MATHEMATICS

Class-VIII

Topic-1

RATIONAL NUMBERS

INDEX

CH-01

RATIONAL NUMBERS

TERMINOLOGIES

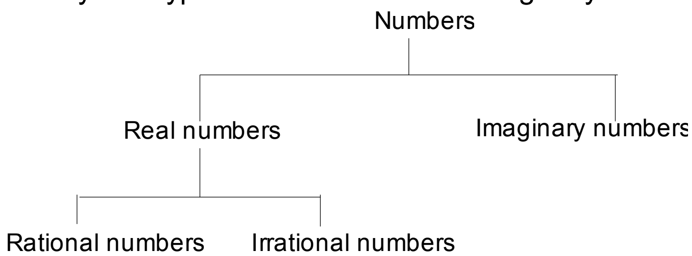
Real Numbers, Composite Numbers, Natural Numbers, Whole Numbers, Integers, Prime numbers, Rational numbers, terminating, non–terminating and repeating, recurrring decimal, decimal represenetation, lowest form, number line, absolute value, HCF, LCM, ascending, descending, closure, commutative, associative, additive identity, additive inverse, multiplicative identity, multiplicative inverse, distributive law, division algorithm, dividend, divisor, quotient, remainder.

INTRODUCTION

We will discuss rational numbers, their representation on the number line, various operations on rational numbers and insertion of rational numbers between given rational numbers .

1.1 RATIONAL NUMBERS

Numbers are basically of 2 types : Real numbers & Imaginary numbers.



(a) Real Numbers

These are the numbers which can represent actual physical quantities in a meaningful way. These can be represented on the number line. Number line is geometrical straight line with arbitrarily defined zero (origin).

(b) Natural numbers

Counting numbers are known as **natural numbers**. **N** = { 1, 2, 3, 4, ... }.

(c) Whole numbers

All natural numbers together with 0 form the collection of all **whole numbers**.
W = { 0, 1, 2, 3, 4, ... }.

(d) Prime Numbers

All natural numbers that have one & itself as their only two distinct factors are **prime numbers** i.e. prime numbers are exactly divisible by 1 and themselves. **For example** : 2, 3, 5, 7, 11, 13, 17, 19, 23, etc...

(e) Composite number

All natural numbers except 1, which are not prime are composite numbers.
For example :. 4, 6, 9, 10 etc

❖ **REMARK :** 1 is neither prime nor composite number.

(f) Integers

All natural numbers , 0 and negative of natural numbers form the collection of all **integers**.
I or **Z** = { ..., –3, –2, –1, 0, 1, 2, 3, ... }.

Identification of Prime Number
Step (i) : Find approximate square root of given number.
Step (ii) : Divide the given number by prime numbers less than approximate square root of number. If given number is not divisible by any of these prime numbers then the number is prime otherwise not.

Illustration 1.1

571 a prime number ?

Sol. Approximate square root = 24.
Prime number < 24 are 2,3,5,7,11,13,17,19 & 23.
But 571 is not divisible by any of these prime numbers. So, 571 is a prime number.

(g) Rational Numbers

Numbers that can be expressed in the form $\frac{p}{q}$, where q is a non–zero integer and p is any integer are called **rational numbers**.

Each of the numbers $\frac{2}{3}, \frac{-5}{7}, \frac{-11}{-5}, \frac{7}{-9}$ is a rational number.

(i) Definition : Numbers that can be expressed in the form $\frac{p}{q}$, where q is a non–zero integer and p is any integer are called **rational numbers**.

Each of the numbers $\frac{2}{3}, \frac{-5}{7}, \frac{-11}{-5}, \frac{7}{-9}$ is a rational number.

(ii) Positive Rational Number : A rational numbers $\frac{p}{q}$ is positive, if p and q are either both positive or both negative. Each of the rational numbers $\frac{2}{3}, \frac{5}{9}, \frac{-7}{-12}, \frac{-3}{-11}$ is a positive rational number.

(iii) Negative Rational Number : A rational number $\frac{p}{q}$ is negative, if p and q are of opposite signs.

$\frac{-3}{7}, \frac{5}{-9}, \frac{-15}{26}$

(iv) Decimal representation of rational numbers

• **Terminating decimals :–** Let **x** be a rational number whose decimal expansion terminates. Then x can be expressed in the form of $\frac{p}{q}$ and prime factorization of **q** is of the form $2^m \times 5^n$, where m, n are non negative integers.

For example : $\frac{1}{2} = 0.5$, $\frac{3}{20} = 0.15$ etc.

• **Non terminating and Repeating (recurring decimal) :–** Let $x = \frac{p}{q}$ be a rational number , such that the prime factorization of **q** is not of the form $2^m \times 5^n$, where m, n are non negative integers. For example $\frac{2}{3} = 0.6666..... = 0.\overline{6}$, $\frac{5}{11} = 0.4545.... = 0.\overline{45}$

(v) Lowest Form of a Rational number

Definition : A rational number $\frac{p}{q}$ is said to be in the lowest form or simplest form if p and q have no common factor other than 1.

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

Step I : Obtain the rational number $\frac{p}{q}$.

Step II : Find the HCF of p and q say m.

Step III : If m = 1, then $\frac{p}{q}$ is in lowest form.

Step IV : If m 1, then $\frac{p \div m}{q \div m}$ is the lowest form of $\frac{p}{q}$

Illustration 1.2

Express each of the following rational numbers to the lowest form.

(i) $\frac{12}{16}$ **(ii)** $\frac{-60}{72}$

Sol. **(i)** We have,

$12 = 2 \times 2 \times 3$ and $16 = 2 \times 2 \times 2 \times 2$

$\therefore$ HCF of 12 and 16 is $2 \times 2 = 4$.

So, $\frac{12}{16}$ is not in lowest form.

Dividing numerator and denominator by 4, we have

$$\frac{12}{16} = \frac{12 \div 4}{16 \div 4} = \frac{3}{4}$$

$\therefore$ is the lowest form .

(ii) We have

$60 = 2 \times 2 \times 3 \times 5$ and $72 = 2 \times 2 \times 2 \times 3 \times 3$

$\therefore$ HCF of 60 and 72 is $2 \times 2 \times 3 = 12$.

Dividing numerator and denominator by 12.

$$\therefore \frac{-60}{72} = \frac{-5}{6} .$$

NOTE:

(i) Two rational numbers are equal, if they have the same standard form.

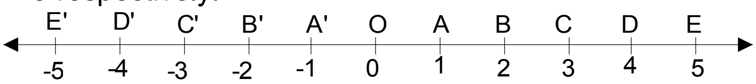
(ii) If $\frac{x}{y}$ is a rational number and m is any non–zero integer, then $\frac{x}{y} = \frac{x \times m}{y \times m}$.

For example : $\frac{3}{8} = \frac{3 \times 4}{8 \times 4} = \frac{12}{32}$.

(iii) If is a rational number and m is a common divisor of x and y, then $\frac{x}{y} = \frac{x \div m}{y \div m}$

For example : $\frac{-27}{45} = \frac{(-27) \div 3}{45 \div 3} = \frac{-9}{15} = \frac{(-9) \div 3}{15 \div 3} = \frac{-3}{5}$.

(vi) Representation of a rational number on a real number line : Draw any line. Take a point 0 on it. Call it 0 (zero). Set off equal distances on the right as well as on the left of 0. Such a distance is known as a unit length. Clearly, the points A, B, C, D, E represent the integers 1, 2, 3, 4, 5 respectively and the points A', B', C', D', E', represent the integers – 1, – 2, – 3, – 4, – 5 respectively.



