c}{d}$ are equivalent if $a \times d = b \times c$.

Important Terms:

Important terms often serve as foundational concepts upon which more complex ideas are built. Introducing them early ensures students have a solid understanding before delving into more advanced topics.

Important Concepts:

Familiarizing with key concepts in advance helps prepare cognitive framework for processing and integrating new information. By highlighting important concepts upfront, students are better equipped to identify connections and relationships between various ideas presented in the chapter.

Important Derivations:

Derivations bridge the gap between theoretical concepts and their practical application, showing students how abstract ideas translate into real-world scenarios.

Important Formulas:

Introducing important formulas upfront brings clarity to the chapter's objectives, guiding students' focus towards essential mathematical principles that will be explored further.

Important Derivations

Angle-Side-Angle (ASA) Congruence Criterion

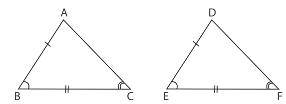
Statement: The Angle-Side-Angle congruence criterion states that if two angles and the included side of one triangle are equal to the corresponding two angles and the included side of the other triangle, then these two triangles are congruent.

Given: Two triangles ABC and DEF such that ∠B = ∠E, ∠C = ∠F and BC = EF.

To prove: ΔABC ≅ ΔDEF

Proof: There are three possibilities.

Case-I: When AB = DE



In this case, we have

AB = DE

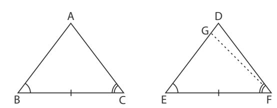
∠B = ∠E [Given]

BC = EF [Given]

So, by SAS criterion of congruence, we have

ΔABC ≅ ΔDEF

Case-II: When AB < ED



In this case take a point G on ED such that EG = AB. Join GF.

Now in ΔABC and ΔGEF, we have

AB = GE [By construction]

∠B = ∠E [Given]

BC = EF[Given]

So, by SAS criterion of congruence, we have

ΔABC ≅ ΔGEF

⇒ ∠ACB = ∠GFE [C.P.C.T.]

But, ∠ACB = ∠DFE (Given)

∴ ∠GFE = ∠DFE

This is possible only when ray FG coincides with ray FD or G coincides with D. Therefore, AB must be equal to DE.

Thus, in ΔABC and ΔDEF, we have

AB = DE [Proved above]

∠B = ∠E [Given]

BC = EF [Given]

Important formulas

- Triangle with base (b) and altitude (h)
  - Area = $\frac{1}{2} \times b \times h$
- Triangle with sides as a, b, c
  - Semi-perimeter (s) = $\frac{a+b+c}{2}$
  - Area = $\sqrt{s(s-a)(s-b)(s-c)}$ (Heron's Formula)
- Isosceles triangle, with base b and equal sides a
  - Area of isosceles triangle = $\frac{a}{4}\sqrt{4b^2 - a^2}$
- Equilateral triangle with side a
  - Area of equilateral triangle = $\frac{\sqrt{3}}{4}a^2$
  - Altitude of an equilateral triangle = $\frac{\sqrt{3}\,a}{2}$
- For right angled triangle
  $(\text{Base})^2 + (\text{altitude})^2 = (\text{Hypotenuse})^2$

Real Life Applications

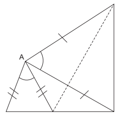
When chocolates are made in factories, they are poured into moulds to give them specific shapes — like hearts, stars, triangles or rectangles. These moulds are congruent, meaning each cavity is exactly the same in shape and size. This ensures that all the chocolates look identical, have the same weight, and can be packed evenly in boxes.

So, congruence helps maintain uniformity in production where large numbers of identical items are required — whether it's chocolates, soaps, or tiles.

Different Problem Types

Type I: Proving Congruency of Triangles Using Different Congruency Criterion

In the given figure, $AC = AE$, $AB = AD$ and $\angle BAD = \angle EAC$. Prove that $BC = DE$.



Step I: Given information and construction

Given that $AC = AE$, $AB = AD$, and $\angle BAD = \angle EAC$, we are required to prove that $BC = DE$.

Construction: Join DE.

Step II: Using angle relations

Since $\angle BAD = \angle EAC$, we can add $\angle DAC$ to both sides of the equation:

$\angle BAD + \angle DAC = \angle EAC + \angle DAC$

This simplifies to:

$\angle BAC = \angle DAE$ (Equation 1).

Step III: Applying the congruence criterion properties

In triangles ΔABC and ΔADE, we know the following:

- $AB = AD$ (given)
- $\angle BAC = \angle DAE$ *(from Equation 1)*
- $AC = AE$ *(given)*

Thus, by the **Side-Angle-Side (SAS) congruence criterion**, we can conclude:

$\Delta ABC \cong \Delta ADE$

Real Life Applications:

Connecting abstract math to real scenarios deepens comprehension and aids in problem-solving.

Learning how math connects with other subjects shows that it's useful in many areas and helps us understand different topics better.

Different Problem Types:

Presenting different types of problems encourages critical thinking and creativity by challenging students to approach each problem uniquely, analyse it, develop strategies, and adapt their approaches to find solutions.

Different problem types challenge students to analyse problems from diverse angles, fostering critical thinking skills essential for problem-solving.

CONCEPT BASED SOLVED EXAMPLES

Multiple Choice Questions (1 M)

1. **A farmer is fencing a rectangular field, and the area of the field is represented by the polynomial $A(x) = x^2 + 5x + 6$. What type of polynomial is $A(x)$?** (*Un*)

   (*a*) Linear (*b*) Quadratic
   (*c*) Cubic (*d*) Constant

Sol. The polynomial $A(x) = x^2 + 5x + 6$ has the highest power of x as 2. A polynomial with the degree of 2 is called a quadratic polynomial.

2. **Which of the following is a linear polynomial?** (*An*)

   (*a*) $2x^2 + 3x + 1$ (*b*) $x + 4$
   (*c*) $5x^3 + 2x$ (*d*) $3x^2 - 5$

Sol. A linear polynomial has the highest power of x as 1. Here, $x + 4$ is the only polynomial with the degree of 1.

3. **Degree of the zero polynomial is** (*Re*) (NCERT Exemplar) (DAV 2024)

   (*a*) 0 (*b*) 1
   (*c*) any natural number (*d*) not defined

Sol. The degree of the zero polynomial is not defined because it has no non-zero terms. A polynomial's degree is determined by the highest power of its variable with a non-zero coefficient, and in the zero polynomial, all coefficients are zero. Therefore, its degree cannot be defined.

4. **Which of the following is not a polynomial?** (*Re*)

   (*a*) $x^3 - 2x^2 + x$ (*b*) $x + 5$
   (*c*) $\frac{1}{x} + 2x^2$ (*d*) $4x^4 - 3x^2 + 1$

Sol. $\frac{1}{x} + 2x^2$, is not a polynomial because it contains $\frac{1}{x}$, which has a negative exponent (x^{-1}).

5. **Degree of the constant polynomial is** (*Re*) (DPS 2024)

   (*a*) 0 (*b*) 1
   (*c*) any natural number (*d*) not defined

Sol. The degree of a constant polynomial is 0 because a constant polynomial can be written as c, where c is a constant, and the variable x has the power 0 (i.e., $c = c \cdot x^0$). Thus, its degree is 0.

6. **The coefficient of x^2 in $(2x^2 - 5)(4 + 3x^3)$ is** (*Ap*) (DAV 2024)

   (*a*) 8 (*b*) –7
   (*c*) 2 (*d*) 3

Sol. $(2x^2 - 5)(4 + 3x^3)$

$$= (2x^2)(4) + (2x^2)(3x^3) + (-5)(4) + (-5)(3x^3).$$
$$= 8x^2 + 6x^5 - 20 - 15x^3.$$

From the expanded polynomial, the term with x^2 is $8x^2$. The coefficient of x^2 is 8.

Answer Key

1. (*b*) 2. (*b*) 3. (*d*) 4. (*c*) 5. (*a*) 6. (*a*)

Assertion and Reason (1 M)

Direction: **In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.**

(*a*) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).
(*b*) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(*c*) Assertion (A) is true, but Reason (R) is false.
(*d*) Assertion (A) is false, but Reason (R) is true.

1. **Assertion (A): A polynomial of degree 0 is called a constant polynomial.**

   Reason (R): The value of a constant polynomial remains the same for all values of x. (*Re*)

Sol. A polynomial of degree 0, such as $f(x) = c$, is constant because it doesn't depend on x. Its value remains the same for all values of x.

Hence, both the assertion and reason are correct, and the reason explains the assertion.

2. **Assertion (A): $f(x) = x^3 - 2x + \frac{1}{x}$ is a polynomial.**

   Reason (R): A polynomial must not have terms with variables in the denominator. (*Un*)

Sol. Assertion (A): $f(x) = x^3 - 2x + \frac{1}{x}$ is a polynomial.

False, because $\frac{1}{x} = x^{-1}$, has a negative power, and polynomials cannot have negative powers.

Reason (R): A polynomial must not have terms with variables in the denominator.

True, as variables in the denominator lead to negative powers.

Hence, A is false but R is true.

Answer Key

1. (*a*) 2. (*d*)

Solved Examples

For each topic, solved examples are provided including tagging of Competencies, PYQs, CBSE SQPs etc that exemplify how to approach and solve questions. This section is designed to reinforce your learning and improve problemsolving skills.

MISCELLANEOUS EXERCISE

Scan Me for Detailed Explanations

Multiple Choice Questions (1 M)

1. The remainder when $x^3 - 2x^2 + x + 1$ is divided by $x - 1$ is, (DAV 2023)

   (*a*) –1 (*b*) 0 (*c*) 1 (*d*) 2

2. If $p(x) = x + 3$, then $p(x) + p(-x)$ is equal to (NCERT Exemplar)

   (*a*) 3 (*b*) $2x$ (*c*) 0 (*d*) 6

3. If $x^{140} + 2x^{151} + k$ is divisible by $x + 1$, then the value of k is (DPS 2024)

   (*a*) 2 (*b*) –2 (*c*) –3 (*d*) 1

4. $\sqrt{2}$ is a polynomial of degree: (NCERT Exemplar) (DPS 2023)

   (*a*) 2 (*b*) 0
   (*c*) 1 (*d*) 1/2

5. Identify the polynomial: "The highest power of the variables is 2, and it has at most two zeroes."

   (*a*) Linear polynomial (*b*) Quadratic polynomial
   (*c*) Cubic polynomial (*d*) Constant polynomial

6. Which of the following statements about polynomials is correct?

   (*i*) A linear polynomial has one term.
   (*ii*) A quadratic polynomial has at most two zeroes.
   (*iii*) The degree of a cubic polynomial is 3.
   (*iv*) Polynomials cannot have fractional powers of variables.

