Chapter 1

RATIONAL NUMBERS

Pythagoras is known as the father of rational numbers. He was an ancient Greek mathematician and philosopher who believed that all numbers could be expressed as a ratio of two integers.

Early mathematicians like Pythagoras and Euclid in ancient Greece had knowledge of rational numbers and their properties. The understanding and development of rational numbers evolved over time through the contributions of various mathematicians across different cultures.

CONCEPT MAP

RATIONAL NUMBERS

- **Standard Form**
- **Rational number between two rational numbers**
- **Represent Rational Numbers on Number Line**
- **Operations on Rational Numbers:** Addition, Subtraction, Multiplication, Division
- **Important Points**
  - Multiplicative inverse of a is $\frac{1}{a}$
  - Multiplicative identity is 1
  - Additive identity is 0.
  - Additive inverse of a is -a
  - Absolute value of a number is its numerical value (without sign)

Operation \ Property	Closure	Commutative	Associative	Distributive
Addition	✓	✓	✓	-
Subtraction	✓	✗	✗	-
Multiplication	✓	✓	✓	✓
Division	✓ (except for 0)	✗	✗	✗

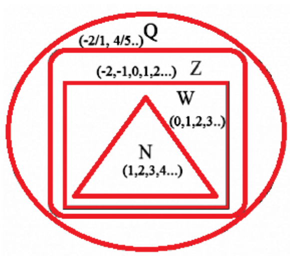
CONCEPT 1.1

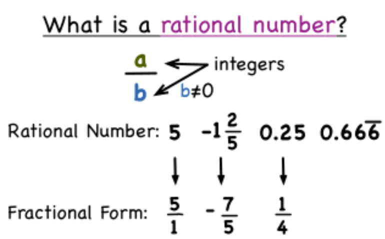
Rational Numbers:

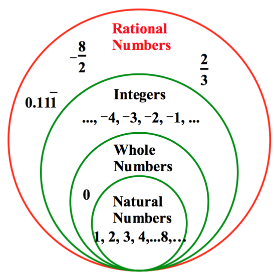
1. As civilisation developed, there was a need to divide quantities into parts.
2. After having extended the system of natural numbers so as to include zero and negative integers, man soon discovered that he could not do all of his arithmetic with only the integers.
3. The system of integers suffered from the defect that division is not always possible within the system.
4. For example, $3 \div 5$ or $-7 \div 3$ had no answer. That is to say, no integer could be found to fill in the blank:
   $5\times$……… $=3$ or $3\times$……… $=-7$.
5. Therefore, man felt they need to go beyond integers and construct a new number system which included integers and in which all divisions could be carried out.
6. The numbers that were created are called rational numbers. The word 'rational' is derived from the word 'ratio' which means comparing one number with another.

Rational Number Definition:

A rational number is any number that can be write in the form of a/b where a and b are integers and b≠ 0. The set of rational numbers is denoted by the capital letter 'Q', and Q comes from the word 'Quotient'.







Example:

Thus, each of the numbers 5/6, –6/11, –13/9, 6/–17 are rational numbers.

Note:

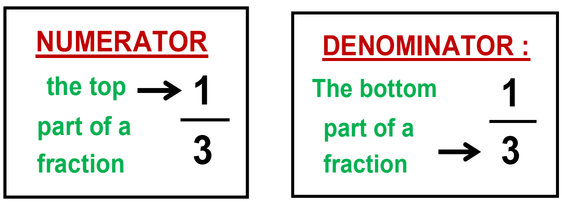
1. **Every natural number is a rational number, but a rational number need not be a natural number.**
   We can write 1=1/1, 2=2/1, 3=3/1 and so on.
   This shows that every natural number n can be written as n/1 which is a rational number.
   But none of the rational numbers like 5/6, 3/8, 1/3, etc., is a natural number.
2. **Zero is a rational number.**
   We can write 0 in anyone of the forms 0/1, 0/–1, 0/2, 0/–2, 0/3, 0/–3 and so on. Thus, 0 can be expressed as p/q, where p = 0 and q is any non-zero integer. Hence, 0 is a rational number.

3. **Every integer is a rational number, but a rational number need not be in integer.**
   We know that $1=1/1$, $2=2/1$, $3=3/1$, $-1=-1/1$, $-2=-2/1$, $-3=-3/1$ and so on.
   In general, any integer n can be written as $n=n/1$, which is a rational number. But rational numbers like $5/7$, $-7/8$, $11/-6$ are not integers.
4. **Every fraction is a rational number, but a rational number need not be a fraction.**
   Let p/q be any fraction. Then, p and q are natural numbers. Since every natural number is an integer, therefore, p and q are integers. Thus, the fraction p/q is the quotient of two integers such that $q \neq 0$. Hence, p/q is a rational number.

   A number like $7/-8$ is a rational number but it is not a fraction since its denominator -8 is not a natural number.
5. A rational number can't have $q = 0$ i.e., denominator of a rational number $\neq 0$ as division by zero is not defined.

Numerator and Denominator:

Let p/q $(q \neq 0)$ be a rational number. It has two terms. One is p above the line '/' and the other is q below the line. p is called the numerator of the rational number and q is called the denominator.



Positive and Negative Rational Numbers:

We have seen that every integer other than '0' is either positive or negative. Same in the case with every rational number. Every rational number other than '0' is either positive or negative.

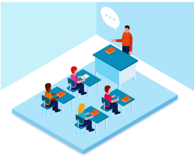
1. A rational number is said to be positive if its numerator and denominator are either both positive or both negative. In other words, a rational number is positive, if its numerator and denominator are of the same sign.

   For example, $5/7$, $29/18$, $-16/-19$, $-27/-83$ are all positive rational numbers.
2. A rational number is said to be negative if its numerator and denominator are such that one of them is a positive integer and the other is a negative integer. In other words, a rational number is negative, if its numerator and denominator are of the opposite signs.

   For example. Each of the numbers $-7/9$, $28/-59$, $-37/11$, $56/-217$ is a negative rational number.

Note that:

1. Every negative integer is a negative rational number. For e.g., -1, -2, -3 and so on, which may be expressed as $-1 = -1/1$, $-2 = -2/1$, $-3 = -3/1$, ... are all negative rational numbers.
2. The rational number 0 is neither positive nor negative.



CLASSROOM DISCUSSION QUESTIONS

CDQ 1.1

1. What prompted the need for rational numbers in mathematics?

(A) Limitations of the integer system
(B) To solve complex equations
(C) Introduction of fractions
(D) Division by zero

2. How are rational numbers defined?

(A) Any number expressed in decimal form
(B) Any number expressed as a quotient of two integers
(C) Any number that includes a fraction
(D) Any number that is not an integer

3. Which set of numbers does the set of rational numbers include?

(A) Natural numbers only
(B) Whole numbers only
(C) Integers and fractions
(D) Irrational numbers

4. What is the numerator of a rational number?

(A) The number above the fraction line
(B) The number below the fraction line
(C) The absolute value of the fraction
(D) The reciprocal of the fraction

5. Which statement about rational numbers is true?

(A) Every fraction is a rational number
(B) Every rational number is an integer
(C) Every integer is an irrational number
(D) Every irrational number is a whole number

6. Which of the following is NOT true about rational numbers?

(A) They can be written as a quotient of two integers
(B) They can be positive or negative
(C) They can have a denominator of zero
(D) They include integers as a subset

7. How are positive rational numbers defined?

(A) When the numerator and denominator have opposite signs
(B) When both the numerator and denominator are positive or negative
(C) When the numerator is negative and the denominator is positive
(D) When the numerator is positive and the denominator is negative

8. What is the denominator of a rational number?

(A) The number above the fraction line
(B) The number below the fraction line
(C) The absolute value of the fraction
(D) The reciprocal of the fraction

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

CONCEPT 1.2

Equivalent Rational Numbers:

The equality of two rational numbers can be checked by any one of the following methods.