Thus, we may represent any integer by a point on the number line. Clearly, every positive integer lies to the right of 0 and every negative integer lies to the left of 0. Similarly, we can represent rational numbers.

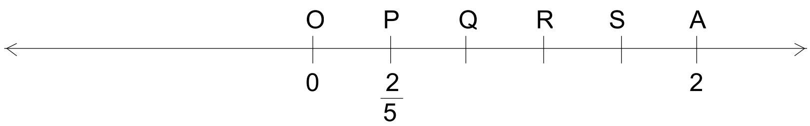
Illustration 1.3

Represent

(a) $\frac{2}{5}$ **(b)** $\frac{-7}{3}$ on the number line.

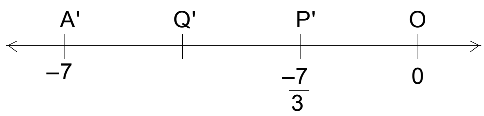
Sol. **(a)** Draw a number line. Mark a point O to represent 0 and another point A to represent the distance 2 units. Divide, OA into 5 equal parts (equal to the denominator of $\frac{2}{5}$), at P, Q, R and S.

The point P represents the rational number $\frac{2}{5}$.



(b) Draw a number line Mark a point O to represent 0 and a point A' at a distance of 7 units on the left of O to represent – 7. Divide OA' into 3 equal parts at P' and Q'.

The point P' represents $\frac{-7}{3}$



(vii) Absolute value : We have learned in earlier class that the absolute value of a rational number is its numerical value (value without signs).

For example : $\left|-\frac{3}{5}\right| = \frac{3}{5}$ and $\left|\frac{7}{9}\right| = \frac{7}{9}$.

Illustration 1.4

Verify that |x + y| ≤ |x| + |y| by taking $x = \frac{7}{9}, y = \frac{-4}{15}$

Sol. If $x = \frac{3}{5}, y = \frac{-4}{15}$, then

$$|x+y| = \left|\frac{3}{5}+\left(\frac{-4}{15}\right)\right| = \left|\frac{9-4}{15}\right| = \left|\frac{5}{15}\right| = \frac{|5|}{|15|} = \frac{5}{15}$$

$$|x|+|y| = \left|\frac{3}{5}\right| + \left|\frac{-4}{15}\right| = \frac{|3|}{|5|} + \frac{|-4|}{|15|} = \frac{3}{5} + \frac{4}{15} = \frac{9+4}{15} = \frac{13}{15}$$

But $\frac{5}{15} < \frac{13}{15}$

Hence |x + y| ≤ |x| + |y| is true in this case.

Illustration 1.5

Verify that |x × y| = |x| × |y| by taking $x = \frac{-5}{3}, y = \frac{7}{9}$

Sol. $|x \times y| = \left|\left(\frac{-5}{3}\times\frac{7}{9}\right)\right| = \left|\frac{-35}{27}\right| = \frac{35}{27} \Rightarrow \quad |x|\times|y| = \left|\left(\frac{-5}{3}\right)\right| \times \left|\frac{7}{9}\right| = \frac{5}{3}\times\frac{7}{9} = \frac{35}{27}$

∴ |x × y| = |x| × |y|

(viii) Comparing two rational numbers : In order 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 IV. The number having greater numerator is the greater rational number.

Illustration 1.6

Which of the two rational numbers $\frac{3}{5}$ and is $\frac{-2}{3}$ greater ?

Sol. Clearly, $\frac{3}{5}$ is a positive rational number and $\frac{-2}{3}$ is a negative rational number. We know that every positive rational number is greater than every negative rational number.

$\therefore \frac{3}{5} > \frac{-2}{3}$

Illustration 1.7

Which of the two rational numbers $\frac{5}{7}$ and $\frac{3}{5}$ is greater ?

Sol. Clearly, denominators of the given rational numbers are positive. The denominators are 7 and 5. The LCM of 7 and 5 is 35. So, we first express each rational number with 35 as common denominator.

$\therefore \frac{5}{7} = \frac{5\times5}{7\times5} = \frac{25}{35}$ and $\frac{3}{5} = \frac{3\times7}{5\times7} = \frac{21}{35}$

Now, we compare the numerators of these rational numbers.

$\therefore\ 25 > 21 \Rightarrow \frac{25}{35} > \frac{21}{35} \Rightarrow \frac{5}{7} > \frac{3}{5}$

Illustration 1.8

Arrange the rational numbers $\frac{-7}{10}, \frac{5}{-8}, \frac{2}{-3}$ in ascending order.

Sol. First write the given rational numbers so that their denominators are positive.

We have,

$\frac{5}{-8} = \frac{5\times(-1)}{-8\times(-1)} = \frac{-5}{8}$ and $\frac{2}{-3} = \frac{2\times(-1)}{-3\times(-1)} = \frac{-2}{3}$

Thus, the given rational numbers with positive denominators are $\frac{-7}{10}, \frac{-5}{8}, \frac{-2}{3}$.

Now, LCM of the denominators 10, 8 and 3 is : 2 × 2 × 5 × 2 × 3 = 120

Write the numbers so that they have a common denominator 120 as follows :

$\frac{-7}{10} = \frac{-7\times12}{10\times12} = \frac{-84}{120}, \frac{-5}{8} = \frac{-5\times15}{8\times15} = \frac{-75}{120}$ and $\frac{-2}{3} = \frac{-2\times40}{3\times40} = \frac{-80}{120}$

Comparing the numerators of these numbers, we get

$-84 < -80 < -75$

$\therefore \frac{-84}{120} < \frac{-80}{120} < \frac{-75}{120} \Rightarrow \frac{-7}{10} < \frac{-2}{3} < \frac{-5}{8} \Rightarrow \frac{-7}{10} < \frac{2}{-3} < \frac{5}{-8}$

Ask yourself

1. Check 972 a prime number ?

2. Express 0.88 into $\frac{p}{q}$ form ?

3. Show that $\frac{-8}{12} = \frac{24}{-36}$?

4. $|-138| - |-243| = ?$

5. Find the greater number in the following pairs of rational numbers :–

(a) $\frac{9}{11}$ and $\frac{10}{12}$ **(b)** $\frac{-5}{8}$ and $\frac{12}{16}$

6. Write the following rational numbers in descending order $\frac{2}{9}, \frac{5}{12}, \frac{7}{15}, \frac{10}{14}$

Answers

1. No **2.** $\frac{22}{25}$ **4.** –105

5. **(a)** $\frac{10}{12} > \frac{9}{11}$ **(b)** $\frac{12}{16} > \frac{-5}{8}$ **6.** $\frac{10}{14} > \frac{7}{15} > \frac{5}{12} > \frac{2}{9}$

1.2 OPERATIONS ON RATIONAL NUMBERS

(a) Addtion

If two rational numbers are to be added we should convert each of them into a rational number with positive denominator.

Case I : When given number have same denominator.

In this case we define $\frac{a}{b} + \frac{c}{b} = \frac{a+c}{b}$.

Illustration 1.9

Add $\frac{7}{5}$ and $\frac{9}{5}$

Sol. $\frac{7}{5} + \frac{9}{5} = \frac{7+9}{5} = \frac{16}{5}$.

Case II : When denominator of given number are unequal.