   (*a*) (*ii*) and (*iii*) only (*b*) (*i*) and (*iv*) only
   (*c*) (*ii*), (*iii*) and (*iv*) only (*d*) (*i*), (*ii*), (*iii*) and (*iv*)

7. Which of the following is not a polynomial? (DPS 2023)

   (*a*) $\frac{1}{5x^{-2}} + 5x + 7$
   (*b*) 8
   (*c*) $a^3 - 2\sqrt{3}a^2 + 4$
   (*d*) $x^2 + 2\sqrt{x}$

8. Riya is planting a square flower bed where each side measures $(2a + 3b - c)$ meters. What is the area of her flower bed?

   (*a*) $4a^2 + 9b^2 + c^2$
   (*b*) $4a^2 + 9b^2 + c^2 + 12ab - 4ac - 6bc$
   (*c*) $4a^2 + 12ab + 9b^2$
   (*d*) $2a^2 + 3b^2 - c^2 + 6ab$

ANSWER KEYS

Multiple Choice Questions

1. (*c*) 2. (*d*) 3. (*d*) 4. (*b*) 5. (*b*) 6. (*c*) 7. (*d*) 8. (*b*)

Assertion and Reason

1. (*a*) 2. (*a*)

Case Based Questions

Case Based-III

(*i*) (*c*) (*ii*) (*a*) (*iii*) (*b*) (*iv*) (*b*) (*v*) (*c*)

At the end of each chapter, you'll find additional exercises intended to test your grasp of the material. These are great for revision and to prepare for exams.

Answer Key and Explanations including Mistake 101, Nailing the right answer and Key takeaway can be accessed through QR code.

Answer Key

Mock Test Paper

Mock Test Papers: *Test your preparedness with our Mock Test Papers designed to mirror the format and difficulty of real exams. Use the detailed explanations to identify areas of strength and opportunities for improvement.*

MOCK TEST PAPER-1

Time allowed : 3 hours **Maximum Marks : 80**

General Instructions:

Read the following instructions carefully and follow them:

(*i*) *This Question Paper has **5** Sections **A, B, C, D,** and **E.***
(*ii*) *All Questions are compulsory. However, an internal choice in **2** Questions of **2** marks, **2** Questions of **3** marks and **2** Questions of **5** marks has been provided. An internal choice has been provided in the **2** marks questions of Section E.*
(*iii*) *Draw neat figures wherever required. Take π = **22/7** wherever required if not Stated.*

SECTION - A

Q 1-20 are multiple choice questions. Each question is of 1 mark.

1. Which of the following is irrational?

   (*a*) 0.14 (*b*) $0.14\overline{16}$ (*c*) $0.\overline{1416}$ (*d*) 0.4014001400014...

2. Express y in terms of x in the equation $5x - 2y = 7$.

   (*a*) $y = \frac{5x-7}{2}$ (*b*) $y = \frac{7-5x}{2}$ (*c*) $y = \frac{7x+5}{2}$ (*d*) $y = \frac{5x+7}{2}$

3. $P(5, -7)$ be a point on the graph. Draw the $PM \perp y$-axis. The coordinates of M are

   (*a*) (0, –7) (*b*) (0, 0) (*c*) (–7, 0) (*d*) (–7, 5)

4. In a frequency distribution, the mid value of a class is 10 and the width of the class is 6. The lower limit of the class is

   (*a*) 6 (*b*) 7 (*c*) 8 (*d*) 12

5. Which of the following point does not lie on the line $y - 2x - 3 = 0$?

   (*a*) (–5, –7) (*b*) (–1, 1) (*c*) (3, 9) (*d*) (3, 7)

6. The total number of propositions in the Euclid's Elements is

   (*a*) 460 (*b*) 465 (*c*) 32 (*d*) 13

7. After rationalising the denominator of $\frac{1}{\sqrt{2}}$, we get

   (*a*) $\frac{\sqrt{2}}{2}$ (*b*) $\frac{2}{\sqrt{2}}$ (*c*) $2\sqrt{2}$ (*d*) None of these

8. The quadrilateral formed by joining the mid-points of the sides of a quadrilateral *PQRS*, taken in order, is a rectangle, if

   (*a*) *PQRS* is a rectangle (*b*) *PQRS* is a parallelogram
   (*c*) diagonals of *PQRS* are perpendicular (*d*) diagonals of *PQRS* are equal

9. Find whether (1, 1) is the solution of the equation $x - 2y = 4$ or not?

   (*a*) Yes (*b*) No (*c*) Can not be determined (*d*) None of these

10. The equation $x = 7$, in two variables, can be written as

    (*a*) $1.x + 1.y = 7$ (*b*) $1.x + 0.y = 7$ (*c*) $0.x + 1.y = 7$ (*d*) $0.x + 0.y = 7$

CONTENTS

Questions have been categorized according to the Bloom's Taxonomy (as per CBSE Board).
The following abbreviations have been used in the book:

(Un) - Understanding | *(Re)* - Remembering | *(Ap)* - Applying
(An) - Analysing | *(Cr)* - Creating | *(Ev)* - Evaluating

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NUMBER SYSTEMS

1

"Number systems are essential in daily life for counting, measuring, coding, financial transactions, digital communication, and managing data in technology, science, and commerce."

SYLLABUS

RATIONAL AND IRRATIONAL NUMBER AND ITS REPRESENTATION ON NUMBER LINE
(Review of representation of natural numbers, integers, rational numbers on the number line. Representation of terminating/non-terminating recurring decimals on the number line through successive magnification, Rational numbers as recurring/ terminating decimals. Examples of non-recurring/non-terminating decimals. Existence of non-rational numbers (irrational numbers) such as $\sqrt{2}$, $\sqrt{3}$ and their representation on the number line.)
REAL NUMBER, Nth ROOT OF A REAL NUMBER, RATIONALIZATION,AND EXPONENT RULES
Explaining that every real number is represented by a unique point on the number line and conversely, viz. Every point on the number line represents a unique real number. Operations on real numbers. Definition of nth root of a real number. Rationalization (with precise meaning) of real numbers of the type $1/(a+b\sqrt{x})$ and $1/(\sqrt{x}+\sqrt{y})$ (and their combinations), where x and y are natural numbers and a and b are integers. Recall of laws of exponents with integral powers. Rational exponents with positive real bases (to be done by particular cases, allowing learners to arrive at the general laws.)

CONCEPT MAP

To Access One Shot Revision Video Scan This QR Code

NUMBER SYSTEMS

Natural Numbers(N)

The numbers used for counting objects are called natural numbers.

$N = \{1,2,3,4,5,6,7...\}$

Whole Numbers(W)

The natural numbers together with zero are called the whole numbers.

$W = \{0, 1, 2, 3, 4, 5, 6 .....\}$

Integers(I or Z)

All natural numbers, 0 and negatives of natural numbers together are known as integers.

I or $Z = \{.... -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, ...\}$

Real Number

The collection of all rational and irrational numbers is called the real numbers, which is denoted by R.

Example: $0, -2, \frac{5}{7} - \frac{63}{112}, \sqrt{2},$ etc.

Important Identities Relating to Square Roots

Let a and b be positive real number. Then,

(i) $\sqrt{ab} = \sqrt{a}\sqrt{b}$

(ii) $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

(iii) $\left(\sqrt{a}+\sqrt{b}\right)\left(\sqrt{a}-\sqrt{b}\right) = a-b$

(iv) $\left(a+\sqrt{b}\right)\left(a-\sqrt{b}\right) = a^2 - b$

(v) $\left(\sqrt{a}+\sqrt{b}\right)\left(\sqrt{c}+\sqrt{d}\right) = \sqrt{ac}+\sqrt{ad}+\sqrt{bc}+\sqrt{bd}$

(vi) $\left(\sqrt{a}+\sqrt{b}\right)^2 = a + 2\sqrt{ab} + b$

Laws of Exponents for Real Number

If a, b are positive real numbers and m, n are rational numbers. Then,

(i) $a^m \times a^n = a^{m+n}$ (ii) $\frac{a^m}{a^n} = a^{m-n}$

(iii) $(a^m)^n = a^{mn}$ (iv) $a^{-m} = \frac{1}{a^m}$

(v) $a^m b^m = (ab)^m$ (vi) $\frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$

(vii) $(a^m)^{\frac{1}{n}} = \left(a^{\frac{1}{n}}\right)^m$ $a^{\frac{m}{n}}$ i.e., $\sqrt[n]{a^m} = \left(\sqrt[n]{a}\right)^m = a^{\frac{m}{n}}$

(viii) $\left(\frac{a}{b}\right)^{-m} = \left(\frac{b}{a}\right)^m$

Rationalization of Real Numbers

Rationalization of real numbers is the process of eliminating radicals (like square roots or cube roots) from the denominator of a fraction.

Example: Rationalise the denominator of $\frac{1}{\sqrt{2}}$.

Solution: Multiply numerator and denominator by $\sqrt{2}$.

$\frac{1}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{1\times\sqrt{2}}{\sqrt{2}\times\sqrt{2}} = \frac{\sqrt{2}}{2}$. This is Retionalized form of $\frac{1}{\sqrt{2}}$

Decimal Expansion of Rational Numbers

The decimal representation of a rational number can be of two types.

1. **Terminating Decimal Expansion:** This indicates that the decimal representation terminates after a certain number of digits.

   Example: $\frac{1}{16} = 0.0625$, In the above example, decimal representation terminates after 4 digits.

2. **Non-Terminating Repeating Decimal Expansion:** These are decimal numbers that continue infinitely with a repeating pattern of digits. **Example:** $\frac{1}{3} = 0.333\ldots$

Representation of Rational Numbers on Number Line

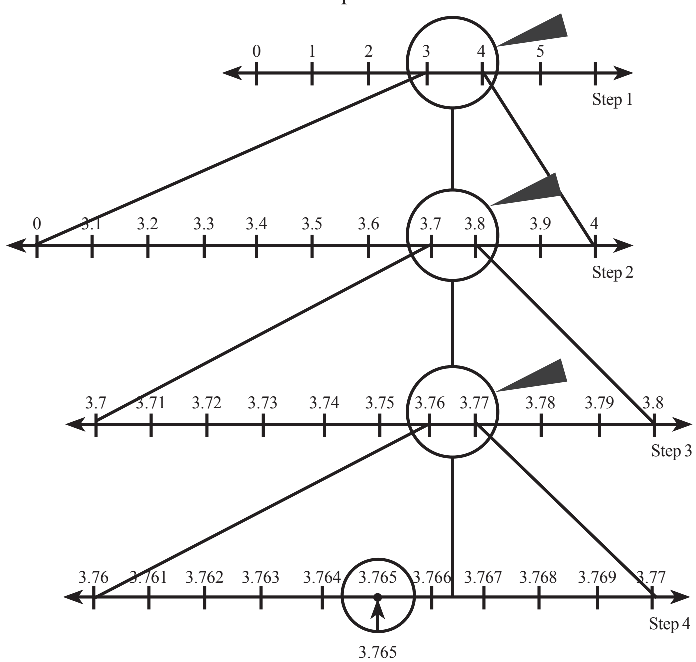
Represent 3.765 on the number line.