Method-1: If the numerator and denominator of a given rational number are multiplied (or divided) by the same non-zero integer, then the new rational number thus formed is said to be equivalent to the given rational number. i.e., Rational numbers p/q and r/s are equivalent to each other if

$$\frac{p\times k}{q\times k}=\frac{r}{s} \text{ or } \frac{p\div k}{q\div k}=\frac{r}{s} \quad \text{[k is a non-zero integer]}$$

Example:

i) $\frac{48}{52}=\frac{12}{13}$ and $\frac{12\times 4}{13\times 4}=\frac{48}{52}$.

Method-2: If the product of the numerator of the 1st rational number and the denominator of the 2nd rational number is equal to the product of the numerator of the 2nd rational number and the denominator of the 1st rational number then they are known as equivalent rational numbers. i.e., Rational numbers p/q and r/s are said to be equivalent to each other if p × s = r × q

Example:

i) $\frac{2}{3}$ and $\frac{6}{9}$ are equivalent to each other because $2\times 9 = 6\times 3 \Rightarrow 18 = 18$

ii) $\frac{3}{4}=\frac{15}{20} \Rightarrow 3 \times 20 = 15 \times 4 \Rightarrow 60 = 60$

Note: A rational number has infinite equivalent rational numbers.

Lowest form of a rational number:

1. A rational number a/b is said to be in the lowest form or simplest form if a and b have no common factor other than 1.
2. In other words, a rational number a/b is said to be in the simplest form, if the HCF of a and b is 1, i.e., a and b are relatively prime.
3. The rational number 3/5 is in the lowest form, because 3 and 5 have no common factor other than 1.
4. However, the rational number 18/60 is not in the lowest form, because 6 is a common factor to both numerator and denominator.

How to convert a rational number into lowest form or simplest form?

Every rational number can be put in the lowest form using the following steps:

Step I : Let us obtain the rational number a/b.

Step II : Find the HCF of a and b.

Step III : If k = 1, then a/b is in lowest form, where k is non-zero integer

Step IV : If $k \neq 1$, then $a \div k / b \div k$ is the lowest form of a/b.

Ex: Determine whether the following rational numbers are in the lowest form or not.

(i) 13/81 (ii) 72/960

Solution:

i) We observe that 13 and 81 have no common factor, i.e., their HCF is 1. Therefore, 13/81 is the lowest form of a rational number.

ii) We have,
$72 = 2 \times 2 \times 2 \times 3 \times 3$ and
$960 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 5$
Thus, HCF of 72 and 960 is $2 \times 2 \times 2 \times 3 = 24$.
Therefore, 72/960 is not in the lowest form.

Standard form of a rational number:

A rational number a/b is said to be in the standard form if b is positive, and the integers a and b have no common divisor other than 1.

How to convert a rational number into standard form?

To express a given rational number in the standard form, we follow the following steps:

Step I: Obtain the rational number.

Step II: See whether the denominator of the rational number is positive or not. If it is negative, multiply or divide numerator and denominator both by -1 so that denominator becomes positive.

Step III: Find the greatest common divisor (GCD) of the absolute values of the numerator and the denominator.

Step IV: Divide the numerator and denominator of the given rational number by the GCD (HCF) obtained in step III. The rational number so obtained is the standard form of the given rational number.

Ex. Write the following rational numbers in their standard form

(i) $\frac{9}{15}$ (ii) $\frac{-8}{2}$ (iii) $\frac{4}{-11}$ (iv) $\frac{-3}{-7}$

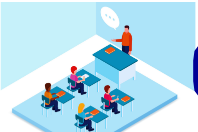
(v) $2\frac{4}{9}$ (vi) $-8\frac{2}{11}$ (vii) 0.2 (viii) $\frac{-444}{492}$

Sol. (i) $\frac{9}{15} = \frac{9 \div 3}{15 \div 3} = \frac{3}{5}$ (ii) $\frac{-8}{2} = -4$ (iii) $\frac{4}{-11} = \frac{4 \times (-1)}{-11 \times (-1)} = \frac{-4}{11}$

(iv) $\frac{-3}{-7} = \frac{(-3) \div (-1)}{(-7) \div (-1)} = \frac{3}{7}$ (v) $2\frac{4}{9} = \frac{22}{9}$ (vi) $-8\frac{2}{11} = \frac{-90}{11}$

(vii) $0.2 = \frac{2}{10} = \frac{1}{5}$.

(viii) We first find the HCF of 444 and 492. It is 12. Dividing the numerator and denominator by 12, we get $\frac{-444}{492} = \frac{-444 \div 12}{492 \div 12} = \frac{-37}{41}$



CLASSROOM DISCUSSION QUESTIONS

CDQ 1.2

1. How can the equivalence of two rational numbers be determined according to Method-1?

(A) If their sum is equal

(B) If their difference is equal

(C) If they can be expressed as a common fraction

(D) If their products are equal

2. How is the lowest form of a rational number obtained?

(A) By dividing the numerator by the denominator

(B) By finding the greatest common divisor of the numerator and denominator

(C) By multiplying the numerator by the denominator

(D) By adding the numerator and denominator

3. Which step is NOT involved in converting a rational number into its lowest form?

(A) Obtaining the rational number

(B) Finding the greatest common divisor

(C) Checking if the denominator is positive

(D) Dividing the numerator and denominator by their greatest common divisor

4. How is the standard form of a rational number achieved?

(A) By multiplying the numerator and denominator by a common factor

(B) By dividing the numerator and denominator by their greatest common divisor

(C) By adding the numerator and denominator

(D) By subtracting the numerator from the denominator

5. Which of the following rational numbers is already in its lowest form?

(A) 1/2 (B) 6/18

(C) 3/9 (D) 5/10

6. Which of the following steps is NOT involved in converting a rational number into its standard form?

(A) Obtaining the rational number

(B) Checking if the denominator is positive

(C) Finding the greatest common divisor

(D) Multiplying the numerator and denominator by a common factor

7. Which of the following rational numbers is NOT in its standard form?

(A) 2/5 (B) 2/7

(C) 8/4 (D) 5/3

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ____ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

CONCEPT 1.3

Comparison of Rational Numbers:

We know how to compare two integers and two fractions. We know that every positive integer is greater than zero and every negative integer is less than zero. Also, every positive integer is greater than every negative integer. Similar to the comparison of integers, we have the following facts about how to compare the rational numbers.

(i) Every positive rational number is greater than 0.
(ii) Every negative rational number is less than 0.
(iii) Every positive rational number is greater than every negative rational number.
(iv) Every rational number represented by a point on the number line is greater than every rational number represented by points on its left.
(v) Every rational number represented by a point on the number line is less than every rational number represented by points on its right.

How to compare the two rational numbers?

To compare any two rational numbers, we can use the following steps:

Step I: Obtain the given rational numbers.
Step II: Write the given rational numbers so that their denominators are positive.
Step III: Find the LCM of the positive denominators of the rational numbers obtained in step II.
Step IV: Express each rational number (obtained in step II) with the LCM (obtained in step III) as common denominator.
Step V: Compare the numerators of rational numbers obtained in step having greater numerator is the greater rational number.

Solved Examples:

Ex: Compare

(i) $\frac{9}{15}$ and $\frac{11}{6}$ (ii) $\frac{3}{-14}$ and $-\frac{5}{21}$.