In this case we take the LCM of their denominators and express each of the given numbers with this LCM as the common denominator. Now we add these numbers as shown above.

Illustration 1.10

Add $\frac{3}{8}$ and $\frac{5}{6}$.

Sol. The denominators of the given rational numbers are 8 and 6 respectively.

LCM of 8 and 6 is 24

Now, $\frac{3}{8} = \frac{3 \times 3}{8 \times 3} = \frac{9}{24}$; $\frac{5}{6} = \frac{5 \times 4}{6 \times 4} = \frac{20}{24}$

$\therefore \frac{3}{8} + \frac{5}{6} = \frac{9}{24} + \frac{20}{24} = \frac{9+20}{24} = \frac{29}{24}$.

Illustration 1.11

Find the sum : $\frac{-7}{5} + \frac{2}{3}$.

Sol. LCM of 5 and 3 = (5 × 3) = 15.

$\therefore \frac{-7}{5} + \frac{2}{3} = \frac{3 \times (-7) + 5 \times 2}{15} = \frac{-21+10}{15} = \frac{-11}{5}$.

(b) Properties of addition

Property 1. Closure Property :

The sum of two rational numbers is always a rational number.

If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers, then $\left(\frac{a}{b}+\frac{c}{d}\right)$ is also a rational number.

For example : Consider the rational numbers $\frac{1}{3}$ and $\frac{3}{4}$. Then, $\left(\frac{1}{3}+\frac{3}{4}\right) = \frac{(4+9)}{12} = \frac{13}{12}$, which is a rational number.

Property 2. Commutative Law :

Two rational numbers can be added in any order.

Thus for any two rational numbers $\frac{a}{b}$ and $\frac{c}{d}$,we have $\left(\frac{a}{b}+\frac{c}{d}\right)=\left(\frac{c}{d}+\frac{a}{b}\right)$.

For example :

(i) $\left(\frac{1}{2}+\frac{3}{4}\right) = \frac{(2+3)}{4} = \frac{5}{4}$ and $\left(\frac{3}{4}+\frac{1}{2}\right) = \frac{(3+2)}{4} = \frac{5}{4}$.

So, $\left(\frac{1}{2}+\frac{3}{4}\right) = \left(\frac{3}{4}+\frac{1}{2}\right)$.

Property 3. Associative Law :

While adding three rational numbers, they can be grouped in any order.

Thus, for any three rational numbers $\frac{a}{b},\frac{c}{d}$ and $\frac{e}{f}$, we have $\left(\frac{a}{b}+\frac{c}{d}\right)+\frac{e}{f}=\frac{a}{b}+\left(\frac{c}{d}+\frac{e}{f}\right)$.

For example, consider three rationals and . Then,

$$\left\{\left(\frac{-2}{3}+\frac{5}{7}\right)+\frac{1}{6}\right\} = \left\{\frac{(-14+15)}{21}+\frac{1}{6}\right\} = \left(\frac{1}{21}+\frac{1}{6}\right) = \frac{(2+7)}{42} = \frac{9}{42}=\frac{3}{14}$$

and $\left\{\frac{-2}{3}+\left(\frac{5}{7}+\frac{1}{6}\right)\right\} = \left\{\frac{-2}{3}+\frac{(30+7)}{42}\right\}=\left(\frac{-2}{3}+\frac{37}{42}\right) = \frac{(-28+37)}{42} = \frac{9}{42} = \frac{3}{14}$.

$\therefore \left\{\left(\frac{-2}{3}+\frac{5}{6}\right)+\frac{1}{6}\right\} = \left\{\frac{-2}{3}+\left(\frac{5}{7}+\frac{1}{6}\right)\right\}$.

Property 4. Existence of Additive identity :

0 is a rational number such that the sum of any rational number and 0 is the rational number itself.

Thus, $\left(\frac{a}{b}+0\right)=\left(0+\frac{a}{b}\right) = \frac{a}{b}$, for every rational number $\frac{a}{b}$.

0 is called the additive identity for rationals.

For example, (i) $\left(\frac{3}{5}+0\right) = \left(\frac{3}{5}+\frac{0}{5}\right) \Rightarrow \frac{(3+0)}{5} = \frac{3}{5}$ and similarly, $\left(0+\frac{3}{5}\right) = \frac{3}{5}$.

$\therefore \left(\frac{3}{5}+0\right) = \left(0+\frac{3}{5}\right) = \frac{3}{5}$.

Property 5. Existence of Additive Inverse :

For every rational number $\frac{a}{b}$, there exists a rational number $\frac{-a}{b}$ such that

$\left(\frac{a}{b}+\frac{-a}{b}\right) = \frac{\{a+(-a)\}}{b} = \frac{0}{b} = 0$ and similarly, $\left(\frac{-a}{b}+\frac{a}{b}\right) = 0$.

Thus, $\left(\frac{a}{b}+\frac{-a}{b}\right)=\left(\frac{-a}{b}+\frac{a}{b}\right) = 0$.

$\frac{-a}{b}$ is called the additive inverse of $\frac{a}{b}$.

For example : $\left(\frac{4}{7}+\frac{-4}{7}\right) = \frac{\{4+(-4)\}}{7} = \frac{0}{7} = 0$ and Similarly, $\left(\frac{-4}{7}+\frac{4}{7}\right) = 0$.

$\therefore \left(\frac{4}{7}+\frac{-4}{7}\right) = \left(\frac{4}{7}+\frac{-4}{7}\right) = 0$.

Thus, $\frac{4}{7}$ and $\frac{-4}{7}$ are additive inverse of each other.

(c) Subtraction

For rational numbers $\frac{a}{b}$ and $\frac{c}{d}$,

we define: $\left(\frac{a}{b}-\frac{c}{d}\right) = \frac{a}{b} + \left(\frac{-c}{d}\right) = \frac{a}{b} + \left(\text{additive inverse of } \frac{c}{d}\right)$

Illustration 1.12

Find the additive inverse of :

(i) $\frac{5}{9}$ **(ii)** $\frac{9}{-11}$

Sol. **(i)** Additive inverse of $\frac{5}{9}$ is $\frac{-5}{9}$.

(ii) In standard form, we write $\frac{9}{-11}$ as $\frac{-9}{11}$. Hence, its additive inverse is $\frac{9}{11}$.

Illustration 1.13

Subtract :

(i) $\frac{-5}{7}$ from $\frac{-2}{5}$ **(ii)** $\frac{9}{16}$ from $\frac{7}{24}$

Sol. **(i)** $\left\{\frac{-2}{5}-\left(\frac{-5}{7}\right)\right\} = \left(\frac{-2}{5}+\frac{5}{7}\right) = \frac{(-14+25)}{35} = \frac{11}{35}$.

(ii) $\frac{7}{24} - \frac{9}{16} = \frac{14-27}{48} = \frac{-13}{48}$.

Illustration 1.14

What number should be added to $\frac{-7}{8}$ to get $\frac{4}{9}$?

Sol. Let the required number to be added be x.

Then, $\frac{-7}{8} + x = \frac{4}{9}$

$x = \left(\frac{4}{9}+\frac{7}{8}\right) = \frac{(32+63)}{72} = \frac{95}{72}$.

Hence, the required number is $\frac{95}{72}$.

(d) Multiplication

For any two rationals $\frac{a}{b}$ and $\frac{c}{d}$, we define : $\left(\frac{a}{b}\times\frac{c}{d}\right) = \frac{(a\times c)}{(b\times d)}$.