Steps to Represent on Number Line:

1. **Locate the Integer Part:** For 3.765, identify between 3 and 4.
2. Divide the interval 3 to 4 into 10 equal parts (for 1st decimal place). 3.7 is the 7th mark.
3. Zoom in further (for 2nd & 3rd decimal places):

   Divide 3.7 to 3.8 into 10 parts → 3.76 is the 6th mark.

   Divide 3.76 to 3.77 into 10 parts → 3.765 is the 5th mark.



Rational Numbers

A rational number is any number that can be expressed in the form of a fraction p/q.

Where, p and q are integers and $q \neq 0$.

Examples: $\frac{3}{4}, \frac{-1}{2}, \frac{1}{3}$

NUMBER SYSTEMS

Irrational Numbers

A number 's' is called irrational, if it cannot be written in the form p/q, where p and q are integers and $q \neq 0$.

Example: $\sqrt{2}, \sqrt{3}, \sqrt[4]{5}, \pi$, etc.

Representation of Irrational Numbers on Number Line

Representing 2 on the Number Line

Step I: Draw a number line with 0 and 1 marked clearly.

Step II: At point 1, draw a perpendicular line upwards of length 1 unit (creating a right angle).

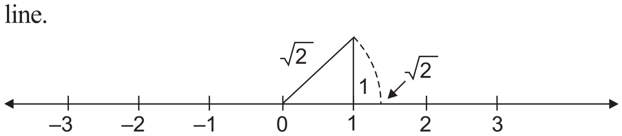
Step III: Connect this new point back to 0 to form a right-angled triangle.

The hypotenuse will be $\sqrt{(1^2 + 1^2)} = \sqrt{2}$ units long.

Step IV: Using a compass:

Place the needle at 0 and stretch the pencil to the hypotenuse end-point. Draw an arc that intersects the number line

The intersection point is exactly $\sqrt{2}$ (≈1.414) on the number line.



Decimal Expansion of Irrational Numbers

Non-Terminating, Non-Repeating Decimal: A non-terminating, non-repeating decimal is a decimal number that continues

endlessly, with no group of digits repeating endlessly. Decimals of this type cannot be represented as fractions, and as a result are irrational numbers.

Examples: (*i*) π is a non-terminating, non-repeating decimal.

$\pi = 3.101\ 592\ 653\ 589\ 793\ 238\ 462\ 643\ 383\ 279 \ldots$

(*ii*) 0.10100100010000100000100000010000000 ...

1 RATIONAL AND IRRATIONAL NUMBER AND ITS REPRESENTATION ON NUMBER LINE

Important Terms

- **Natural Numbers:** The numbers used for counting objects are called natural numbers.

  These are 1, 2, 3, 4, 5, 6 ...... and so on. The collection of natural numbers is denoted by *N*.

  Note: 1 is the smallest natural number.

- **Whole Numbers:** The natural numbers together with zero are called the whole numbers. The whole numbers are denoted by *W*.

  Thus, W = {0, 1, 2, 3, 4, 5, 6 .....}

  Note: 0 is the smallest whole number.

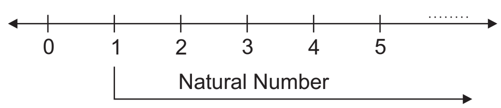
- **Integers:** All natural numbers, 0 and negatives of natural numbers together are known as integers. The collection of integers is denoted by I or Z.

  Thus, I or Z = {.... –5, –4, –3, –2, –1, 0, 1, 2, 3, 4, 5, ...}

Important Concepts

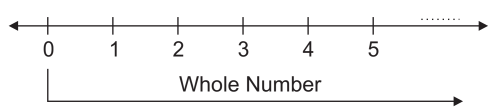
- **Representation of Numbers on the Number Line:**
  - **Representation of Natural Numbers:** Draw a line and mark a point on it, which represents 0 (zero)

  Now mark point at equal intervals of length, on the right hand side of zero (0) as shown below.

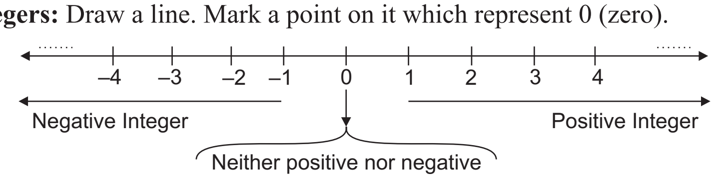


  The above number line represents natural number. All the integer on the right-hand side of 0 represent the natural number, thus forming an infinite set of numbers.

  - **Representation of Whole Numbers:** This is similar as above, but with the inclusion of 0 in the numbers line as follows:



  - **Representation of Integers:** Draw a line. Mark a point on it which represent 0 (zero).



  Dots on either side show the continuation of integers indefinitely on each side.

- **Rational Numbers and Equivalent Rational Numbers:**

  A rational number is any number that can be expressed in the form of a fraction $\frac{p}{q}$, Where p and q are integers and $q \neq 0$.

  Examples: $\frac{3}{4} \cdot \frac{-1}{2} \cdot \frac{1}{3}$

  Note: There are infinitely many rational numbers between any two given rational numbers.

  Equivalent rational numbers are different fractions that represent the same value or the same point on the number line, even though they may look different.

  Example: The numbers $\frac{1}{2}, \frac{2}{4}, \frac{10}{20}, \frac{25}{50}, \frac{47}{94}$ are equivalent rational numbers as all these numbers represent the same value 0.5.

  Note: Two rational numbers $\frac{a}{b}$ and $\frac{c}{d}$ are equivalent if $a \times d = b \times c$.

Properties of Rational Numbers

1. **Commutative property:** For rational numbers, addition and multiplication are commutative.

   Commutative law of addition: $a + b = b + a$

   Commutative law of multiplication: $a \times b = b \times a$

2. **Associative property:** Rational numbers follow the associative property for addition and multiplication.

   Associative property of addition: $(a + b) + c = a + (b + c)$

   Associative property of multiplication: $(a \cdot b) \cdot c = a \cdot (b \cdot c)$

3. **Distribution property of multiplication over addition:** $a \cdot (b + c) = a \cdot b + b \cdot c$

4. **Closure property:** The sum or subtraction or multiplication of two rational numbers is also a rational number.

   Note: The division of two rational numbers does not obey closure property because division by zero is not defined.

Decimal Expansion of Rational Numbers

The decimal representation of a rational number can be of two types:

1. **Terminating:** This indicates that the decimal representation terminates after a certain number of digits

   Example: $\frac{1}{16} = 0.0625$

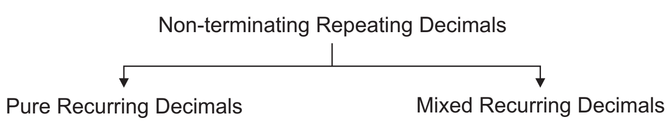
   In the above example, decimal representation terminates after 4 digits

   Condition for a rational number to be a terminated decimal:

   A rational number $\frac{p}{q}$ in its simplest form can be expressed as a terminating decimal only of its denominator has no other factors except 2 or 5 or both.

   In other words, a rational number $\frac{p}{q}$ is a terminating decimal if and only if the denominator q can be expressed as $q = 2^m \times 5^n$ where $m, n = 0, 1, 2, 3$ ....

2. **Non-Terminating repeating:**



(*a*) A decimal in which all the digit after the decimal point are repeated. These type of decimals are known as pure recurring decimals.

For Example: $0.\overline{7}$, $0.\overline{18}$, $0.\overline{234}$ are pure recurring decimals where the bar above the digits indicates the block of digit that replaces.

(*b*) A decimal in which at least one of the digits after the decimal point is not repeated and then some digit or digits are repeated. This type of decimals are known as mixed recurring decimals.

For Example: $0.2\overline{7}$, $0.12\overline{3}$

Condition for a rational number to be a recurring decimal

A rational number $\frac{p}{q}$ (in its lowest terms) is a recurring decimal if and only if its denominator q has a prime factor other than 2 or 5.

Note: The decimal expansion of rational number is either terminating or non-terminating recurring. Moreover a number whose decimal expansion is terminating or non-terminating recurring is rational.

Representation of rational numbers on number line:

1. Terminating Decimals

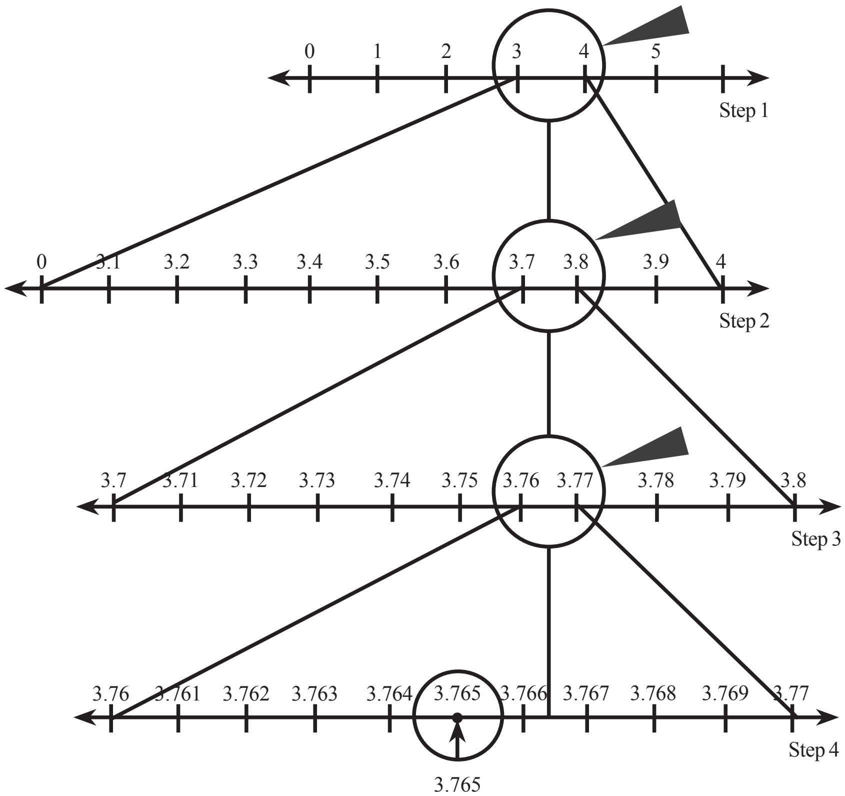
Example: Represent 3.765 on the number line.