Sol. (i) LCM of 15 and 6 = $3 \times 5 \times 2 = 30$

$$\begin{array}{r|l} 3 & 15,\ 6 \\ \hline & 5,\ 2 \end{array}$$

$$\frac{9}{15}=\frac{9\times 2}{15\times 2}=\frac{18}{30}, \frac{11}{6}=\frac{11\times 5}{6\times 5}=\frac{55}{30}$$

Since, 18<55.

$$\therefore \frac{18}{30}<\frac{55}{30} \therefore \frac{9}{15}<\frac{11}{6}.$$

(ii) $\frac{3}{-14}=\frac{-3}{14}, \frac{-5}{21}=\frac{-5}{21}$

LCM of 14 and 21 is $2\times7\times3 = 42$

2	14,	21
7	7,	21
	1,	3

$$\frac{-3}{14}=\frac{-3\times3}{14\times3}=\frac{-9}{42},\frac{-5}{21}=\frac{-5\times2}{21\times2}=\frac{-10}{42}$$

Since $-9>-10$.

$$\therefore \frac{-9}{42}>\frac{-10}{42}\therefore \frac{-3}{14}>\frac{-5}{21}$$

Ex: Arrange the rational numbers $\frac{-3}{7},\frac{5}{-14},-\frac{7}{12}$ in ascending order.

Sol: First, we write each rational number in standard form, i.e. with positive denominator.

The numbers thus written are $\frac{-3}{7},\frac{-5}{14},\frac{-7}{12}$.

LCM of 7, 14 and 12 = $7\times2\times6 = 84$.

7	7,	14,	12
2	1,	2,	12
		1,	6

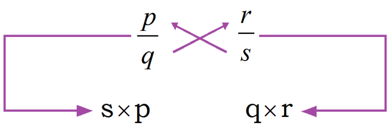
$$\frac{-3}{7}=\frac{-3\times12}{7\times12}=\frac{-36}{84},\frac{-5}{14}=\frac{-5\times6}{14\times6}=\frac{-30}{84},\frac{-7}{12}=\frac{-7\times7}{12\times7}=\frac{-49}{84}$$

Since, $-49<-36<-30$, therefore, $\frac{-49}{84}<\frac{-36}{84}<\frac{-30}{84}$

$$\therefore \frac{-7}{12}<\frac{-3}{7}<\frac{-5}{14}, i.e., -\frac{7}{12},\frac{-3}{7} \, and \, \frac{5}{-14}$$ are in ascending order.

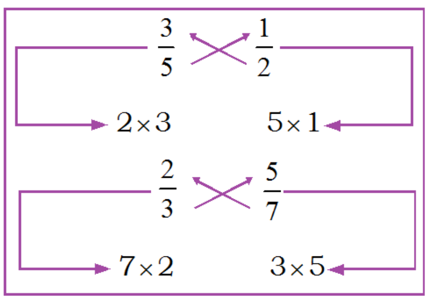
Second Method:

To compare two rational numbers $\frac{p}{q}$ and $\frac{r}{s}$, we compare the products $s\times p$ and $q\times r$ and define their inequality as under:



(1) $\frac{p}{q} > \frac{r}{s}$, if $s\times p>q\times r$.

(2) $\frac{p}{q} < \frac{r}{s}$, if $s\times p<q\times r$.

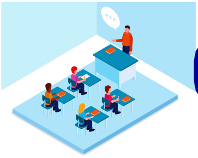


Ex: (i) $\frac{3}{5}>\frac{1}{2}$, since $2\times3>5\times1$

(ii) $\frac{2}{3}<\frac{5}{7}$, since $7\times2<3\times5$

(iii) $\frac{-8}{-14}<\frac{13}{21}$, Rewriting $\frac{-8}{-14}$ in standard form as $\frac{8}{14}$.

Now, $8\times21<14\times13$



CLASSROOM DISCUSSION QUESTIONS

CDQ 1.3

1. Which of the following statements about rational numbers is true?

(A) Every positive rational number is less than 0

(B) Every negative rational number is greater than 0

(C) Every positive rational number is greater than every negative rational number

(D) Every rational number is less than every negative rational number

2. What is the first step in comparing two rational numbers?

(A) Write the rational numbers so that their denominators are positive

(B) Find the LCM of the denominators of the rational numbers

(C) Obtain the given rational numbers

(D) Express each rational number with a common denominator

3. In the comparison of rational numbers, what does the numerator of the expression with the greater numerator signify?

(A) The smaller rational number

(B) The larger rational number

(C) The sum of the rational numbers

(D) The product of the rational numbers

4. How are rational numbers arranged in ascending order using the given method?

(A) By comparing their numerators

(B) By comparing their denominators

(C) By comparing their LCMs

(D) By comparing the products of numerators and denominators

5. In the second method of comparison, when is one rational number greater than the other?

(A) When their sum is greater than their product

(B) When the product of the numerator and denominator is greater

(C) When their product is greater than their sum

(D) When the difference between their numerator and denominator is greater

6. Which of the following is NOT a step involved in comparing rational numbers?

(A) Obtaining the given rational numbers

(B) Finding the LCM of the denominators

(C) Finding the HCF of the numerators

(D) Expressing each rational number with a common denominator

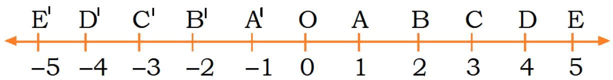
MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

CONCEPT 1.4

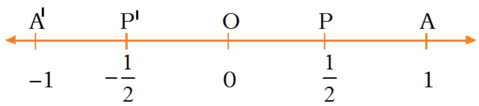
Rational Numbers on a Number Line:

If you draw any line as shown below, take a point O on it which you may call the zero point, set off equal distances on both sides of O on the line, then these distances will be considered as of unit length. If we name the points on the right as A, B, C, D, E, ... and the corresponding points on the left as $A^{|}, B^{|}, C^{|}, D^{|}, E^{|}$.............will represent the points –1, –2, –3, –4, –5, .. respectively.

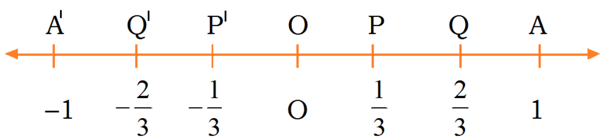


In the same manner as done above, we can represent rational numbers on a number line and obtain a rational number line.

(i) If we bisect OA, we get the point P which represents the rational number $\frac{1}{2}$. Similarly, if we bisect $OA^{|}$, we get the point $P^{|}$ which represents the rational number $-\frac{1}{2}$.



(ii) If we divide the length OA and $OA^{|}$ into three equal parts and label the points of division as P, Q, $P^{|}$, $Q^{|}$ as shown, then P, Q will represent the rational numbers –(1/3) and –(2/3) respectively.



A rational number line is one whose points are associated with rational numbers. Each point on this line is associated with a rational number, and each number is associated with a point on the line.

Solved Examples:

Ex: **Represent $\frac{5}{3}$ and $\frac{-5}{3}$ on the number line.**

Sol: $\frac{5}{3}$ and $\frac{-5}{3}$ can be written as $1\frac{2}{3}$ and $-1\frac{2}{3}$.

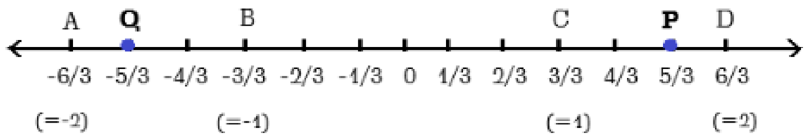
Step-1: In order to represent $\frac{5}{3}$ and $\frac{-5}{3}$ on the number line, we draw a number line and mark a point O on it to represent zero.

Step-2: Since $1\frac{2}{3}$ and $-1\frac{2}{3}$ lie between 1 & 2 and –1 & –2 therefore mark the points A and B & C and D on left & right side of O, such that A, B, C, D represent –2, –1, 1, 2.