Illustration 1.15

Find each of the following products :

(i) $\frac{-15}{4}\times\frac{-3}{8}$ **(ii)** $\frac{3}{7}\times\frac{-5}{8}$

Sol. We have

(i) $\frac{-15}{4}\times\frac{-3}{8} = \frac{(-15)\times(-3)}{4\times 8} = \frac{45}{32}$.

(ii) $\frac{3}{7}\times\frac{-5}{8} = \frac{3x(-5)}{7x8} = \frac{-15}{56}$.

Properties of Multiplication

Property 1. Closure Property :

The product of two rational numbers is always a rational number.

If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers then $\left(\frac{a}{b}\times\frac{c}{d}\right)$ is also a rational number .

For example : Consider the rational numbers and .

Then, $\left(\frac{1}{2}\times\frac{5}{7}\right) = \frac{(1\times 5)}{(2\times 7)} = \frac{5}{14}$, which is a rational number.

Property 2. Commutative Law :

Two rational numbers can be multiplied in any order.

Thus, for any rational numbers $\frac{a}{b}$ and $\frac{c}{d}$, we have :

$\left(\frac{a}{b}\times\frac{c}{d}\right) = \left(\frac{c}{d}\times\frac{a}{b}\right)$.

For example : let us consider the rational numbers $\frac{3}{4}$ and $\frac{5}{7}$. Then,

$\left(\frac{3}{4}\times\frac{5}{7}\right) = \frac{(3\times5)}{(4\times7)} = \frac{15}{28}$ and $\left(\frac{5}{7}\times\frac{3}{4}\right) = \frac{(5\times3)}{(7\times4)} = \frac{15}{28}$.

$\left(\frac{3}{4}\times\frac{5}{7}\right) = \left(\frac{5}{7}\times\frac{3}{4}\right)$

Property 3. Associative Law :

While multiplying three or more rational numbers, they can be grouped in any order.

Thus, for any rationals $\frac{a}{b}$, $\frac{c}{d}$ and $\frac{e}{f}$, we have

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

For example : Consider the rationals $\frac{-5}{2}$, $\frac{-7}{4}$ and $\frac{1}{3}$. We have

$\left(\frac{-5}{2}\times\frac{-7}{4}\right)\times\frac{1}{3} = \left\{\frac{(-5)\times(-7)}{2\times4}\times\frac{1}{3}\right\} = \left(\frac{35}{8}\times\frac{1}{3}\right) = \frac{(35\times1)}{(8\times3)} = \frac{35}{24}$

and $\frac{-5}{2} \times \left(\frac{-7}{4}\times\frac{1}{3}\right) = \frac{-5}{2} \times \frac{(-7)\times1}{4\times3} = \left(\frac{-5}{2}\times\frac{-7}{12}\right) = \frac{(-5)\times(-7)}{(2\times12)} = \frac{35}{24}$.

$\therefore \left(\frac{-5}{2}\times\frac{-7}{4}\right) \times \frac{1}{3} = \frac{-5}{2}\times\left(\frac{-7}{4}\times\frac{1}{3}\right)$.

Property 4. Existence of Multiplicative Identity :

For any rational number $\frac{a}{b}$, we have

$\left(\frac{a}{b}\times1\right) = \left(1\times\frac{a}{b}\right) = \frac{a}{b}$.

1 is called the multiplicative identity for rationals.

For example : Consider the rational number $\frac{3}{4}$. Then, we have

$\left(\frac{3}{4}\times1\right) = \left(\frac{3}{4}\times\frac{1}{1}\right) = \frac{(3\times1)}{(4\times1)} = \frac{3}{4}$ and $\left(1\times\frac{3}{4}\right) = \left(\frac{1}{1}\times\frac{3}{4}\right) = \frac{(1\times3)}{(1\times4)} = \frac{3}{4}$.

Property 5. Existence of Multiplicative Inverse :

Every nonzero rational number $\frac{a}{b}$ has its multiplicative inverse $\frac{b}{a}$.

Thus, $\left(\frac{a}{b}\times\frac{b}{a}\right) = \left(\frac{b}{a}\times\frac{a}{b}\right) = 1$.

$\frac{b}{a}$ is called the reciprocal of $\frac{a}{b}$. Clearly, zero has no reciprocal. Reciprocal of 1 is 1 and the reciprocal of (–1) is (–1).

For example : Reciprocal of $\frac{5}{7}$ is $\frac{7}{5}$, since $\left(\frac{5}{7}\times\frac{7}{5}\right) = \left(\frac{7}{5}\times\frac{5}{7}\right) = 1$.

Property 6. Distributive Law of Multiplication Over Addition :

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

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

For example : Consider the rational numbers $\frac{-3}{4}, \frac{2}{3}$ and $\frac{-5}{6}$. We have

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

Again, $\left(\frac{-3}{4}\right) \times \frac{2}{3} = \frac{(-3)\times 2}{4\times 3} = \frac{-6}{12} = \frac{-1}{2}$ and $\left(\frac{-3}{4}\right) \times \left(\frac{-5}{6}\right) \frac{(-3)\times(-5)}{4\times 6} = \frac{15}{24} = \frac{5}{8} = .$

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

Hence,

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

Property 7. Multiplicative Property of 0 :

Every rational number multiplied with 0 gives 0.

Thus, for any rational number $\frac{a}{b}$, we have : $\left(\frac{a}{b}\times 0\right) = \left(0\times\frac{a}{b}\right) = 0.$

For example, $\left(\frac{5}{18}\times 0\right) = \left(\frac{5}{18}\times\frac{0}{1}\right) = \frac{(5\times 0)}{(18\times 1)} = \frac{0}{18} = 0.$

Similarly, $\left(0\times\frac{5}{18}\right) = 0.$

Illustration 1.16

Find the reciprocal of each of the following :

(i) -8 **(ii)** $\frac{5}{16}$

Sol. **(i)** Reciprocal of -8 is $\frac{1}{-8}$, i.e., $\frac{-1}{8}$. **(ii)** Reciprocal of $\frac{5}{16}$ is $\frac{16}{5}$.

(d) Division

When $\frac{a}{b}$ is divided by $\frac{c}{d}$, then $\frac{a}{b}$ is called dividend; $\frac{c}{d}$ is called the divisor and the result is known as quotient.

Properties of division

Property 1. Closure Property :

If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers such that $\frac{c}{d} \neq 0$, then $\left(\frac{a}{b}\div\frac{c}{d}\right)$ is also a rational number.

Property 2.

For every rational number $\frac{a}{b}$, we have: $\left(\frac{a}{b} \div 1\right) = \frac{a}{b}$

Property 3.

For every non–zero rational number $\frac{a}{b}$, we have $\left(\frac{a}{b} \div \frac{a}{b}\right)$ =1

Illustration 1.17

Divide $\frac{4}{7}$ by $\frac{-3}{8}$.

Sol. $\frac{4}{7} \div \frac{-3}{8} = \frac{4}{7} \times \frac{-8}{3} = \frac{-32}{21}$.

(e) Insertion of Rational number between two given Rational Numbers:

If a and b be two rational number such that a < b, then $\frac{1}{2}$ (a + b) is a rational number between a and b.

Illustration 1.18

Find 3 Rational numbers between $\frac{1}{3} \& \frac{1}{2}$.

Sol. A rational number between $\frac{1}{3} \& \frac{1}{2}$.