Steps to Represent on Number Line:

1. Locate the integer part: For 3.765, identify between 3 and 4.
2. Divide the interval 3 to 4 into 10 equal parts (for 1st decimal place). 3.7 is the 7th mark.
3. Zoom in further (for 2nwd & 3rd decimal places):

Divide 3.7 to 3.8 into 10 parts → 3.76 is the 6th mark.

Divide 3.76 to 3.77 into 10 parts → 3.765 is the 5th mark.



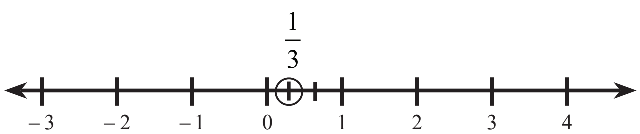
2. Non-Terminating Recurring Decimals

(*a*) For fraction conversions:

Example: Represent $0.\overline{3}$ on the number line.

Convert to fraction (if possible): $0.\overline{3} = \frac{1}{3}$

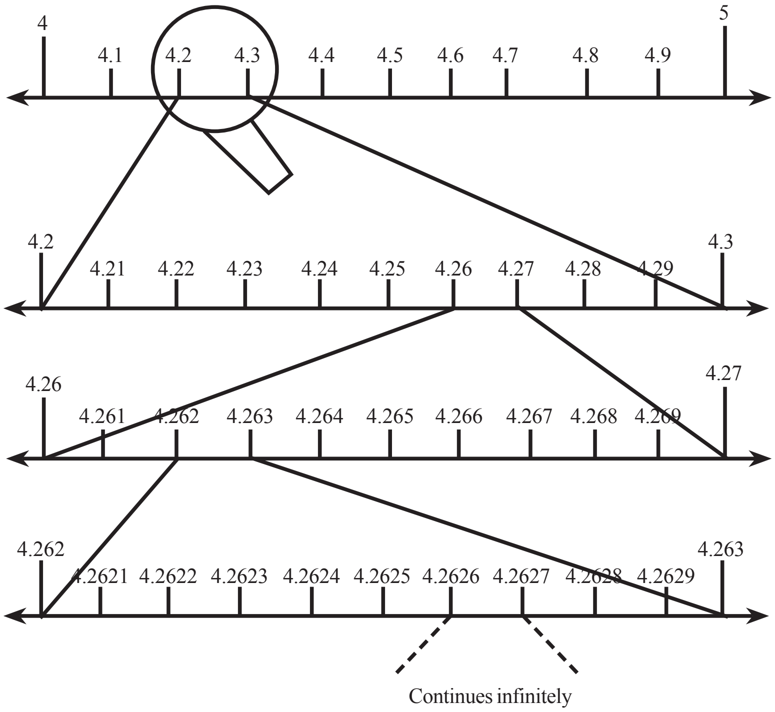
Approximate the position: Divide the interval 0 to 1 into 3 equal parts: 1/3 is the 1st mark.



(*b*) For non-fraction conversions, use successive approximation:

Example: Visualise $4.\overline{26}$ on the number line, up to 4 decimal place.

$4.\overline{26} = 4.2626 \ldots$



- **Irrational Numbers:** A number is called irrational, if it cannot be written in the form p/q,where p and q are integers and $q \neq 0$.

  Example: $\sqrt{2}, \sqrt{3}, \sqrt[4]{5}$,π, etc.

- **Properties of Irrational Numbers:**

  (*i*) There are infinitely many irrational numbers between any two rational numbers.

  (*ii*) The collection of irrational numbers is dense everywhere, i.e.,"Between two irrational numbers a and b with $a < b$, there lies at least one irrational number and hence an infinite number of irrational numbers."

- **Decimal Expansion of Irrational numbers:**

  Non-Terminating, Non-Repeating Decimal: A non-terminating, non-repeating decimal is a decimal number that continues endlessly, with no group of digits repeating endlessly. Decimals of this type cannot be represented as fractions, and as a result are irrational numbers.

  Examples:

  (i) π is a non-terminating, non-repeating decimal.

  π = 3.101 592 653 589 793 238 462 643 383 279 ...

  (ii) e is a non-terminating, non-repeating decimal.

  e = 2.718 281 828 459 045 235 360 287 471 325 ...

  Note:

  (i) The decimal expansion of an irrational number is non-terminating non-recurring. Moreover, a number whose decimal expansion is non-terminating non-recurring is irrational.

  (ii) Non-terminating, non-repeating decimals can be easily created by using a pattern.

  Examples:

  (i) 0.10100100010000100000100000010000000 ...

  (ii) 28012112211122211112222111112222221111111222222 ...

- **Representation of irrational numbers on number line:**

  Example: Representing $\sqrt{10}$ on the Number Line

  Step 1: Understanding $\sqrt{10}$

- $\sqrt{10}$ is the positive number that, when multiplied by itself, gives 10.
- Its approximate value is 3.16227..., which is non-terminating and non-repeating.

  Step 2: Geometric Construction

  We can use the Pythagorean theorem to locate $\sqrt{10}$ on the number line.

(*a*) Draw the Number Line: Start with a horizontal number line marked with integers (0, 1, 2, etc.).

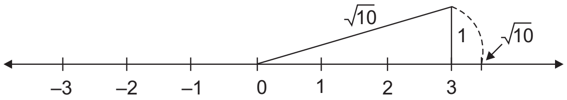
(*b*) Construct a Unit Square: From 0, move to 3 on the number line. This segment from 0 to 3 is of length 3.

At the point 3, draw a perpendicular line upwards of length 1, forming a vertical side of a square.

Complete the square by drawing a horizontal line back to the y-axis and a vertical line down to 0.

(*c*) Draw the Diagonal: The diagonal of this unit square from 0 to the opposite corner has a length of $\sqrt{(3^2 + 1^2)} = \sqrt{10}$ by the Pythagorean theorem.

(*d*) Transfer the Diagonal to the Number Line: Using a compass, place the needle at 0 and the pencil at the end of the diagonal (the corner of the square). Swing an arc that intersects the number line. The point of intersection is $\sqrt{10}$ from the origin.



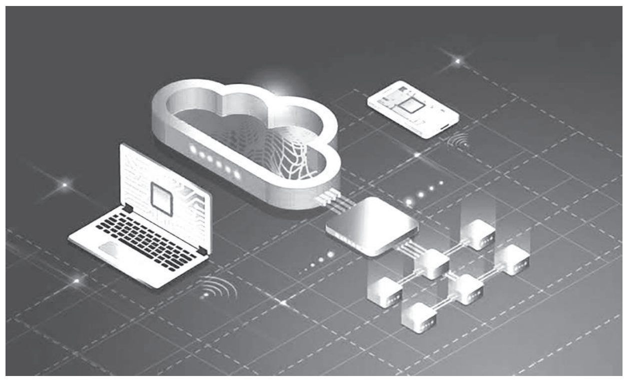
Real Life Applications

- **Measuring Speed in Cars:** When you're in a car, the speedometer shows how fast you're going. Engineers use π to measure how fast the wheels turn, which helps calculate the car's speed. This is why speedometers work so accurately—they're designed with the number like π in the background.

- **For Construction:** Builders use rational numbers, like 2.5 meters, to measure wall lengths. However, for things like diagonal supports in square structures, they use irrational numbers like $\sqrt{2}$, (about 1.414). Additionally, when working with round objects like pipes and arches, they rely on the irrational number π (approximately 3.14159) to get accurate measurements.

- **For Finance and Economic Models:** Simple interest rates, like 5% (written as 5/100), use rational numbers for calculations. On the other hand, for more accurate predictions in finance, especially with continuous growth, irrational numbers like e (about 2.71828) are used in advanced models to calculate growth over time.

- **In technology:** Computers store data in exact amounts, like 1920×1080 pixels, using rational numbers. However, for securing digital communications, encryption algorithms like RSA use irrational numbers, such as √2 and π, to protect information and keep it safe.



Different Problem Types

Type I: Finding Rational Numbers Between Two Given numbers

Method-1: Find five rational numbers between 1 and 2

Solution:

Step I: To find a rational number between two numbers *r* and *s*, add *r* and *s*, then divide by 2.

Here, we find the midpoint between 1 and 2. $\Rightarrow \frac{1+2}{2} = \frac{3}{2}$

Step II: The number $\frac{3}{2}$ is between 1 and 2. We can continue this process to find additional rational numbers.

Step III: To find more numbers, take the midpoint between 1 and $\frac{3}{2}$, and between $\frac{3}{2}$ and 2.

$$\frac{1+\frac{3}{2}}{2} = \frac{5}{4}, \quad \frac{\frac{3}{2}+2}{2} = \frac{7}{4}$$

Step IV: Repeat this to find additional rational numbers.

$$\frac{\frac{3}{2}+\frac{5}{4}}{2} = \frac{11}{8}, \quad \frac{\frac{3}{2}+\frac{7}{4}}{2} = \frac{13}{8}$$

The five rational numbers between 1 and 2 are $\frac{3}{2}, \frac{5}{4}, \frac{11}{8}, \frac{13}{8}, \frac{7}{4}$.

Example: Find three rational numbers between 2 and 3.

Solution: To find rational numbers between 2 and 3, we can use the midpoint method repeatedly.

First, find the midpoint between 2 and 3: $\frac{2+3}{2} = \frac{5}{2}$

Next, find another rational number by taking the midpoint between 2 and $\frac{5}{2}$: $\frac{2+\frac{5}{2}}{2} = \frac{9}{4}$

Finally, find one more by taking the midpoint between $\frac{5}{2}$ and 3: $\frac{\frac{5}{2}+3}{2} = \frac{11}{4}$

The three rational numbers between 2 and 3 are $\frac{5}{2}, \frac{9}{4}, \frac{11}{4}$

Method-2: Finding 3 Rational Numbers Between $\frac{4}{7}$ and $\frac{3}{5}$.