Step-3: Now the denominator of rational number is 3.

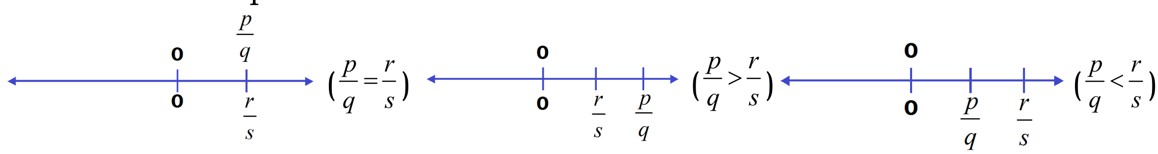
$\therefore$ Divide the intervals into 3 equal parts.

Step-4: Since the numerator is 2, then mark second point on the parts. P and Q are the required points.



Order Relation:

There are three possibilities:



(i) If the rational numbers $\frac{p}{q}$ and $\frac{r}{s}$ correspond to the same point on the number line, then the two numbers are equal, i.e., $\frac{p}{q}=\frac{r}{s}$. If $\frac{p}{q} \neq \frac{r}{s}$, then $\frac{p}{q}$ will either be to the right or to the left to $\frac{r}{s}$.

(ii) If $\frac{p}{q}$ lies to the right of $\frac{r}{s}$, then $\frac{p}{q} > \frac{r}{s}$.

(iii) If $\frac{p}{q}$ lies to the left of $\frac{r}{s}$, then $\frac{p}{q} < \frac{r}{s}$.

Order Properties of Rational Numbers:

Property 1. For each rational number x, one and only one of the following is true. (i) $x>0$ (ii) $x = 0$ (iii) $x<0$

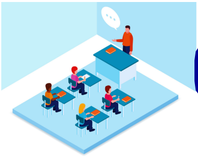
Property 2. For any two rational numbers x and y, one and only one of the following is true. (i) $x>y$ (ii) $x = y$ (iii) $x < y$.

Property 3. If x, y, z are any three rational numbers such that $x>y$ and $y>z$; then $x>z$.

Absolute Value of a Rational Number:

Recall that the absolute value of an integer is an integer. Thus, $|9| = 9$, $|-23|=23$, $|0|=0$, etc. Similarly, the absolute value of a rational number is a rational number with no regard to its sign.

Thus, $\left|\frac{5}{7}\right| = \frac{5}{7}$; $\left|\frac{-11}{13}\right| = \left|\frac{-11}{13}\right| = \frac{11}{13}$; $\left|\frac{65}{-24}\right| = \left|\frac{-65}{24}\right| = \frac{65}{24}$.



CLASSROOM DISCUSSION QUESTIONS

CDQ 1.4

1. How can rational numbers be represented on a number line?

(A) By marking equal distances on the line

(B) By bisecting the line into unequal parts

(C) By dividing the line into fractions

(D) By randomly assigning points on the line

2. Which property states that for each rational number x, it is either greater than 0, equal to 0, or less than 0?

(A) Property 1

(B) Property 2

(C) Property 3

(D) Absolute Value Property

3. What is the absolute value of –5/3?

(A) 5/3

(B) –5/3

(C) 5

(D) –5

4. What does the order relation property of rational numbers state?

(A) If two rational numbers are equal, they lie on the same point on the number line

(B) If one rational number lies to the right of another, it is greater

(C) If one rational number lies to the left of another, it is greater

(D) All of the above

5. What is the absolute value of 0?

(A) 0

(B) 1

(C) –1

(D) Undefined

6. If a rational number x is greater than 0, what does property 1 imply?

(A) $x = 0$

(B) $x > 0$

(C) $x < 0$

*(D) All the above

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ____ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

CONCEPT 1.5

Properties of Rational Numbers:

Property	Operations on Rational Numbers			
Name	**Addition**	**Subtraction**	**Multiplication**	**Division***
Closure	a+b ∈ Q	a–b ∈ Q	a×b ∈ Q	a÷b ∈ Q
Commutative	a+b = b+a	a–b ≠ b–a	a–b = b–a	a÷b ≠ b÷a
Associative	(a+b)+c =a+(b+c)	(a–b)–c ≠a–(b–c)	(a×b)×c = a×(b×c)	(a÷b)÷c ≠ a÷(b÷c)
Distributive	a×(b+c) = ab + ac	a×(b–c) = ab–ac	Not applicable	Not applicable
Where a, b, c ∈ Q (set of rational numbers), *b is a non-zero rational number				

Closure Property:

* Rational numbers are closed under addition. That is, for any two rational numbers a and b. a+b is also a rational number.

  For example, for any two rational numbers $\frac{2}{5}$ and $\frac{3}{2}$, the sum $\frac{2}{5}+\frac{3}{2}=\frac{19}{10}$ which is again a rational number.
* Rational numbers are closed under subtraction. That is, for any two rational numbers a and b, a–b is also a rational number.
  For example, for any two rational numbers 1/5 and 3/4, the difference $\frac{1}{5}-\frac{3}{4}=\frac{-11}{20}$ which is again a rational number.
* Rational numbers are closed under **multiplication.**
  That is, for any two rational numbers a and b, a×b is also a rational number.
  For example, for any two rational numbers 2/5 and -3/7, the product $\frac{2}{5}\times\frac{-3}{7}=\frac{-6}{35}$ which is again a rational number.
* Rational numbers are not closed under **division.**
  For example, for any two rational numbers 2 and 0,2÷0 is not defined.

Commutativity:

* Rational numbers are commutative under addition. This means rational numbers can be added in any order. That is, for any two rational numbers a and b, a+b=b+a.

  For example, $\frac{2}{5}+\left(\frac{-5}{3}\right)=\left(\frac{-5}{3}\right)+\frac{2}{5}=\frac{-19}{6}$
* Rational numbers are not commutative under subtraction.

For example, for any two rational numbers $\frac{3}{4}$ and $\frac{5}{2}$, $\left(\frac{3}{4}\right)-\left(\frac{5}{2}\right)=\frac{-7}{4}$

and $\left(\frac{5}{2}\right)-\left(\frac{3}{4}\right)=\frac{7}{4}$.

Therefore, $\left(\frac{3}{4}\right)-\left(\frac{5}{2}\right)\neq\left(\frac{5}{2}\right)-\left(\frac{3}{4}\right)$

* Rational numbers are commutative under multiplication.

For example, for any two rational numbers $\frac{13}{14}$ and $\frac{5}{7}$,

$\frac{13}{14}\times\frac{5}{7}=\frac{65}{98}$ and $\frac{5}{7}\times\frac{13}{14}=\frac{65}{98}$.

* Rational numbers are not commutative under division.

For example, for any two rational numbers 2 and 5, $2\div5\neq5\div2$.

Associativity:

* Rational numbers are associative under addition. That is, for any three rational numbers a,b and c, a+(b+c) = (a+b)+c.

For example, $\frac{2}{5}+\left(\frac{1}{5}+1\right)=\left(\frac{2}{5}+\frac{1}{5}\right)+1=\frac{8}{5}$

* Rational numbers are not associative under subtraction.

For example, for any three rational numbers $\frac{2}{3}$, $\frac{1}{3}$ and 1, $\frac{2}{3}-\left(\frac{1}{3}-1\right)=\frac{4}{3}$

and $\left(\frac{2}{3}-\frac{1}{3}\right)-1=\frac{-2}{3}$ Therefore, $\frac{2}{3}-\left(\frac{1}{3}-1\right)\neq\left(\frac{2}{3}-\frac{1}{3}\right)-1$

* Rational numbers are associative under multiplication. That is, for any three rational numbers a,b and c, $a\times(b\times c)=(a\times b)\times c$.