$= \frac{\frac{1}{3}+\frac{1}{2}}{2} = \frac{\frac{2+3}{6}}{2} = \frac{5}{12} \left(\therefore \frac{1}{3}, \frac{5}{12}, \frac{1}{2}\right)$

A rational number between $\frac{1}{3}$ *and* $\frac{5}{12}$

$= \frac{\frac{1}{3}+\frac{5}{12}}{2} = \frac{\frac{4+5}{12}}{2} = \frac{9}{24}$.

A rational number between $\frac{5}{12}$ *and* $\frac{1}{2}$

$= \frac{\frac{5}{12}+\frac{1}{2}}{2} = \frac{\frac{5}{12}+\frac{6}{12}}{2} = \frac{11}{24}$; $\left(\therefore \frac{1}{3}, \frac{9}{24}, \frac{5}{12}, \frac{11}{24}, \frac{1}{2}\right)$

$\therefore$ Three rational number between $\frac{1}{3} \& \frac{1}{2}$ are $\frac{5}{12}, \frac{9}{24}, \frac{11}{24}$.

Illustration 1.19

Find 5 rational number between $\frac{-3}{5}$ and $\frac{1}{4}$.

Sol. Convert to equivalent rational numbers having same denominators

$\frac{-3}{5} = \frac{-3 \times 4}{5 \times 4} = \frac{-12}{20}$ and $\frac{1}{4} = \frac{1 \times 5}{4 \times 5} = \frac{5}{20}$

The integers between –12 and 5 are – 11, –10, – 9,..., 3, 4.

The corresponding rational number are . $\frac{-11}{20}, \frac{-10}{20}, \frac{-9}{20}, \ldots\ldots, \frac{2}{20}, \frac{3}{20}, \frac{4}{20}$

Selecting any five of them , we get

$\frac{-11}{20}, \frac{-10}{20}, \frac{-9}{20}, \frac{-8}{20}, \frac{-7}{20}$ are five rational numbers between $\frac{-3}{5}$ and $\frac{1}{4}$

Ask yourself

1. The sum of two rational numbers is $\frac{-8}{9}$. If one of the numbers is $\frac{-5}{7}$, find the other.
2. What should be subtracted from $\frac{-4}{9}$ so as to get $\frac{5}{12}$?
3. The product of two rational numbers is $\frac{-25}{49}$. If one of the numbers is $\frac{5}{8}$, find the other?
4. Divide the sum of $\frac{-7}{6}$ and $\frac{4}{5}$ by their product .
5. Write any 5 rational numbers between $\frac{-5}{6}$ and $\frac{7}{8}$.
6. Find two rational numbers whose absolute value is $\frac{1}{5}$.

Answers

1.	$-\frac{11}{63}$	**2.**	$-\frac{31}{36}$	**3.**	$-\frac{40}{49}$
4.	$\frac{11}{28}$	**5.**	$\frac{-19}{24}, \frac{-18}{24}, \frac{-17}{24}, \frac{-16}{24}, \frac{-15}{24}$	**6.**	$\frac{-1}{5}$ and $\frac{1}{5}$

Add to Your Knowledge

1. DIVISION ALGORITHM

Division Algorithm : General representation of result is,

$$\frac{Dividend}{Divisor} = Quotient + \frac{Remainder}{Divisor}$$

Dividend = (Divisor × Quotient) + Remainder

Example. On dividing 4150 by certain number, the quotient is 55 and the remainder is 25. Find the divisor.

Sol. $4150 = 55 \times x + 25 \Rightarrow 55x = 4125 \Rightarrow x = \frac{4125}{55} = 75.$

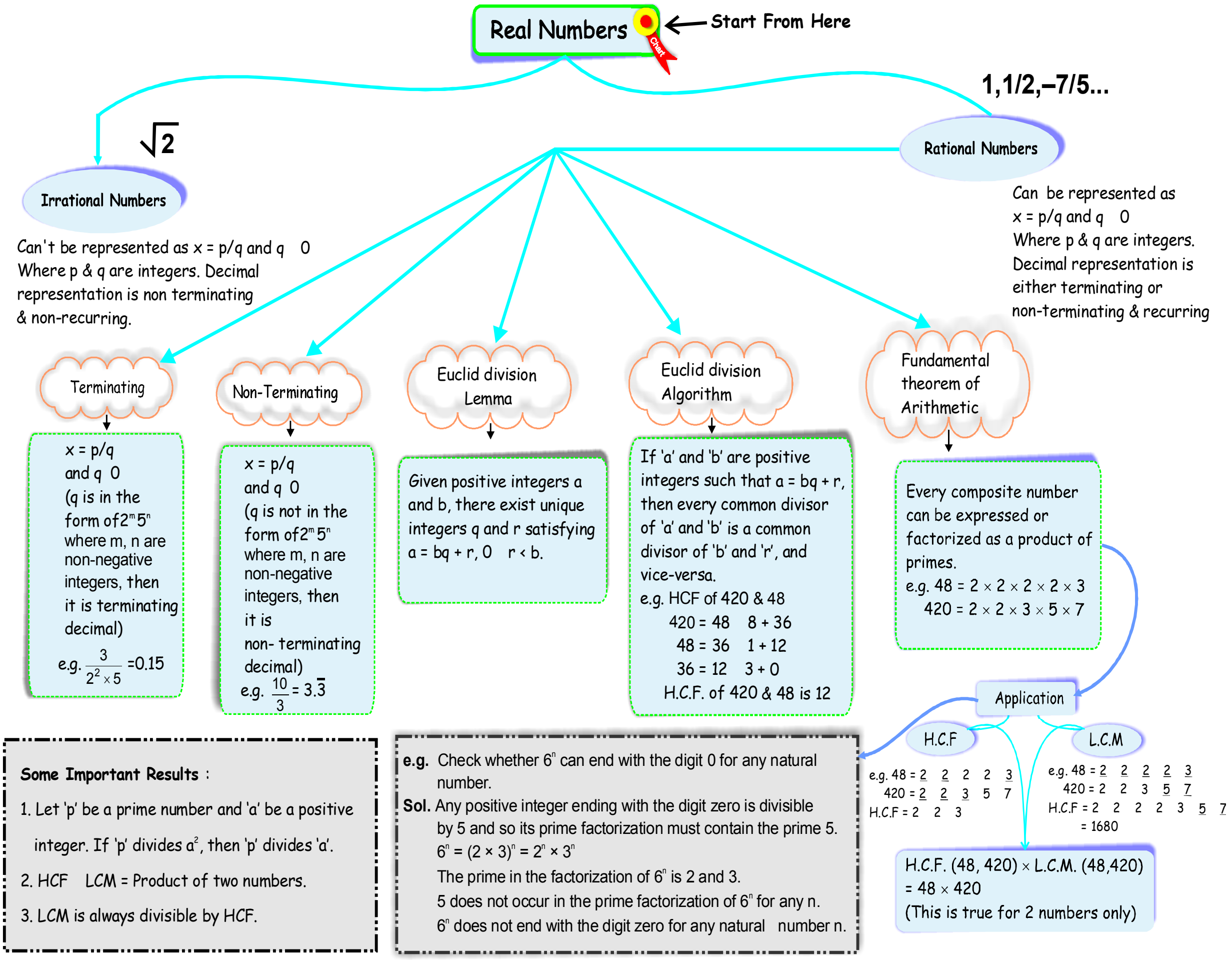
2. In order to convert a non terminating and repeating decimal number into fraction, follow the following steps :–

Step 1 – To obtain the numerator subtract the number formed by non–repeating digits from the complete number without decimal .