Solution:

Step I: Make Denominators the Same

Find LCM of 7 and 5 → 35

Convert both fractions: $\frac{4}{7} = \frac{(4\times5)}{(7\times5)} = \frac{20}{35}, \frac{3}{5} = \frac{(3\times7)}{(5\times7)} = \frac{21}{35}$

Step II: Increase the Denominator:

Since $\frac{20}{35}$ and $\frac{21}{35}$ are consecutive, multiply numerator & denominator by 4 (3 + 1) to create more gaps: $\frac{20}{35} = \frac{80}{140}, \frac{21}{35} = \frac{84}{140}$

Step III: Pick 3 Numbers Between Them

Now, we can choose any 3 fractions between $\frac{80}{140}$ and $\frac{84}{140}$, such as:

$\frac{81}{140}, \frac{82}{140} = \frac{41}{70}$ (simplified), $\frac{83}{140}$

Hence, Three rational numbers between $\frac{4}{7}$ and $\frac{3}{5}$ are $\frac{81}{140}, \frac{41}{70}, \frac{83}{140}$.

Example: Find 2 rational numbers between $\frac{2}{3}$ and $\frac{4}{5}$.

Solution: Convert to common denominator (LCM of 3,5 = 15): $\frac{2}{3} = \frac{10}{15}, \frac{4}{5} = \frac{12}{15}$

Multiply numerator & denominator by 2 to create more gaps:

$\frac{10}{15} = \frac{20}{30}, \quad \frac{12}{15} = \frac{24}{30}$

Select 2 numbers between them: $\frac{21}{30}, \frac{22}{30}$

Hence, Two rational numbers between $\frac{2}{3}$ and $\frac{4}{5}$ are $\frac{21}{30}$ and $\frac{22}{30}$.

Type II: Locating Irrational Number on the Number Line

Locate $\sqrt{2}$ on the number line.

Solution:

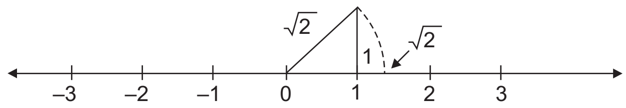
Step I: Draw a number line with 0 and 1 marked clearly.

Step II: At point 1, draw a perpendicular line upwards of length 1 unit (creating a right angle).

Step III: Connect this new point back to 0 to form a right-angled triangle. The hypotenuse will be $\sqrt{(1^2+1^2)} = \sqrt{2}$ units long.

Step IV: Using a compass: Place the needle at 0 and stretch the pencil to the hypotenuse end-point. Draw an arc that intersects the number line

The intersection point is exactly $\sqrt{2}$ ($\approx$1.414) on the number line.



Example: Locate $\sqrt{3}$ on the number line.

Solution: Construct a number line and mark a point O, representing zero. Let point A represents 1 as shown in Figure. Clearly, OA = 1 unit. Now, draw a right angled triangle OAB in which AB = OA = 1 unit.

Using Pythagoras theorem, we have

$$OB^2 = OA^2 + AB^2 = 1^2 + 1^2$$

$$\Rightarrow OB^2 = 2 \quad \Rightarrow \quad OB = \sqrt{2}$$

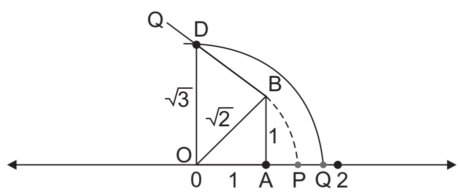
Taking O as centre and OB as a radius draw an arc intersecting the number line at point P.

Then P corresponds to $\sqrt{2}$ on the number line. Now draw DB of 1 unit length perpendicular to OB. Then using Pythagoras theorem, we have

$OD^2 = OB^2 + DB^2$

$\Rightarrow OD^2 = \left(\sqrt{2}\right)^2 + 1^2 = 2 + 1 = 3 \quad \Rightarrow \quad OD = \sqrt{3}$

Taking O as centre and OD as a radius draw an arc which intersects the number line at the point Q. Clearly, Q corresponds to $\sqrt{3}$.



Type III: Expressing a Recurring Decimal as a Fraction

Express 0.3333 ... in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

Step I: Let $x = 0.3333...$

Step II: Multiply both sides by 10 to shift the decimal: $10x = 3.3333...$

Step III: Recognize that $3.3333... = 3 + x$ because $x = 0.3333...$

So we can rewrite the equation as: $10x = 3 + x$

Step IV: Subtract x from both sides to isolate x: $10x - x = 3 \Rightarrow 9x = 3$

Step V: Divide both sides by 9 to solve for x : $x = \frac{3}{9} = \frac{1}{3}$

Thus, $0.3333... = \frac{1}{3}$, represented in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

Example: Show that 0.2353535... = $0.2\overline{35}$ can be expressed in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

Solution: Let $x = 0.2\overline{35}$. Over here, note that 2 does not repeat, but the block 35 repeats. Since two digits are repeating, we multiply x by 100 to get

$100x = 23.53535...$

So, $100x = 23.3 + 0.235353... = 23.3 + x \Rightarrow 99x = 23.3 \Rightarrow 99x = \frac{233}{10} \Rightarrow x = \frac{233}{990}$

Hence, $0.2\overline{35} = \frac{233}{990}$

CONCEPT BASED SOLVED EXAMPLES

Multiple Choice Questions (1 M)

1. Every rational number is: ***(Re)* (KVS 2024) (NCERT Exemplar)**

(*a*) a natural number (*b*) an integer
(*c*) a real number (*d*) a whole number

Sol. A rational number is any that can be expressed in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

Rational numbers include integers, fractions, and terminating or repeating decimals, but not all rational numbers are natural numbers, integers, or whole numbers.

However, every rational number is part of the real numbers, which include both rational and irrational numbers.

2. If p is prime number, then $\sqrt{p}$ is a: ***(An)***

(*a*) irrational number (*b*) whole number
(*c*) real number (*d*) natural number

Sol. A prime p is a natural greater than 1 that is divisible only by 1 and itself.

The square root of a prime number $\sqrt{p}$ is not a perfect square, as p cannot be expressed as the square of any integer.

Since $\sqrt{p}$ cannot be expressed as a ratio of integers, it is an irrational number.

3. Which of the following is irrational? ***(Un)***

(*a*) 0.01 (*b*) $0.01\overline{46}$
(*c*) 0.014232323... (*d*) 0.1498325...

Sol. 0.01 is a terminating decimal, so it is rational.

$0.01\overline{46}$ is a non-terminating recurring decimal, so it is rational.

0.014232323.... . This is a non-terminating decimal with a repeating pattern (23 repeats). Any repeating decimal is rational.

0.1498325.... . This is a non-terminating and non-repeating decimal. Such numbers are irrational.

4. The product of any two irrational numbers is ***(Re)* (NCERT Exemplar)**

(*a*) always an irrational number
(*b*) always a rational number
(*c*) always an integer
(*d*) sometimes rational, sometime irrational

Sol. Sometimes rational, sometimes irrational.

The product of two irrational numbers is not always an irrational number. For example:

$\sqrt{2} \times \sqrt{2} = 2$, which is a rational number.

However, $\sqrt{2} \times \sqrt{3} = \sqrt{6}$, which is an irrational number.

5. The decimal expansion of $\sqrt{5}$ is: ***(Re)***

(*a*) terminating
(*b*) non-terminating recurring
(*c*) non-terminating non-recurring
(*d*) none of these

Sol. $\sqrt{5}$ is an irrational number because 5 is not a perfect square.

The decimal expansion of any irrational number is non-terminating and non-recurring.

Thus, the decimal expansion of $\sqrt{5}$ does not terminate and does not repeat.

6. An irrational number between π and 5 is: ***(An)***

(*a*) 2π (*b*) $\frac{\pi}{2}$ (*c*) $\pi + 1$ (*d*) $\pi - 1$

Sol. 2π: Greater than 5, not between π and 5.

$\frac{\pi}{2}$: Less then π, not between π and 5.

$\pi + 1$: Lies between π and 5 ($\pi + 1 \approx 4.14$) and is irrational. Correct.

$\pi - 1$: Less than π, not between π and 5.

7. Every point on a number line represents: ***(Re)***

(*a*) a unique real number (*b*) integers
(*c*) rational number (*d*) all of these

Sol. Every point on the number line represents a unique real number because the number line includes all rational and irrational numbers, ensuring one-to-one correspondence with real numbers.

8. If $x = 0.232323...$ and $y = 0.22222...$ then $x + y =$ ***(Ap)***

(*a*) $0.\overline{45}$ (*b*) 0.45 (*c*) $0.\overline{43}$ (*d*) $0.4\overline{5}$

Sol. Write $x = 0.\overline{23}$ and $y = 0.\overline{2}$.

Add directly using decimals:

$$x + y = 0.232323... + 0.222222... = 0.454545...$$

Recognize $0.454545... = 0.\overline{45}$.

9. Which of the following is an irrational nu+6mber? ***(An)***

(*a*) 0.090909.... (*b*) 22/7
(*c*) 0.25 (*d*) $\sqrt{3}$

Sol. (*a*) This is a repeating decimal, and repeating decimals can be expressed as fractions.

For example, $0.090909... = \frac{1}{11}$, which makes it a rational number.

(*b*) This is a fraction and can be expressed as the ratio of two integers. Hence, $\frac{22}{7}$ is a rational number.

(*c*) This is a terminating decimal and can be written as $\frac{1}{4}$.

Therefore, 0.25 is a rational number.

(*d*) The square root of 3 is an irrational number. As 3 is a prime number and square root of a prime number is alsways an irrational number.

10. A rational number between $\sqrt{2}$ and $\sqrt{3}$ is **(*Un*) (NCERT Exemplar)**

(*a*) $\frac{\sqrt{2}+\sqrt{3}}{2}$ (*b*) $\frac{\sqrt{2}.\sqrt{3}}{2}$

(*c*) 1.5 (*d*) 1.8

Sol. The square roots $\sqrt{2} \approx 1.414$ and $\sqrt{3} \approx 1.732$ have their approximate values in the range (1.414, 1.732).

Among the given options:

$\frac{\sqrt{2}+\sqrt{3}}{2}$ is not rational because it involves square roots in its expression.

$\frac{\sqrt{2}.\sqrt{3}}{2}$ is also not rational for the same reason.

1.5 is a rational number, and it lies between 1.414 and 1.732.

11. A student represents an integer 8 as 8*I*. Which of the following is true about the integer? **(*Re*) (CBSE QB)**

(*a*) It is an irrational number as it is in the form *p*/*q* where $q \neq 0$.