For example. $\frac{3}{5}\times\left(\frac{2}{7}\times1\right)=\left(\frac{3}{5}\times\frac{2}{7}\right)\times1=\frac{6}{35}$

* Rational numbers are not associative under division.

For example, for any three rational numbers $\frac{2}{7}$, $\frac{-1}{14}$ and $\frac{3}{7}$

$\frac{2}{7}\div\left\{\left(\frac{-1}{14}\right)\div\frac{3}{7}\right\}=\frac{-12}{7}$ and $\left\{\frac{2}{7}\div\left(\frac{-1}{14}\right)\right\}\div\frac{3}{7}=\frac{-28}{3}$

Therefore, $\frac{2}{7}\div\left\{\left(\frac{-1}{14}\right)\div\frac{3}{7}\right\}\neq\left\{\frac{2}{7}\div\left(\frac{-1}{14}\right)\right\}\div\frac{3}{7}$

CLASSROOM DISCUSSION QUESTIONS

CDQ 1.5

1. **Which property states that rational numbers are closed under addition, subtraction, and multiplication, but not under division?**
   (A) Commutativity
   (B) Associativity
   (C) Closure Property
   (D) Distributive Property

2. **Rational numbers are commutative under which operation?**
   (A) Addition
   (B) Subtraction
   (C) Multiplication
   (D) Division

3. **Which property states that rational numbers can be added in any order?**
   (A) Commutativity under addition
   (B) Associativity under addition
   (C) Commutativity under multiplication
   (D) Associativity under multiplication

4. **Rational numbers are not commutative under which operation?**
   (A) Addition
   (B) Subtraction
   (C) Multiplication
   (D) Division

5. **Rational numbers are associative under which operation?**
   (A) Addition
   (B) Subtraction
   (C) Multiplication
   (D) Division

6. **Which property states that for any three rational numbers a, b, and c, $a+(b+c) = (a+b)+c$?**
   (A) Associativity under addition
   (B) Associativity under multiplication
   (C) Associativity under subtraction
   (D) Associativity under division

7. **Rational numbers are not associative under which operation?**
   (A) Addition
   (B) Subtraction
   (C) Multiplication
   (D) None

8. **What property states that rational numbers can be multiplied in any order?**
   (A) Commutativity under multiplication
   (B) Associativity under multiplication
   (C) Closure Property
   (D) Distributive Property

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

CONCEPT 1.6

Distributivity of multiplication over addition and subtraction for rational numbers:

For any three rational numbers a,b and c,

a × (b+c) = ab+ac and a × (b–c) = ab–ac.

Consider any three rational numbers -3/4, 2/3 and -5/6.

$$\frac{-3}{4}\times\left\{\frac{2}{3}+\left(\frac{-5}{6}\right)\right\}=\frac{-3}{4}\times\left\{\frac{(4)+(-5)}{6}\right\}=\frac{-3}{4}\times\left(\frac{-1}{6}\right)=\frac{3}{24}=\frac{1}{8}$$

Also, $\frac{-3}{4}\times\frac{2}{3}=\frac{-3\times2}{4\times3}=\frac{-6}{12}=\frac{-1}{2}$ *and* $\frac{-3}{4}\times\frac{-5}{6}=\frac{5}{8}$

Therefore, $\left(\frac{-3}{4}\times\frac{2}{3}\right)+\left(\frac{-3}{4}\times\frac{-5}{6}\right)=\frac{-1}{2}+\frac{5}{8}=\frac{1}{8}$

Thus, $\frac{-3}{4}\times\left\{\frac{2}{3}+\frac{-5}{6}\right\}=\left(\frac{-3}{4}\times\frac{2}{3}\right)+\left(\frac{-3}{4}\times\frac{-5}{6}\right)$

And $\frac{-3}{4}\times\left\{\frac{2}{3}-\left(\frac{-5}{6}\right)\right\}=\frac{-3}{4}\times\left\{\frac{2}{3}+\frac{5}{6}\right\}=\frac{-3}{4}\times\left\{\frac{4+5}{6}\right\}=\frac{-3}{4}\times\frac{9}{6}=\frac{-9}{8}$

And $\left(\frac{-3}{4}\times\frac{2}{3}\right)-\left(\frac{-3}{4}\times\frac{-5}{6}\right)=\frac{-1}{2}-\frac{5}{8}=\frac{-4-5}{8}=\frac{-9}{8}$

Thus $\frac{-3}{4}\times\left\{\frac{2}{3}-\frac{-5}{6}\right\}=\left(-\frac{3}{4}\times\frac{2}{3}\right)-\left(\frac{-3}{4}\times\frac{-5}{6}\right)$

Additive Identity (Role of 0):

Zero is called the identity for the addition of rational numbers. It is the additive identity for integers and whole numbers as well. In general, for any rational number a, a+0 = 0+a = a.

Ex: $\frac{7}{9}+0=\frac{7}{9},\ 0+\frac{7}{9}=\frac{7}{9}$ $\qquad \therefore\frac{7}{9}+0=0+\frac{7}{9}=\frac{7}{9}$

Additive inverse:

Negative or additive inverse of a rational number is a rational number which when added to the given rational number gives '0'. If p/q and r/s are two rational numbers and (p/q)+(r/s) =0, then p/q is called the additive inverse or negative of r/s and vice-versa.

Ex: Additive inverse of -3/4 is 3/4 and additive inverse of 3/4 is -3/4

Existence of right identity:

In case of subtraction, any rational number $\frac{a}{b}$, $\frac{a}{b}-0=\frac{a}{b}$ but $0-\frac{a}{b}=-\frac{a}{b}\left(\text{not equal to}\frac{a}{b}\right)$. Therefore, only the right identity exists for subtraction.

Existence of multiplicative identity (Role of 1):

For any rational number $\frac{a}{b}$, we have $\frac{a}{b}\times 1 = 1\times\frac{a}{b} = \frac{a}{b}$. Here, '1' is called multiplicative identity for rational numbers.

Example: a) $\frac{3}{5}\times 1 = 1\times\frac{3}{5} = \frac{3}{5}$ b) $\frac{2}{11}\times 1 = 1\times\frac{2}{11} = \frac{2}{11}$

Multiplicative Inverse Property:

Every non-zero rational number a/b has multiplicative inverse b/a, such that $\frac{a}{b}\times\frac{b}{a} = \frac{b}{a}\times\frac{a}{b} = 1$

Example: i) $\frac{2}{3}\times\frac{3}{2} = \frac{3}{2}\times\frac{2}{3} = 1$. i.e., Reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$

Note: a) b/a is called the reciprocal of a/b.
b) Zero has no reciprocal.
c) Reciprocal of '1' is '1' and reciprocal of (–1) is (–1).
d) We denote the reciprocal of $\frac{a}{b}$ by $\left(\frac{a}{b}\right)^{-1}$, clearly $\left(\frac{a}{b}\right)^{-1} = \frac{b}{a}$.

Density Property of Rational Numbers:

Between any two given rational numbers there exists uncountable rational numbers. This property of rational numbers is called the property of density.

Theorem: Show that between any two distinct rational numbers a and b, there exists another rational number.

Solution: Since a ≠ b, without any loss of generality we may assume that a < b.

Now a < b, $\therefore$ a + a < a + b $\Rightarrow$ 2a < a + b $\Rightarrow$ $a < \frac{a+b}{2}$ .... (1)

Also, a < b $\therefore$ a + b < b + b $\Rightarrow$ a + b < 2b $\Rightarrow$ $\frac{a+b}{2} < b$ .... (2)

From (1) & (2), $a < \frac{a+b}{2} < b$

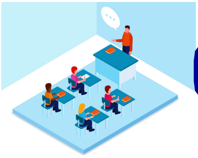
Clearly, $\frac{a+b}{2}$ is a rational number lying between a and b.