Step 2 – To obtain the denominator take the number of nines = Number of repeating digits and after that put the number zeros = number of non repeating digits.

For example :– $0.7\overline{37} = \frac{737-7}{990} = \frac{730}{990} = \frac{73}{99}$

Concept Map


Real Numbers
Start From Here
1,1/2,–7/5...
Rational Numbers
Can be represented as x = p/q and q 0 Where p & q are integers. Decimal representation is either terminating or non-terminating & recurring
√2
Irrational Numbers
Can't be represented as x = p/q and q 0 Where p & q are integers. Decimal representation is non terminating & non-recurring.
Terminating
x = p/q and q 0 (q is in the form of 2^m 5^n where m, n are non-negative integers, then it is terminating decimal)
e.g. 3/(2^2 × 5) = 0.15
Non-Terminating
x = p/q and q 0 (q is not in the form of 2^m 5^n where m, n are non-negative integers, then it is non- terminating decimal)
e.g. 10/3 = 3.3̄
Euclid division Lemma
Given positive integers a and b, there exist unique integers q and r satisfying a = bq + r, 0 r < b.
Euclid division Algorithm
If 'a' and 'b' are positive integers such that a = bq + r, then every common divisor of 'a' and 'b' is a common divisor of 'b' and 'r', and vice-versa.
e.g. HCF of 420 & 48
420 = 48 8 + 36
48 = 36 1 + 12
36 = 12 3 + 0
H.C.F. of 420 & 48 is 12
Fundamental theorem of Arithmetic
Every composite number can be expressed or factorized as a product of primes.
e.g. 48 = 2 × 2 × 2 × 2 × 3
420 = 2 × 2 × 3 × 5 × 7
Application
H.C.F
e.g. 48 = 2 2 2 2 3
420 = 2 2 3 5 7
H.C.F = 2 2 3
L.C.M
e.g. 48 = 2 2 2 2 3
420 = 2 2 3 5 7
H.C.F = 2 2 2 2 3 5 7
= 1680
H.C.F. (48, 420) × L.C.M. (48,420)
= 48 × 420
(This is true for 2 numbers only)
Some Important Results :
1. Let 'p' be a prime number and 'a' be a positive integer. If 'p' divides a², then 'p' divides 'a'.
2. HCF LCM = Product of two numbers.
3. LCM is always divisible by HCF.
e.g. Check whether 6^n can end with the digit 0 for any natural number.
Sol. Any positive integer ending with the digit zero is divisible by 5 and so its prime factorization must contain the prime 5.
6^n = (2 × 3)^n = 2^n × 3^n
The prime in the factorization of 6^n is 2 and 3.
5 does not occur in the prime factorization of 6^n for any n.
6^n does not end with the digit zero for any natural number n.

Summary

1. Zero is neither positive nor negative rational number.

2. There can be infinte rational numbers between two given rational number .

3. 1.066666..... can also be written as $1.0\overline{6}$, to represent a recurring decimal.

4. By repeated use of commutative and associative properties , the sum (multiplication) of three or more rational numbers can be found and this sum (product) remians the same , whatever be the order of numbers before addition (multiplication) . This is also called the re–arrangement property of addition(multiplication) of rational numbers.

5. The reciprocal or multiplicative inverse of 0 does not exist. Hence , **zero has no multiplicative inverse.**

6. Division by zero is meaningless (not defined) .

7. Each rational number can be represented by a point on the number line but vice versa is not always true.

8. **Dividend = Divisor x quotient + remainder.**

Exercise-1

SECTION –A (FIXED RESPONSE TYPE)

OBJECTIVE QUESTIONS

1. Which of the following is prime

(A) 141 (B) 241 (C) 341 (D) 441

2. Which of the following natural numbers is neither prime nor composite.

(A) 0 (B) 1 (C) 2 (D) None

3. The reciprocal of a negative rational number :

(A) is a positive rational number

(B) is a negative rational number

(C) can be either a positive or a negative rational number

(D) does not exist

4. Lowest form of $\frac{-219}{365}$.

(A) $-\frac{73}{125}$ (B) $-\frac{3}{5}$ (C) $\frac{3}{5}$ (D) None of these

5. $|-138|-|-243|$ = ?

(A) 105 (B) 381 (C) –381 (D) – 105

6. Which of the following is (are) greater than x when x = $\frac{9}{11}$?

(i) $\frac{1}{x}$ **(ii)** $\frac{x+1}{x}$ **(iii)** $\frac{x+1}{x-1}$

(A) (i) only (B) (i) and (ii) only (C) (i) and (iii) only (D) (ii) and (iii) only

7. Arrange the following fractions in ascending order $\frac{3}{7},\frac{4}{5},\frac{7}{9},\frac{1}{2}$.

(A) $\frac{4}{5},\frac{7}{9},\frac{3}{7},\frac{1}{2}$ (B) $\frac{3}{7},\frac{1}{2},\frac{7}{9},\frac{4}{5}$ (C) $\frac{4}{5},\frac{7}{9},\frac{1}{2},\frac{3}{7}$ (D) $\frac{1}{2},\frac{3}{7},\frac{7}{9},\frac{4}{5}$

8. Multiplicative inverse of $\frac{3}{5}$ is :

(A) 1 (B) 0 (C) $\frac{-3}{5}$ (D) $\frac{5}{3}$

9. What number should be subtracted from – 5 to get $\frac{8}{9}$.

(A) $\frac{-53}{9}$ (B) $\frac{37}{9}$ (C) $\frac{9}{37}$ (D) $\frac{-9}{37}$

10. If x/y = 6/5 then $\frac{x^2+y^2}{x^2-y^2}$ is :

(A) $\frac{36}{25}$ (B) $\frac{25}{36}$ (C) $\frac{11}{61}$ (D) $\frac{61}{11}$

11. The product of a non – zero rational number with an irrational number is :

(A) Irrational number (B) Rational number (C) Whole number (D) Natural number

12. If $\frac{3}{11}$ of a number is 22, what is $\frac{6}{11}$ of that number ?

(A) 6 (B) 11 (C) 12 (D) 44

13. How many rational numbers exist between any two distinct rational numbers ?

(A) 2 (B) 3 (C) 11 (D) Infinite

14. Rational number between 1 and 2

(A) $\frac{5}{6}$ (B) $\frac{6}{5}$ (C) $\frac{3}{7}$ (D) $\frac{7}{3}$

FILL IN THE BLANKS

1. All natural numbers that have one and itself as their only 2 distinct factors are _________.

2. $\frac{5}{11}$ is ___________ decimal

3. Lowest form of 8/12 is _________ .

4. $\frac{3}{7}\times\frac{5}{8} = \times\frac{3}{7}$ ______.

5. $\frac{3}{7}\times\left(\frac{5}{8}+\frac{4}{7}\right) = \frac{3}{7}\times\frac{5}{8}+\frac{3}{7}\times$ _______

6. $\frac{37}{58}\times$ _______ = 1.

7. $\frac{4}{9}\times$ _______ $=\frac{4}{9}$.

8. $\frac{-5}{9}+$ _______ = 0.

9. Additive inverse of 5 is ____ ___.

10. Product of 2/3 and –3/2 is _________.

TRUE / FALSE

1. 91 is a prime number.