(*b*) It is a rational number as it is in the form *p*/*q* where $q \neq 0$.

(*c*) It is not a rational number as rational number is in the form *p*/*q* where $q \neq$ I.

(*d*) It is not an irrational number as irrational number is in the form *p*/*q* where $q \neq$ I.

Sol. Rational Numbers are those numbers which can be expressed as a fraction *p*/*q* where *p* and *q* are integers and $q \neq 0$.

Irrational Numbers are those Numbers which cannot be expressed as simple fractions *p*/*q* (where $q \neq 0$).

Hence, 8 is rational because it can be written as *p*/*q* (like 8/1) with $q \neq 0$.

Answer Key

1. (*c*)	2. (*a*)	3. (*d*)	4. (*d*)	5. (*c*)
6. (*c*)	7. (*a*)	8. (*a*)	9. (*d*)	10. (*c*)
11. (*b*)				

Assertion and Reason **(1 M)**

Direction: **In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.**

(*a*) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).

(*b*) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(*c*) Assertion (A) is true, but Reason (R) is false.

(*d*) Assertion (A) is false, but Reason (R) is true.

1. Assertion (A): Sum of 2 and $\sqrt{3}$ is an irrational number.

Reason (R): Sum of any two real numbers is always irrational number. **(*Re*)**

Sol. Assertion (A): The sum of 2 and $\sqrt{3}$ is an irrational number. This is true because 2 is a rational number, $\sqrt{3}$ is an irrational number, and the sum of a rational number and an irrational number is always irrational.

Reason (R): The sum of any two real number is always an irrational number. This is false because the sum of two real numbers can be rational or irrational depending on the numbers (e.g., 2 + 3 = 5, which is rational).

Assertion (A) is true, but Reason (R) is false.

2. Assertion (A): Three rational number between $\frac{2}{5}$ and $\frac{3}{5}$ are $\frac{9}{20}, \frac{10}{20}$ and $\frac{11}{20}$.

Reason (R): A rational number between two rational numbers *p* and *q* is $\frac{p+q}{2}$ **(*Ev*)**

Sol. Assertion (A): Three rational numbers between $\frac{2}{5}$ and $\frac{3}{5}$ are $\frac{9}{20}, \frac{10}{20}$, and $\frac{11}{20}$.

Use the formula $\frac{p+q}{2}$:

Let $p = \frac{2}{5} = \frac{8}{20}$ and $q = \frac{3}{5} = \frac{12}{20}$.

First midpoint: $\frac{p+q}{2} = \frac{\frac{8}{20}+\frac{12}{20}}{2} = \frac{20}{40} = \frac{10}{20}$

So, $\frac{10}{20}$ lies between $\frac{2}{5}$ and $\frac{3}{5}$.

Rational numbers $\frac{9}{20}$ (before midpoint) and $\frac{11}{20}$ (after midpoint) also lie between $\frac{2}{5}$ and $\frac{3}{5}$.

Thus, $\frac{9}{20}, \frac{10}{20}$, and $\frac{11}{20}$ satisfy the assertion.

Assertion (A) is true.

Reason (R): A rational number between two rational numbers *p* and *q* is $\frac{p+q}{2}$. Reason (R) is true.

Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).

3. **Assertion (A): $2+3\sqrt{6}$ is an irrational number.**

Reason (R): Sum of a two irrational numbers is always an irrational number. ***(Un)***

Sol. Assertion (A): $2+3\sqrt{6}$ is an irrational number.

2 is a rational number, and $3\sqrt{6}$ is irrational because $\sqrt{6}$ is irrational and multiplying it by 3 doesn't change its nature. The sum of a rational number (2) and an irrational number $(3\sqrt{6})$ is always irrational.

Hence, Assertion (A) is true.

Reason (R): The sum of two irrational numbers is always an irrational number.

This statement is false, as the sum of two irrational number can sometimes be rational.

For example, $\sqrt{2}+(-\sqrt{2})=0$, which is rational.

Hence, Reason (R) is false.

Assertion (A) is true, but Reason (R) is false.

4. **Assertion (A): Every integer is a rational number.**

Reason (R): Every integer '*m*' can be expressed in the form $\frac{m}{1}$ ***(Re)*** **(KVS 2023)**

Sol. Assertion (A): Every integer is rational number.

This statement is true because rational number are defined as numbers that can be expressed in the form $\frac{p}{q}$, where p and q are integers, and $q \neq 0$. Every integer m can be written as $\frac{m}{1}$, which satisfies this condition.

Reason (R): Every integer m can be expressed in the form $\frac{m}{1}$.

This statement is also True, as it explains why integers are rational numbers.

Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.

Answer Key

1. (c) 2. (a) 3. (c) 4. (a)

Subjective Questions

Very Short Answer Type Questions (1 or 2 M)

1. **Find a rational number between 3 and 4.** ***(Ev)***

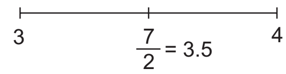
Sol. We know that, $\frac{r+s}{2}$ is between r and s. *(1 M)*

Therefore, a rational number between 3 and 4 is

$$\frac{3+4}{2}=\frac{7}{2}$$

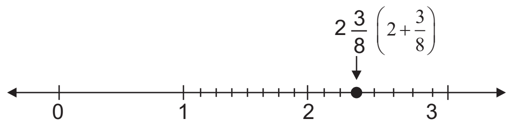
$$\left(3<\frac{7}{2}<4\right)$$

Hence, $\frac{7}{2}$ (= 3.5) is a rational number between 3 and 4. *(1 M)*



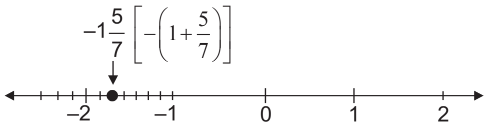
2. **Represent (*i*) $2\frac{3}{8}$ and (*ii*) $-1\frac{5}{7}$ on the number line.** ***(Un)***

Sol. (*i*)



(1 M)

(*ii*)



(1 M)

3. $\frac{\sqrt{98}}{\sqrt{2}}$ **a rational number or not?** ***(An)***

Sol. $\frac{\sqrt{98}}{\sqrt{2}}=\sqrt{\frac{98}{2}}=\sqrt{49}=7$ *(1 M)*

So, it is a rational number because 7 can be writen as $\frac{7}{1}$ which is the $\frac{p}{q}$ from, where $q \neq 0$. *(1 M)*

4. **Is the product of two irrational numbers always irrational? Justify your answer.** ***(Re)***

Sol. No; sometime rational, sometimes irrational. *(1 M)*

For example, $\sqrt{5}\times\sqrt{5}=\sqrt{25}=5$ is rational and $\sqrt{3}\times\sqrt{5}=\sqrt{15}$ is irrational. *(1 M)*

5. **Find an irrational number between $\frac{1}{7}$ and $\frac{2}{7}$.** ***(Un)*** **(NCERT Intext)**

Sol. Since,

$\frac{1}{7}=0.142857142857142857....=0.\overline{142857}$

$\frac{2}{7}=0.\overline{285714}$ *(½ M)*

To find an irrational number between $\frac{1}{7}$ and $\frac{2}{7}$ we find a number which is non-terminating non-recurring lying between them. *(½ M)*

Hence, an irrational number between $\frac{1}{7}$ and $\frac{2}{7}$ is 0.150150015000150000… *(1 M)*

6. **Find a different irrational numbers between the rational numbers $\frac{5}{7}$ and $\frac{9}{11}$.** ***(Un)***

Sol. Since,

$\frac{5}{7}\approx 0.\overline{714285}\approx 0.714285714285...$

$\frac{9}{11}\approx 0.\overline{81}\approx 0.818181818181...$ *(½ M)*

To find an irrational number between $\frac{5}{7}$ and $\frac{9}{11}$ we find a number which is non-terminating non-recurring lying between them. *(½ M)*

Hence, an irrational number between $\frac{5}{7}$ and $\frac{9}{11}$ is 0.72072007200072000... *(1 M)*

7. Show that 0.2353535... = $0.2\overline{35}$ can be expressed in the form *p*/*q*, where *p* and *q* are integers and *q* ≠ 0. **(*Un*) (KVS 2024)**

Sol. Let $x = 0.2\overline{35}$

Separate the repeating part: $x = 0.2 + 0.0\overline{35}$, let $y = 0.0\overline{35}$

Multiply y by 10: $10y = 0.\overline{35}$ … (*i*)

Multiply y by 1000: $1000y = 35.\overline{35}$ … (*ii*) *(1 M)*

from equation (*ii*) – (*i*)

$$\Rightarrow \quad 1000y - 10y = 35 \quad \Rightarrow \quad 990y = 35 \quad \Rightarrow \quad y = \frac{35}{990}$$

Substitute y back into x : $x, = 0.2 + \frac{35}{990} = \frac{198}{990} + \frac{35}{990}$.

Hence, $0.2\overline{35} = \frac{233}{990}$. *(1 M)*

Short Answer Type Questions (2 or 3 M)

1. Find three rational numbers between $\frac{5}{7}$ and $\frac{6}{7}$. **(*Ev*) (NCERT Exemplar)**

Sol. To find three rational numbers between them, multiply numerator and denominator by 4 (3 + 1):

$$\frac{5}{7} = \frac{5\times4}{7\times4} = \frac{20}{28}$$

$$\frac{6}{7} = \frac{6\times4}{7\times7} = \frac{24}{28}$$

Now three rational numbers between $\frac{20}{28}$ and $\frac{24}{28}$ are $\frac{21}{28}, \frac{22}{28}, \frac{23}{28}$. *(2 M)*

2. Find three rational numbers between

(*i*) –1 and –2 **(*ii*) $\frac{1}{10}$ and $\frac{11}{100}$** **(*Un*)**

Sol. (*i*) To find three rational numbers between them, multiply numerator and denominator by 4 (3 + 1):

$$-1 = \frac{-4}{4}, -2 = \frac{-8}{4}$$

Now three rational numbers between $\frac{-4}{4}$ and $= \frac{-8}{4}$ are $\frac{-5}{8}, \frac{-6}{8}, \frac{-7}{8}$ *(1½ M)*

(*ii*) Make denominators same LCM (10, 100) = 100

Now, both rational numbers, $\frac{1}{10} = \frac{10}{100}, \frac{11}{100}$

To find three rational numbers between them, multiply numerator and denominator by 4 (3 + 1):

$$\frac{10}{100} = \frac{40}{400}, \frac{11}{100} = \frac{44}{400}$$

Now three rational numbers between $\frac{40}{400}$ and $\frac{44}{400}$ are $\frac{41}{400}, \frac{42}{400}, \frac{43}{400}$ *(1½ M)*

3. Express 0.00323232... in the form p/q, where p and q are integers and q ≠ 0. **(*Cr*) (NCERT Exemplar)**

Sol. Let x = 0.00323232...