Note: A rational number between any two rational numbers a and b is $\frac{1}{2}(a+b)$.

Example: A rational number between $\frac{1}{4}$ and $\frac{2}{3}$ is $\frac{1}{2}\left(\frac{1}{4}+\frac{2}{3}\right) = \frac{1}{2}\left(\frac{3+8}{12}\right) = \frac{1}{2}\times\frac{11}{12} = \frac{11}{24}$

ii) Let a and b be two rational numbers such that $a < b$. Suppose to find 'n' rational numbers between a and b. Let $d = \frac{b-a}{n+1}$.

Then 'n' rational numbers lying between a and b are
(a + d), (a + 2d), (a + 3d), . . . (a + nd).



CLASSROOM DISCUSSION QUESTIONS

CDQ 1.6

1. Which property states that a(b+c)=ab+ac for any three rational numbers a, b and c?

(A) Associative Property
(B) Distributive Property
(C) Commutative Property
(D) Closure Property

2. What is the additive identity for rational numbers 0?

(A) 1
(B) –1
(C) 0
(D) Undefined

3. What is the additive inverse of –3/4?

(A) 3/4 (B) –3/4
(C) 4/3 (D) –4/3

4. Which property states that every non-zero rational number has a multiplicative inverse?

(A) Distributive Property
(B) Additive Identity
(C) Multiplicative Inverse Property
(D) Commutative Property

5. What is the reciprocal of 3/5?

(A) 5/3
(B) 3/5
(C) –5/3
(D) –3/5

6. Which theorem states that between any two distinct rational numbers a and b, there exists another rational number?

(A) Additive Identity Theorem
(B) Density Property Theorem
(C) Multiplicative Inverse Theorem
(D) Existence of Right Identity Theorem

7. What is the multiplicative identity for rational numbers?

(A) –1
(B) 0
(C) 1
(D) Undefined

8. Which property states that rational numbers are closed under addition, subtraction, and multiplication, but not under division?

(A) Closure Property
(B) Associative Property
(C) Distributive Property
(D) Commutative Property

9. What is the additive inverse of 1/3?

(A) 3 (B) –3
(C) 1/3 (D) –1/3

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

C.D.F. CONCEPTS, DEFINITIONS AND FORMULAE

1. A number which can be expressed in the form of p/q, where p and q are integers and $q \neq 0$ is called a rational number.
2. '0' is neither positive nor negative but, it is rational.
3. All fractions are rational numbers, but every rational number need not be a fraction.
4. Rationals are either terminating decimal or non-terminating recurring decimal expansions
5. A rational number has infinite equivalent rational numbers.
6. Let $\frac{a}{b}, \frac{c}{d}$ and $\frac{e}{f}$ are three rational numbers such that

   a) **Closure property:** $\frac{a}{b}+\frac{c}{d}$ is a rational number.

   b) **Commutative property:** $\frac{a}{b}+\frac{c}{d}=\frac{c}{d}+\frac{a}{b}$.

   c) **Associative property:** $\left(\frac{a}{b}+\frac{c}{d}\right)+\frac{e}{f}=\frac{a}{b}+\left(\frac{c}{d}+\frac{e}{f}\right)$

   d) **Additive Identity:** $a + 0 = 0 + a = a$; '0' is called the additive identity of 'a'.

   e) **Additive inverse:** $\frac{p}{q} + \frac{r}{s} = 0$, then $\frac{p}{q}$ is called the additive inverse or negative of $\frac{r}{s}$

7. Let rational numbers $\frac{a}{b}, \frac{c}{d}$ and $\frac{e}{f}$ such that

   a) Closure Property: $\left(\frac{a}{b}\times\frac{c}{d}\right)$ is also a rational number.

   b) Commutative property: $\frac{a}{b} \times \frac{c}{d}=\frac{c}{d}\times\frac{a}{b}$

   c) Associative Property: $\left(\frac{a}{b}\times\frac{c}{d}\right)\times\frac{e}{f}=\frac{a}{b}\times\left(\frac{c}{d}\times\frac{e}{f}\right)$

   d) Multiplicative identity: $\frac{a}{b}\times 1=1\times\frac{a}{b}=\frac{a}{b}$. Here, '1' is called multiplicative identity for rational numbers.

   e) Distributive law of multiplication over addition:

   $$\frac{a}{b}\times\left(\frac{c}{d}+\frac{e}{f}\right)=\left(\frac{a}{b}\times\frac{c}{d}\right)+\left(\frac{a}{b}\times\frac{e}{f}\right)$$

8. A rational number $\frac{b}{a}$ is multiplicative inverse of $\frac{a}{b}$.

ADVANCED WORKSHEET

LEVEL 1

Single Correct Answer Type (S.C.A.T)

1. If a, b are two whole numbers and b≠0 then b is said to be always

(A) Integer
(B) Natural Number
(C) Whole Number
(D) Fraction

2. A number which can be expressed in the form of p/q, where p and q are integer, q≠o is called___.

(A) Rational Number
(B) Natural Number
(C) Whole Number
(D) Fractional Number

3. Which of the following is negative rational number.

(A) $\frac{-5}{-101}$ (B) $\frac{-27}{-185}$

(C) $\frac{-241}{16}$ (D) $\frac{36}{55}$

4. Which of the following is true?

(A) $\frac{-5}{-19}$ is positive rational number

(B) $\frac{7}{13}$ is positive rational

(C) Both A and B are true
(D) Both A and B are false.

5. If $\frac{3}{13}$ is a rational number then

(A) 13 is Denominator
(B) 3 is Denominator
(C) 3 is Numerator
(D) Both A and C are true

6. Which of the following forms a pair of equivalent rational numbers?

(A) $\frac{14}{35}$ and $\frac{21}{45}$

(B) $\frac{-12}{26}$ and $\frac{-18}{39}$

(C) $\frac{-7}{28}$ and $\frac{-5}{20}$

(D) Both B and C

7. The standard form of $\frac{192}{-168}$ is

(A) -2/3
(B) -8/7
(C) -1/7
(D) -6/7

8. The value of x for which the two rational numbers $\frac{3}{7}, \frac{x}{42}$ are equivalent is

(A) 18
(B) 15
(C) 12
(D) 10

9. If $\frac{x}{3} = \frac{72}{54}$ then the value of x =

(A) 7

(B) 5

(C) 4

(D) 9

10. Name the property of multiplication of rational numbers illustrated by the given statement.

$$\frac{7}{4} \times \left(\frac{-8}{3} + \frac{-13}{12}\right) = \left(\frac{7}{4} \times \frac{-8}{3}\right) + \left(\frac{7}{4} \times \frac{-13}{12}\right)$$

(A) Commutativity

(B) Associativity of multiplication

(C) Distributivity of multiplication over addition

(D) None of these

11. The additive inverse of –a/b is ______.

(A) a/b

(B) b/a

(C) –b/a

(D) –a/b

12. Which of the following statement is false?

(A) Zero has a reciprocal

(B) The product of two negative rational numbers is always positive

(C) The reciprocal of a positive rational number is positive

(D) The product of two positive rational numbers is always positive

13. $\frac{-1}{5} \square \frac{4}{-5}$

(A) <

(B) >

(C) =

(D) None

14. The sum of any two rational numbers is always a rational number. This statement indicates ______ property

(A) Identity

(B) Associative

(C) Commutative

(D) Closure

15. If a,b,c,d $\in$ Q and if $\frac{a}{b} \times \frac{c}{d} = \frac{c}{d} \times \frac{a}{b}$ then we say that a,b,c and d are in