2. Prime number can also be negative integers .

3. 2 is the only even prime number.

4. 0 is a rational number.

5. Rational number cannot be represented on real number line.

6. $\frac{3}{5} > \frac{2}{3}$.

7. The sum of 2 rational number is always a rational number.

8. Reciprocal of a positive rational number can either be negative or positive.

9. There are only 4 integers between –3 and 2.

10. There exist infinite rational number between any 2 integers.

MATCH THE COLUMN

1. Match the value of column–I with the value in column–II

Column–I		**Column–II**	
(A)	2/3 1/2	(p)	1/2
(B)	6/7–1/2	(q)	4/3
(C)	2/3+4/5	(r)	6/5
(D)	42	(s)	22/15
(E)	7/21/7	(t)	5/14
(F)	4/5 3/2	(u)	2

2.

Column–I	**Column–II**
(A) $\frac{4}{7} \times \left(\frac{3}{5} \times 7\right) = \left(\frac{4}{7} \times \frac{3}{5}\right) \times 7$	(p) commutativity under addition
(B) $\frac{-1}{9} \times 1 = 1 \times \frac{-1}{9} = \frac{-1}{9}$	(q) associativity under multiplication
(C) $\frac{4}{7} \times \frac{7}{4} = 1$	(r) existence of multiplicative identity
(D) $6 + \frac{5}{9} = \frac{5}{9} + 6$	(s) existence of additive identity
(E) $-\frac{3}{8} + 0 = 0 + \left(\frac{-3}{8}\right) = \frac{-3}{8}$	(t) existence of multiplicative inverse

SECTION –B (FREE RESPONSE TYPE)

VERY SHORT ANSWER TYPE

1. Smallest natural number is

2. Smallest composite number is

3. Smallest prime number is

4. Only even prime number is

5. Represent $\frac{13}{5}$ and $\frac{-13}{5}$ on the number line.

6. Represent -17.5 on the number line.

7. Find the additive inverse of the following :

(a) $\frac{1}{3}$ **(b)** 0 **(c)** 5 **(d)** $\frac{5}{-7}$

8. Find the multiplicative inverse of the following :

(a) $\frac{7}{5}$ **(b)** 0 **(c)** -8 **(d)** $\frac{-2}{5}$

SHORT ANSWER TYPE

9. Arrange the following rational number in ascending order : $\frac{1}{3}, \frac{5}{8}, \frac{23}{24}, \frac{5}{6}$.

10. Standard form of $\frac{205}{82}$.

11. The product of two rational numbers is $\frac{-5}{7}$, if one of the number is $\frac{2}{9}$, find the other.

12. Find the number which when divided by $\frac{8}{21}$ gives 1.

13. Give three rational numbers between – 2 and – 1.

14. Give three rational numbers between 3 and 4.

15. Find three different rational numbers between $\frac{5}{7}$ and $\frac{9}{11}$.

LONG ANSWER TYPE

16. **(i)** Verify that $|x + y| \le |x| + |y|$ by taking $x = \frac{-5}{12}$, $y = \frac{-7}{18}$

(ii) Verify that $|x \times y| = |x| \times |y|$ by taking $x = \frac{-2}{3}$, $y = \frac{-9}{8}$.

17. **(i)** Which rational number is its own additive inverse ?
(ii) Is the difference of two rational numbers a rational number ?
(iii) Is addition commutative on rational numbers ?
(iv) Is addition associative on rational numbers ?
(v) Is subtraction commutative on rational numbers ?
(vi) Is subtraction associative on rational numbers ?
(vii) What is the negative of negative rational number ?

18. The cost of $3\frac{7}{9}$ m cloth is Rs $212\frac{4}{5}$.. Find the cost of $7\frac{2}{3}$ m cloth.

19. Simplify :

(i) $2\frac{3}{4}\times 1\frac{2}{3}+9\frac{11}{12}-1\frac{5}{6}$. **(ii)** $5-\left[\frac{3}{4}+\left\{2\frac{1}{2}-\left(0.5+\overline{\frac{1}{6}-\frac{1}{7}}\right)\right\}\right]$.

Exercise-2

SECTION –A (COMPETITIVE EXAMINATION QUESTION)

OBJECTIVE QUESTIONS

1. There are four prime numbers written in ascending order. The product of the first three is 385 and that of the last three is 1001. The last number is :
(A) 11 (B) 13 (C) 17 (D) 19

2. Let x, y and z be distinct integers where x and y are odd and positive, and z is even and positive. Which one of the following statements cannot be true ?
(A) $(x - z)^2y$ is even (B) $(x - z)y^2$ is odd (C) $(x - z)y$ is odd (D) $(x - y)^2z$ is even

3. Choose the rational number which does not lie between rational numbers 3/5 and 2/3
(A) 46/75 (B) 47/ 75 (C) 49/75 (D) 50/75

4. Evaluate : $\frac{8-[5-(-3+2)]\div 2}{|5-3|-|5-8|\div 3}$.
(A) 2 (B) 3 (C) 4 (D) 5

5. A student was asked to multiply a number by $\frac{3}{2}$. Instead he divided the number by $\frac{3}{2}$ and obtained a number smaller by $\frac{2}{3}$, the number is :
(A) $\frac{4}{5}$ (B) $\frac{3}{5}$ (C) $\frac{2}{3}$ (D) $\frac{1}{2}$

6. Which one of the following is Rational number in simplest form ?
(A) $\frac{-8}{28}$ (B) $\frac{-13}{38}$ (C) $\frac{14}{-49}$ (D) $\frac{16}{56}$

7. If a and b are positive integers, then which of the following is correct?
(A) a + b is rational (B) a – b is a positive integer
(C) $\frac{a}{b}$ is irrational (D) None of these

8. $\left[\frac{9}{4}\times\frac{3}{5}\div\frac{12}{5}+\frac{7}{8}\div\frac{5}{4}+\frac{3}{5}\right]$ is equal to
(A) $1\frac{69}{80}$ (B) $1\frac{41}{80}$ (C) $2\frac{2}{9}$ (D) $20\frac{7}{9}$

9. The product $\left(2-\frac{1}{3}\right)\left(2-\frac{3}{5}\right)\left(2-\frac{5}{7}\right)$ ...... $\left(2-\frac{97}{99}\right)$ is equal to :
(A) $\frac{5}{99}$ (B) $\frac{101}{99}$ (C) $\frac{101}{3}$ (D) $\frac{97}{99}$

10. The product of the following fractions
$\frac{\frac{1}{2}-\frac{1}{3}}{\frac{1}{3}-\frac{1}{4}}\times\frac{\frac{1}{4}-\frac{1}{5}}{\frac{1}{5}-\frac{1}{6}}\times\frac{\frac{1}{6}-\frac{1}{7}}{\frac{1}{7}-\frac{1}{8}}\times......\times\frac{\frac{1}{99}-\frac{1}{99}}{\frac{1}{99}-\frac{1}{100}}$, is :
(A) 2 (B) 50 (C) 100 (D)

SECTION –B (TECHIE STUFF)

11. $0.\overline{018}$ can be expressed in the rational form as :
(A) $\frac{18}{1000}$ (B) $\frac{18}{990}$ (C) $\frac{18}{9900}$ (D) $\frac{18}{999}$

12. On dividing a number by 999, the quotient is 366 and the remainder is 103. The number is :
(A) 364724 (B) 365387 (C) 365737 (D) 366757