Then, 100x = 0.323232... ...(i)

Also 10000x = 32.323232... ...(ii) *(1 M)*

Subtracting (i) from (ii), we get

10000x – 100x = 32.323232... – 0.323232... *(1 M)*

⇒ 9900x = 32

$$\Rightarrow x = \frac{32}{9900} \Rightarrow x = \frac{8}{2475}.$$ *(1 M)*

4. Write 3/13 in decimal form and find what kind of decimal expansion it has. **(*Cr*) (NCERT Exemplar)**

Sol. By long division, we have

$$\begin{array}{r}
0.230769230 \\
13\,\overline{)\,3.0000000} \\
-26 \\ \hline
40 \\
-39 \\ \hline
100 \\
-91 \\ \hline
90 \\
-78 \\ \hline
120 \\
-117 \\ \hline
30 \\
-26 \\ \hline
40 \\
-39 \\ \hline
1
\end{array}$$ *(2 M)*

$\therefore \frac{3}{13} = 0.\overline{230769}$, non-terminating and repeating. *(1 M)*

5. Locate $\sqrt{13}$ on the number line. **(*Cr*) (NCERT Exemplar)**

Sol. Locate $\sqrt{13}$ on the number line.

We write 13 as the sum of the squares of two natural numbers: $13 = 9 + 4 = 3^2 + 2^2$

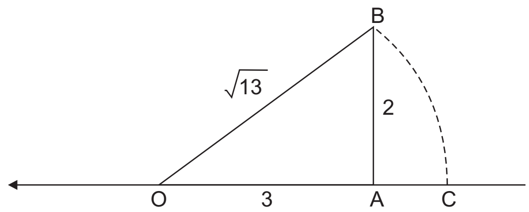
On the number line, take OA = 3 units.

Draw BA = 2 units, perpendicular to OA. Join OB (see Fig.). *(1 M)*

By Pythagoras theorem.

$$OB = \sqrt{13}$$

Using a compass with centre O and radius OB, draw an arc which intersects the number line at the point C. Then, C corresponds to $\sqrt{13}$.



(2 M)

Long Answer Type Questions (4 or 5 M)

1. Find five rational numbers between $\frac{3}{5}$ and $\frac{4}{5}$. (*Cr*) (NCERT Intext)

Sol. Rational number between *a* and $b = \frac{1}{2}(a+b)$

$\therefore$ Rational number between $\frac{3}{5}$ and $\frac{4}{5} = \frac{1}{2}\left(\frac{3}{5}+\frac{4}{5}\right)$

$$= \frac{1}{2}\times\frac{7}{5} = \frac{7}{10} \quad (1\ M)$$

Rational number between $\frac{3}{5}$ and $\frac{7}{10}$

$$= \frac{1}{2}\left(\frac{3}{5}+\frac{7}{10}\right) = \frac{1}{2}\left(\frac{6+7}{10}\right) = \frac{1}{2}\times\frac{13}{10} = \frac{13}{20} \quad (1\ M)$$

Rational number between $\frac{7}{10}$ and $\frac{4}{5}$

$$= \frac{1}{2}\left(\frac{7}{10}+\frac{4}{5}\right) = \frac{1}{2}\left(\frac{7+8}{10}\right) = \frac{1}{2}\times\frac{15}{10} = \frac{15}{20} = \frac{3}{4} \quad (1\ M)$$

Rational number between $\frac{3}{5}$ and $\frac{13}{20}$

$$= \frac{1}{2}\left(\frac{3}{5}+\frac{13}{20}\right) = \frac{1}{2}\left(\frac{12+13}{20}\right)$$

$$= \frac{1}{2}\times\frac{25}{20} = \frac{25}{40} = \frac{5}{8} \quad (1\ M)$$

and rational number between $\frac{3}{4}$ and $\frac{4}{5}$

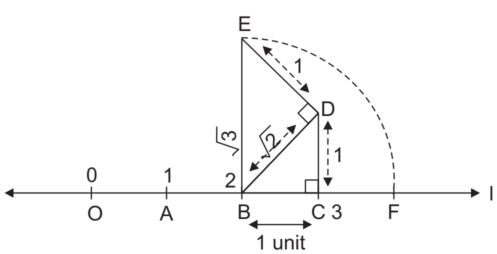
$$= \frac{1}{2}\left(\frac{3}{4}+\frac{4}{5}\right) = \frac{1}{2}\left(\frac{15+16}{20}\right) = \frac{1}{2}\times\frac{31}{20} = \frac{31}{40} \quad (1\ M)$$

Hence, Required rational numbers are $\frac{5}{8}, \frac{13}{20}, \frac{7}{10}, \frac{3}{4}, \frac{31}{40}$

2. Represent $2+\sqrt{3}$ on number line. (*Un*)

Sol. On the number line *l*, mark the points O, A, B and C such that OA = AB = BC = 1 unit.

Draw CD $\perp$ *l* such that CD = 1 unit. Join BD.



(2 M)

In ΔBCD, BD = $\sqrt{1^2+1^2} = \sqrt{2}$ units (1 M)

At D, draw ED $\perp$ BD, such that DE = 1 unit.

Join BE.

InΔBED, BE = $\sqrt{\left(\sqrt{2}\right)^2+1^2} = \sqrt{3}$ units (1 M)

Taking B as centre and BE as radius, draw an arc intersecting line *l* at F.

$\therefore$ BE = BF = $\sqrt{3}$ units

Here, OB = 2 units, BF = $\sqrt{3}$ units

$\therefore$ OF = OB + BF = (2 + $\sqrt{3}$) units

Here, Point F Represent $(2+\sqrt{3})$ an number line. (1 M)

3. Find six rational numbers between 3 and 4. (*Cr*)

Sol. A rational number between 3 and 4 is

$$\frac{1}{2}(3+4) = \frac{7}{2} \quad i.e., \quad 3<\frac{7}{2}<4$$

Now, a rational number between 3 and $\frac{7}{2}$ is

$$\frac{1}{2}\left(3+\frac{7}{2}\right) = \frac{13}{4} \quad i.e.,\ 3<\frac{13}{4}<\frac{7}{2}<4 \quad (1\ M)$$

A rational number between $\frac{13}{4}$ and $\frac{7}{2}$ is

$$\frac{1}{2}\left(\frac{13}{4}+\frac{7}{2}\right) = \frac{27}{8} \quad i.e.,\ 3<\frac{13}{4}<\frac{27}{8}<\frac{7}{2}<4 \quad (1\ M)$$

A rational number between $\frac{7}{2}$ and 4 is

$$\frac{1}{2}\left(\frac{7}{2}+4\right) = \frac{15}{4} \quad i.e.,\ 3<\frac{13}{4}<\frac{27}{8}<\frac{7}{2}<\frac{15}{4}<4 \quad (1\ M)$$

A rational number between $\frac{7}{2}$ and $\frac{15}{4}$ is

$$\frac{1}{2}\left(\frac{7}{2}+\frac{15}{4}\right) = \frac{29}{8} \quad i.e.,\ 3<\frac{13}{4}<\frac{27}{8}<\frac{7}{2}<\frac{29}{8}<\frac{15}{4}<4 \quad (1\ M)$$

A rational number between $\frac{15}{4}$ and 4 is

$$\frac{1}{2}\left(\frac{15}{4}+4\right) = \frac{31}{8} \quad i.e.,\ 3<\frac{13}{4}<\frac{27}{8}<\frac{7}{2}<\frac{29}{8}<\frac{15}{4}<\frac{31}{8}<4$$

(1 M)

Hence, 6 rational numbers between 3 and 4 are

$\frac{13}{4}, \frac{27}{8}, \frac{7}{2}, \frac{29}{8}, \frac{15}{4}$ and $\frac{31}{8}$.

4. Write the following in decimal form and say what kind of decimal expansion each has: (*Ev*)

(*i*) $\frac{36}{100}$ (*ii*) $\frac{1}{11}$

(*iii*) $4\frac{1}{8}$ (*iv*) $\frac{3}{13}$

(*v*) $\frac{2}{11}$

Sol. (*i*) $\frac{36}{100}$

Decimal Form: $\frac{36}{100} = 0.36$

Type of expansion: Terminating (ends after 2 decimal places) (*1 M*)

(*ii*) $\frac{1}{11}$

$$\begin{array}{r|l} & 0.0909 \\ 11 & 1.00 \\ & -99 \\ \hline & 100 \\ & -99 \\ \hline & 1 \\ \hline \end{array}$$

Decimal Form: $\frac{1}{11} = 0.\overline{09}$

Type of Expansion: Non-terminating repeating (repeats "09" infinitely). (*1 M*)

(*iii*) $4\frac{1}{8} = \frac{33}{8}$

$$\begin{array}{r|l} & 4.125 \\ 8 & 33.0 \\ & -32 \\ \hline & 10 \\ & -8 \\ \hline & 20 \\ & -16 \\ \hline & 40 \\ & -40 \\ \hline & 0 \\ \hline \end{array}$$

Decimal Form: $\frac{33}{8} = 4.125$

Type of Expansion: Terminating (ends after 3 decimal place). (*1 M*)

(*iv*) $\frac{3}{13}$

$$\begin{array}{r|l} & 0.23076923\ldots \\ 13 & 3.00000000 \\ & -26 \\ \hline & 40 \\ & -39 \\ \hline & 10 \\ & -00 \\ \hline & 100 \\ & -91 \\ \hline & 90 \\ & -78 \\ \hline & 120 \\ & -117 \\ \hline & 30 \\ & -26 \\ \hline & 40 \\ & -39 \\ \hline & 1 \\ \hline \end{array}$$

Decimal form $\frac{3}{13} = 0.23076923 \ldots = 0.\overline{230769}$ (*1 M*)

Type of Expansion: Non-terminating recurring decimal

(*v*) $\frac{2}{11}$

$$\begin{array}{r|l} & 0.1818 \\ 11 & 20 \\ & -11 \\ \hline & 90 \\ & -88 \\ \hline & 20 \\ & -11 \\ \hline & 90 \\ & -88 \\ \hline & 2 \\ \hline \end{array}$$