(A) Closed under multiplication

(B) Commutative under multiplication

(C) Associative under addition

(D) Closed under subtraction

16. Addition of rational numbers satisfy the property?

(A) Commutative

(B) Associative

(C) Closure

(D) All of these

17. Which of the following set of numbers is closed under subtraction?

(A) Fractions

(B) Negative integers

(C) Natural numbers

(D) Rational numbers

18. If x and y are two rational numbers, then which of the following statement is wrong?

(A) $|x+y| \le |x|+|y|$

(B) $|x \times y| = |x| \times |y|$

(C) $|x-y| \le |x|-|y|$

(D) None of these

19. How many rational numbers are there between any two given rational number?

(A) Only one

(B) Only two

(C) Countless

(D) Nothing can be said

20. If a and b are two rational numbers, then

(A) $\frac{a+b}{2} < a$

(B) $\frac{a+b}{2} < b$

(C) $\frac{a+b}{2} = a$

(D) $\frac{a+b}{2} > b$

21. The rational number that does not have a reciprocal is

(A) 0

(B) 1

(C) –1

(D) 1/2

22. The reciprocal of negative rational number is

(A) A positive rational number

(B) A negative rational number

(C) 0

(D) –1

23. Which of the following is not true?

(A) Rational numbers are closed under addition.

(B) Rational numbers are closed under subtraction.

(C) Rational numbers are closed under multiplication.

(D) Rational numbers are closed under division.

24. If p : every fraction is a rational number and q : every rational number is a fraction, the which of the following is correct?

(A) p is true and q is false

(B) p is false and q is true

(C) Both p and q are true

(D) Both p and q are false.

25. The descending order of $\frac{-2}{3}, \frac{5}{6}$ and $\frac{-1}{6}$ is

(A) $\frac{5}{6}, \frac{-2}{3}, \frac{-1}{6}$

(B) $\frac{5}{6}, \frac{-1}{6}, \frac{-2}{3}$

(C) $\frac{-2}{3}, \frac{-1}{6}, \frac{5}{6}$

(D) $\frac{-1}{6}, \frac{-2}{3}, \frac{5}{6}$

26. If x is greater between $-3\frac{1}{2}$ and $-4\frac{2}{5}$ then $x+\frac{21}{2}=$

(A) $-4\frac{2}{5}$

(B) $-3\frac{1}{2}$

(C) $\frac{-7}{2}$

(D) 7

27. If the second greatest of $\frac{-3}{6},\frac{-4}{3},\frac{-9}{4},\frac{-13}{4}$ is y then $y+\frac{4}{3}=$

(A) $\frac{-13}{4}$

(B) 0

(C) 1

(D) $\frac{8}{3}$

28. If $\frac{3}{7}+p+\left(\frac{8}{21}\right)+\frac{5}{22}=\frac{-125}{462}$ then 3p =

(A) $\frac{302}{231}$

(B) $-\frac{302}{231}$

(C) $\frac{302}{77}$

(D) $-\frac{302}{77}$

29. The difference of sum of $\frac{-4}{7},\frac{5}{14}$ and $\frac{9}{14},\frac{23}{14}$ is equal to

(A) $\frac{7}{2}$

(B) $\frac{15}{14}$

(C) $\frac{5}{2}$

(D) $\frac{3}{2}$

30. Lekha purchased $1\frac{1}{4}$kg of apples, $2\frac{1}{2}$kg of grapes, $1\frac{1}{2}$kg of mangoes and 2 kg of watermelon totally she purchased

(A) $7\frac{1}{4}kg$

(B) $8\frac{1}{4}kg$

(C) $6\frac{1}{4}kg$

(D) $5\frac{1}{4}kg$

31. The difference of denominator and numerator of reciprocal of rational number $\frac{5}{4}+\frac{2}{5}$ is

(A) 20

(B) 33

(C) 13

(D) 53

32. The three rational numbers between 3 and 4 are

(A) $\frac{-2}{5}, \frac{-3}{5}, \frac{-11}{6}$

(B) $\frac{-1}{5}, \frac{-2}{5}, \frac{-11}{5}$

(C) $\frac{-1}{4}, \frac{-3}{2}, \frac{-13}{4}$

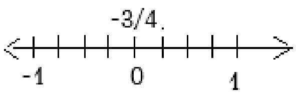
(D) $\frac{7}{2}, \frac{15}{4}, \frac{13}{4}$

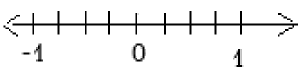
33. $\frac{5}{8}$ is rational number between $\frac{3}{4}$ and $\frac{1}{2}$ which of the following is not a rational number between $\frac{3}{4}$ and $\frac{1}{2}$?

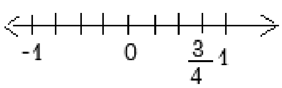
(A) $\frac{11}{16}$ (B) $\frac{10}{16}$

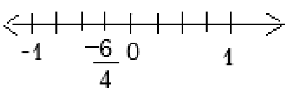
(C) $\frac{13}{16}$ (D) $\frac{9}{16}$

34. The sum of $\frac{-3}{4}$ and $\frac{3}{4}$ and representation on number line is

(A) $\frac{-3}{4}$ and 

(B) $\frac{0}{4}$ and 

(C) $\frac{3}{4}$ and 

(D) $\frac{-6}{4}$ and 

35. If $x = \frac{-1}{3}$ and $y = \frac{2}{7}$ then $|x+y|$

(A) $\frac{-1}{21}$

(B) 21

(C) $\frac{1}{21}$

(D) $\frac{6}{21}$

36. The value of

$$34 - |3 \times (-4)| + |4 \times 2 - (-5)| =$$

(A) 45

(B) 25

(C) 35

(D) 56

37. If $\left|\frac{56-(-8)}{-6-2}\right| \times \left(\frac{-1}{4}\right) = m$ then $m-3=$

(A) −5

(B) 0

(C) 1

(D) −2

38. The sum of the additive inverse and multiplicative inverse of 2 is ____.

(A) 3/2

(B) −3/2

(C) 1/2

(D) −1/2

39. The rational number which is not lying between 5/16 and 1/2 is __

(A) 3/8

(B) 7/16

(C) 1/4

(D) 13/32

40. Which of the following statements is true?

(A) $\frac{5}{7} < \frac{7}{9} < \frac{9}{11} < \frac{11}{13}$

(B) $\frac{11}{13} < \frac{9}{11} < \frac{7}{9} < \frac{5}{7}$

(C) $\frac{5}{7} < \frac{11}{13} < \frac{7}{9} < \frac{9}{11}$

(D) $\frac{5}{7} < \frac{9}{11} < \frac{11}{13} < \frac{7}{9}$

41. If 24 trousers of equal size can be prepared in 54 metres of cloth, what length of cloth is required for each trouser?