13. The number 2.525252........ can be written as a fraction, when reduced to the lowest term, the sum of the numerator and denominator is:–
(A) 7 (B) 29 (C) 141 (D) 349

Exercise-3

SECTION –A (PREVIOUS YEAR EXAMINATION QUESTIONS)

1. $0.\overline{2}+0.\overline{3}+0.\overline{4}+0.\overline{5}$ is equiralent to **[Aryabhatta 2005]**
(A) $\frac{14}{9}$ (B) $\frac{15}{9}$ (C) $\frac{1}{3}$ (D) 1

2. If a number is divided by 45, then the remainder is 32. if the same number is divided by 15, then the remainder is **[Aryabhatta 2008]**
(A) 2 (B) 3 (C) 16 (D) 4

3. A rational number can be expressed as a terminating decimal if the denominator has factors **[NSTSE 2010]**

(A) 2 or 5 (B) 3 or 5 (C) 2, 3 or 5 (D) None of these

4. The product of x^2y and $\left(\frac{x}{y}\right)$ is equal to the quotient obtained when x^2 is divided by **[NSTSE 2010]**

(A) 0 (B) 1 (C) X (D) $\frac{1}{x}$

5. If $1+\frac{1}{x}=\frac{x+1}{x}$, which does 'x' equal to ? **[NSTSE – 2011]**

(A) 1 or 2 only (B) 1 and 0 only

(C) + 1 or – 2 only (D) any number except '0'

6. Identify a rational number between $\frac{1}{3}$ and $\frac{4}{5}$ **[NSTSE 2012]**

(A) $\frac{1}{4}$ (B) $\frac{9}{10}$ (C) $\frac{17}{30}$ (D) 1

7. Which of the statements is true about consecutive natural numbers ? **[NSTSE 2012]**

(A) There are 2n + 1 numbers between squares of consecutive numbers.

(B) There are 2n non–perfect square numbers between the squares of consecutive numbers.

(C) The sum of the squares of two consecutive numbers is not a perfect square

(D) $n^2 - 1$ is the standard form of the difference between two consecutive numbers

8. Identify the ones that is/are greater than 'm' if m = $\frac{9}{11}$ **[NSTSE 2014]**

(i) $\frac{1}{m}$ **(ii)** $\frac{m+1}{m}$ **(iii)** $\frac{m+1}{m-1}$

(A) (i) only (B) (ii) and (iii) only (C) (i) and (iii) only (D) (i) and (ii) only

9. Which number is in the middle if $\frac{-1}{6}, \frac{4}{9}, \frac{6}{-7}, \frac{2}{5}$ and $\frac{-3}{4}$ are arranged in descending order **[NSTSE 2014]**

(A) $\frac{2}{5}$ (B) $\frac{4}{9}$ (C) $\frac{-1}{6}$ (D) $\frac{-6}{7}$

10. If the division N ÷ 5 leaves a remainder of 3, what might be the ones digit of N ? **[NSTSE 2014]**

(A) 2 (B) 3 (C) 4 (D) 6

11. Which of the following numbers does NOT have a multiplicative inverse? **[NSTSE 2014]**

(A) $-\frac{1}{3}$ (B) 0 (C) 1 (D) 3

12. Nalini and three of her friends worked together to make a quilt. The given table lists the fractional part of the quilt that each of the girls made. Which list shows the girls in order from the one who sewed the most to the one who sewed the least? **[NSTSE 2014]**

Girl	Parts Sewn
Nalini	$\frac{3}{8}$
Kamini	$\frac{1}{5}$
Shalini	$\frac{2}{5}$
Reena	$\frac{1}{40}$

(A) Reena, Nalini, Shalini, Kamini
(B) Shalini, Nalini, Kamini, Reena
(C) Reena, Karnini, Nalini, Shalini
(D) Kamini, Shalini, Nalini, Reena

13. The difference between the place value and the face value of 6 in the numeral 856973 is__________. **[NSTSE 2014]**
(A) 973
(B) 6973
(C) 5994
(D) None of these

14. Which of the following expressions is true? **[NSTSE 2014]**
(A) $0.09 > \frac{7}{8}$
(B) 6% < 0.09
(C) $\frac{7}{8} < 8.0 \times 10^{-3}$
(D) $8.0 \times 10^{-3} > 6\%$

15. If x:y = 5:2, then (8x + 9y) : (8x + 2y) is **[NSTSE 2014]**
(A) 22 : 29
(B) 26 : 61
(C) 29 : 22
(D) 61: 26

16. Closure property for rational numbers is satisfied in case of ________ **[NSTSE 2014]**
(A) Addition
(B) Subtraction
(C) Multiplication
(D) All of these

17. Which of the following statements is INCORRECT for rational numbers? **[NSTSE 2014]**
(A) The rational number O is the additive identity for rational numbers.
(B) The rational number 1 is the multiplicative identity for rational numbers
(C) Subtraction is associative for rational numbers.
(D) There are infinite rational numbers between any two given rational numbers.

Answer Key

Exercise-1

SECTION -A (FIXED RESPONSE TYPE)

OBJECTIVE QUESTIONS

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Ans.	B	B	B	B	D	B	B	D	A	D	A	D	D	B

FILL IN THE BLANKS

1. Prime **2.** non terminating repeating **3.** (2/3)

4. 5/8 **5.** (4/7) **6.** (58/37) **7.** 1

8. (5/9) **9.** (– 5) **10.** (–1)

TRUE / FALSE

1. False **2.** False **3.** True **4.** True

5. False **6.** False **7.** True **8.** False

9. True **10.** True

MATCH THE COLUMN

1. (A) q, (B) t, (C) s, (D) u, (E) p, (F) r

2. (A) q, (B) r, (C) t, (D) p, (E) s

SECTION -B (FREE RESPONSE TYPE)

VERY SHORT ANSWER TYPE

1. 1 **2.** 4 **3.** 2 **4.** 2

7. **(a)** $-\frac{1}{3}$ **(b)** 0 **(c)** – 5 **(d)** 5/7

8. **(a)** 5/7 **(b)** Does not exist **(c)** – 1/8 **(d)** – 5/2

SHORT ANSWER TYPE

9. $(\frac{1}{3} < \frac{5}{8} < \frac{5}{6} < \frac{23}{24})$ **10.** $\frac{5}{2}$ **11.** $\left(\frac{-45}{14}\right)$ **12.** $\frac{8}{21}$

13. $(-\frac{7}{4}, -\frac{3}{2}, -\frac{5}{4})$ **14.** $(\frac{31}{10}, \frac{33}{10}, \frac{37}{10})$ **15.** $\left(\frac{56}{77}, \frac{57}{77}, \frac{58}{77}\right)$

LONG ANSWER TYPE

16. **(i)** **(ii)**

17. **(i)** 0 **(ii)** yes **(iii)** yes **(iv)** yes

(v) no **(vi)** no **(vii)** positive rational number

18. Rs. $431\frac{73}{85}$ **19.** **(i)** $12\frac{2}{3}$ **(ii)** $2\frac{23}{84}$

Exercise-2

SECTION -A (COMPETITIVE EXAMINATION QUESTION)

OBJECTIVE QUESTIONS

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13
Ans.	B	A	D	D	A	B	A	A	C	C	D	C	D

Exercise-3

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ans.	A	A	A	D	D	C	B	D	C	B	B	B	C	B	C	D	C