Decimal Form: $\frac{2}{11} = 0.\overline{18}$

Type of Expansion: Non-terminating repeating (repeats '18' infinitely). (*1 M*)

5. Express the following in the form $\frac{p}{q}$, where *p* and *q* are integers and q ≠ 0. **(*Ev*) (NCERT Intext)**

(*i*) $0.\overline{6}$ (*ii*) $0.4\overline{7}$ (*iii*) $0.\overline{001}$

Sol. (*i*) 0.6 (Repeating: 0.6666…)

Let: $x = 0.\overline{6}$ ...(*i*)

Multiply by 10, $10x = 6.\overline{6}$ ...(*ii*)

Equation (*ii*) – (*i*)

$\Rightarrow 10x - x = 6.\overline{6} - 0.\overline{6}$ (½ *M*)

$\Rightarrow 9x = 6$

$\Rightarrow x = \frac{6}{9} = \frac{2}{3}$

Hence, $0.\overline{6} = \frac{2}{3}$ (*1 M*)

(*ii*) Let $x = 4.4\overline{7}$

$x = 0.4777$ … (*i*)

Multiply by 10 to shift the decimal point

$10x = 4.777$ … (*ii*)

Multiply eq. (*i*) by 100 to shift the repeating part

$100x = 47.777$ … (*iii*)

Equation (*iii*) – (*ii*)

$\Rightarrow 100x - 10x = 47.777 \ldots - 4.777 \ldots$ (*1 M*)

$\Rightarrow 90x = 43$

$\Rightarrow x = \frac{43}{90}$

Hence, $4.4\overline{7} = \frac{43}{90}$ (*1 M*)

(*iii*) Let: $x = 0.\overline{001}$ … (*i*)

Multiply by 1000 (since the repeating part has 3 digits):

$1000x = 1.\overline{001}$ … (*ii*)

Equation: (*ii*) – (*i*)

$\Rightarrow 1000x - x = 1.\overline{001} - 0.\overline{001} \Rightarrow x = \frac{1}{999}$

Hence, $0.\overline{001} = \frac{1}{999}$ (*1½ M*)

MOCK TEST PAPER-1

Time allowed : 3 hours **Maximum Marks : 80**

General Instructions:

Read the following instructions carefully and follow them:

*(i) This Question Paper has **5** Sections **A, B, C, D,** and **E.***

*(ii) All Questions are compulsory. However, an internal choice in **2** Questions of **2** marks, **2** Questions of **3** marks and **2** Questions of **5** marks has been provided. An internal choice has been provided in the **2** marks questions of Section E.*

*(iii) Draw neat figures wherever required. Take π **= 22/7** wherever required if not Stated.*

SECTION - A

Q 1-20 are multiple choice questions. Each question is of 1 mark.

1. Which of the following is irrational?

(*a*) 0.14 (*b*) $0.14\overline{16}$ (*c*) $0.\overline{1416}$ (*d*) 0.4014001400014...

2. Express y in terms of x in the equation $5x - 2y = 7$.

(*a*) $y = \frac{5x-7}{2}$ (*b*) $y = \frac{7-5x}{2}$ (*c*) $y = \frac{7x+5}{2}$ (*d*) $y = \frac{5x+7}{2}$

3. $P(5, -7)$ be a point on the graph. Draw the $PM \perp y$-axis. The coordinates of M are

(*a*) (0, –7) (*b*) (0, 0) (*c*) (–7, 0) (*d*) (–7, 5)

4. In a frequency distribution, the mid value of a class is 10 and the width of the class is 6. The lower limit of the class is

(*a*) 6 (*b*) 7 (*c*) 8 (*d*) 12

5. Which of the following point does not lie on the line $y - 2x - 3 = 0$?

(*a*) (–5, –7) (*b*) (–1, 1) (*c*) (3, 9) (*d*) (3, 7)

6. The total number of propositions in the Euclid's Elements is

(*a*) 460 (*b*) 465 (*c*) 32 (*d*) 13

7. After rationalising the denominator of $\frac{1}{\sqrt{2}}$, we get

(*a*) $\frac{\sqrt{2}}{2}$ (*b*) $\frac{2}{\sqrt{2}}$ (*c*) $2\sqrt{2}$ (*d*) None of these

8. The quadrilateral formed by joining the mid-points of the sides of a quadrilateral $PQRS$, taken in order, is a rectangle, if

(*a*) $PQRS$ is a rectangle (*b*) $PQRS$ is a parallelogram

(*c*) diagonals of $PQRS$ are perpendicular (*d*) diagonals of $PQRS$ are equal

9. Find whether (1, 1) is the solution of the equation $x - 2y = 4$ or not?

(*a*) Yes (*b*) No (*c*) Can not be determined (*d*) None of these

10. The equation $x = 7$, in two variables, can be written as

(*a*) $1.x + 1.y = 7$ (*b*) $1.x + 0.y = 7$ (*c*) $0.x + 1.y = 7$ (*d*) $0.x + 0.y = 7$

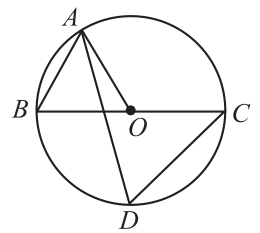
11. If given that $\Delta ABC \cong \Delta FDE$ and $AB = 5$ cm, $B = 40°$ and $A = 80°$. Then which of the following is true?

(a) $DF = 5$ cm, $\angle F = 60°$ (b) $DF = 5$ cm, $\angle E = 60°$ (c) $DE = 5$ cm, $\angle E = 60°$ (d) $DE = 5$ cm, $\angle D = 40°$

12. How many linear equations in x and y can be satisfied by $x = 1$ and $y = 2$?

(a) Only one (b) Two (c) Infinitely many (d) Three

13. In figure, BC is a diameter of the circle and $\angle BAO = 60°$. Then $\angle ADC$ is equal to



(a) 30° (b) 45° (c) 60° (d) 120°

14. The product $\sqrt[3]{2} \cdot \sqrt[4]{2} \cdot \sqrt[12]{32}$ equals

(a) $\sqrt{2}$ (b) 2 (c) $\sqrt[12]{2}$ (d) $\sqrt[12]{32}$

15. The cost of 2 kg of apples and 1 kg of grapes on a day was found to be ₹160. A linear equation in two variables to represent the above data is

(a) $x - 2y = 160$ (b) $2x + y = 160$ (c) $x + y = 160$ (d) $2x - y = 160$

16. In triangles ABC and PQR, $AB = AC$, $\angle C = \angle P$ and $\angle B = \angle Q$. The two triangles are

(a) isosceles but not congruent (b) isosceles and congruent

(c) congruent but not isosceles (d) neither congruent nor isosceles

17. To draw a histogram to represent the following frequency distribution:

Class interval	5–10	10–15	15–25	25–45	45–75
Frequency	6	12	10	8	15

The adjusted frequency for the class 25–45 is

(a) 6 (b) 5 (c) 2 (d) 3

18. The total surface area of a cone whose radius is $\frac{r}{2}$ and slant height $2l$ is

(a) $2\pi r(l + r)$ (b) $\pi r\left(l + \frac{r}{2}\right)$ (c) $\pi r(l + r)$ (d) $2\pi rl$

DIRECTIONS: In the question number **19** and **20**, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**. Choose the correct option out of the following:

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of (A).

(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

(c) Assertion (A) is true but Reason (R) is false.

(d) Assertion (A) is false but Reason (R) is true.

19. **Assertion (A):** The perimeter of a right angled triangle is 60 cm and its hypotenuse is 26 cm . The other sides of the triangle are 10 cm and 24 cm. Also, the area of the triangle is 120 cm^2.

Reason (R): $(\text{Base})^2 + (\text{Perpendicular})^2 = (\text{Hypotenuse})^2$

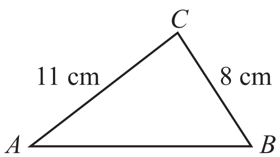
20. **Assertion (A):** A linear equation $2x + 3y = 5$ has a unique solution.

Reason (R): A linear equation in two variables has infinitely many solutions.

SECTION - B

Section-B consists of 5 questions of 2 marks each.

21. Find the area of a triangle, two sides of which are 8 cm and 11 cm and the perimeter is 32 cm.



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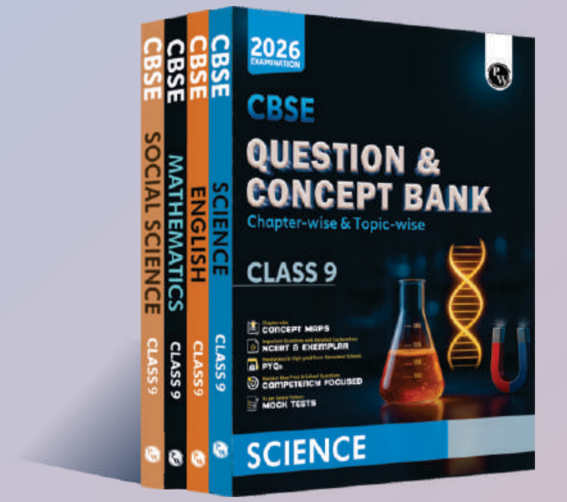

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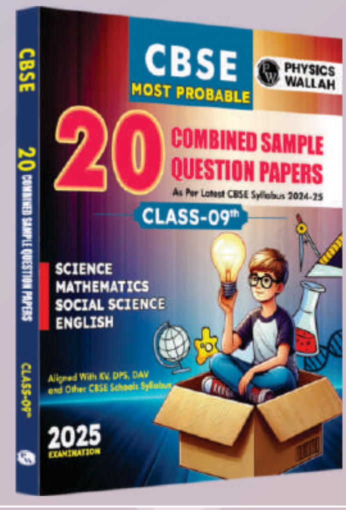

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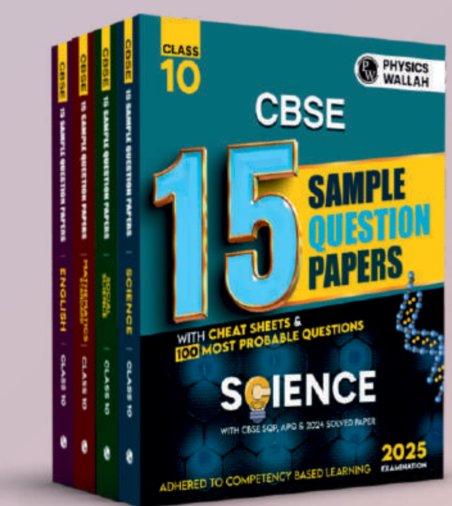

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