(A) 4/3 m

(B) 9/4 m

(C) 8/9 m

(D) 14/9 m

42. The value of $\frac{7}{12} + \frac{19}{10}$ is ____.

(A) 133/12

(B) 371/12

(C) 149/60

(D) 5411/990

43. A rational number between $\frac{1}{4}$ and $\frac{1}{3}$ is

(A) 7/24

(B) 0.29

(C) 13/48

(D) All the above

44. Simplify :

$$\left(-\frac{7}{18} \times \frac{15}{-7}\right) - \left(1 \times \frac{1}{4}\right) + \left(\frac{1}{2} \times \frac{1}{4}\right)$$

(A) 27

(B) –303/40

(C) 5/11

(D) 17/24

45. What should be subtracted from $\left(\frac{3}{4} - \frac{2}{3}\right)$ to get $\frac{-1}{6}$?

(A) –6/13

(B) 1/4

(C) 2/7

(D) –1/8

46. The cost of $7\frac{2}{3}$ metres of rope is Rs. $12\frac{3}{4}$. Find its cost per metre.

(A) Rs. $\frac{53}{92}$

(B) Rs. $\frac{153}{92}$

(C) Rs. $\frac{1173}{12}$

(D) Rs. $\frac{173}{35}$

Multi Correct Question (M.C.Q)

47. The product of two numbers is $\frac{-16}{35}$. If one of the numbers is $\frac{-15}{14}$, then the other

(A) $\frac{-32}{-75}$ (B) $\frac{-8}{3}$

(C) $\frac{-2}{5}$ (D) $\frac{32}{75}$

48. Identify the expressions for which commutative property holds?

(A) $(-5)+(-3)$

(B) $(-17)-(-9)$

(C) $(13)\times(17)$

(D) $(19)\div(31)$

49. Which of the following statements are true?

(A) Closure property holds for subtraction of whole numbers.

(B) Closure property holds for division of all rational numbers.

(C) Commutative property holds for addition of whole numbers.

(D) Commutative property holds for multiplication of rational numbers.

50. Which of the following statements are true?

(A) The multiplicative and additive inverses of 1 are different.

(B) The multiplicative inverse is always reciprocal of that number.

(C) The additive inverse is always negative of that number.

(D) The multiplicative and additive inverses of 0 are the same.

51. Which of the following are multiplicative inverses of the integers lying between –4 and 2?

(A) 1/3 (B) 1/4

(C) –1 (D) 1

Comprehension Passage (C.P.T)

Passage - I

From a starting point A, Kalyan Walks $\frac{3}{4}$ km towards east and then $\frac{6}{7}$ km towards west to reach point C.

52. Where will kalyan be now from the starting point A?

(A) $\frac{9}{28}$ km towards west

(B) $\frac{3}{28}$ km towards west

(C) $\frac{3}{28}$ km towards east

(D) $\frac{9}{28}$ km towards east

53. How much total distance Kalyan walks to reach point C?

(A) $\frac{45}{28}$ km (B) $\frac{43}{28}$ km

(C) $\frac{47}{28}$ km (D) $\frac{49}{28}$ km

54. How much more distance he walked towards east than west

(A) $\frac{-9}{28}km$ (B) $\frac{3}{28}km$

(C) $\frac{9}{28}km$ (D) $\frac{-3}{28}km$

PASSAGE - II

If $\frac{a}{b},\frac{c}{d}$ and $\frac{e}{f}$ are any three rational numbers, then

$$\frac{a}{b}\times\left(\frac{c}{d}+\frac{e}{f}\right)=\frac{a}{b}\times\frac{c}{d}+\frac{a}{b}\times\frac{e}{f}$$

55. $\frac{2}{3}\times\frac{-7}{10}+\frac{-2}{3}\times\frac{8}{9}=?\times\left[\frac{-7}{10}+?\right]$

(A) $\frac{2}{3},\frac{8}{9}$ (B) $\frac{-2}{3},\frac{-8}{9}$

(C) $\frac{2}{3},\frac{-8}{9}$ (D) $\frac{-2}{3},\frac{8}{9}$

56. Name the property used above.

(A) Commutativity of multiplication over addition

(B) Commutativity of addition over multiplication

(C) Distributivity of multiplication over addition

(D) Distributivity of addition over multiplication

57. $\frac{2}{5}\times\frac{-8}{9}+?\times\frac{5}{9}=\frac{2}{5}\times[?+?]$

(A) $\frac{2}{5},\frac{-8}{9},\frac{5}{9}$ (B) $\frac{2}{5},\frac{8}{9},\frac{-5}{9}$

(C) $\frac{-2}{5},\frac{-8}{9},\frac{-5}{9}$ (D) $\frac{-2}{5},\frac{-8}{9},\frac{5}{9}$

Matrix Matching Type (M.M.T.)

I. Column - I

58. $\frac{-9}{10}+\frac{22}{15}$

59. $-2\frac{1}{9}-6$

60. $\frac{-6}{5}\times\frac{9}{11}$

61. $\frac{3}{13}\div\frac{-4}{65}$

Column - II

(A) $\frac{-54}{55}$

(B) $\frac{-15}{4}$

(C) $\frac{17}{30}$

(D) $-\frac{73}{9}$

II. Column I

62. The multiplicative inverse of $\frac{1}{5}+\frac{2}{7}$

63. The multiplicative inverse of $\frac{2}{5}+\frac{3}{2}$

64. The multiplicative inverse of $\frac{5}{7}+\frac{3}{11}$

65. The multiplicative inverse of $\frac{1}{9}+\frac{1}{6}$

Column II

(A) $\frac{10}{19}$

(B) $\frac{35}{17}$

(C) $\frac{18}{5}$

(D) $\frac{77}{76}$

Assertion Reason Type (A.R.T.)

(A) Both assertion and reason are true and the reason is the correct explanation of assertion.

(B) Both assertion and reason are true but reason is not a correct explanation of assertion.

(C) Assertion is true and reason is false.

(D) Assertion is false and reason is true.

66. Assertion (A): The product of –5 and –9 is 45.

Reason (R): The product of two rational numbers is always a rational number.

67. Assertion (A): The reciprocal of –5/11 is 11/5.

Reason (R): The reciprocal of a negative number is always a negative number.

68. Assertion (A): The integers between 0 and 4 are 1, 2 and 3.

Reason (R): The integers between two positive integers are always positive.

69. Assertion (A): 1/2, 3/7, 4/19 are rational numbers between 0 and 1.

Reason (R): The rational numbers between two integers are always proper fractions.

Integer Type Question (I.T.Q.)

70. The rational number whose reciprocal does not exist is _____.

71. The multiplicative inverse of 2/16 is _______.

72. The additive inverse for $-\left(\frac{3}{5}+\frac{7}{5}\right)$ is ______.

73. The multiplicative inverse of $\left(\frac{1}{2}-\frac{1}{3}\right)$ is ______.)

Previous Question (P.Q.)

74. Find $\frac{4}{7}\times\frac{14}{3}\div\frac{2}{3}$ (NCERT)

(A) 4 (B) 5

(C) 3 (D) 2

75. A farmer has a field of area $49\frac{4}{5}$ hac. He wants to divide it equally among his one son and two daughters. Find the area of each one's share. (NCERT)

(A) $16\frac{3}{5}$ hac (B) $17\frac{2}{9}$ hac

(C) $\frac{495}{5}$ hac (D) $\frac{78}{9}$ hac

76. The numerical expression $\frac{3}{8}+\frac{(-5)}{7}=\frac{-19}{56}$ shows that (NCERT)

(A) rational numbers are closed under addition.

(B) rational numbers are not closed under addition.

(C) rational numbers are closed under multiplication.

(D) addition of rational numbers is not commutative.

77. Which of the following is not true? (NCERT)

(A) rational numbers are closed under addition.

(B) rational numbers are closed under subtraction.

(C) rational numbers are closed under multiplication.

(D) rational numbers are closed under division.

78. Which of the following set of numbers is closed under subtraction? (NSTSE)

(A) Fractions

(B) Negative integers

(C) Natural numbers

(D) Rational numbers

79. Identify a rational number between 1/3 and 4/5. (NSTSE)

(A) $\frac{1}{4}$ (B) $\frac{9}{10}$

(C) $\frac{17}{30}$ (D) $2\frac{7}{10}$

80. Which of the following is true of the rational number –2/3? (NSTSE)

(A) It lies to the left side of 0 on the number line.

(B) It lies to the right side of 0 on the number line.

(C) It is not possible to represent it on the number line.

(D) It cannot be determined on which side of 0 the number lies.