CHAPTER 1

RATIONAL NUMBER

1. Natural Numbers: Numbers which are used for counting are called Natural Number. The set of natural number is denoted by 'N'.

For Example: Set of Natural Numbers, N = {1, 2, 3, ...}

2. Whole Numbers: All set of natural numbers together with 0 form whole numbers. The set of whole number is denoted by 'W'.

For Example: Set of whole numbers, W. = {0, 1, 2, 3, ...}

3. Integers: The collection of all whole numbers i.e. positive, zero and negative numbers, are called integers. The set of integers is denoted by Z or I.

For Example: Set of Integers, Z or I = {..., –3, –2, –1, 0, 1, 2, 3, ... }

4. Rational numbers: A number '*r*' is called a rational number, if it can be written in the form *p*/*q*, where *p* and *q* are integers and $q \neq 0$. The set of rational numbers is denoted by Q.

For Example: Set of rational numbers, $Q=\left\{\frac{p}{q}: p, q \in I, q \neq 0\right\}$

Example: of Rational Number: $\frac{7}{9}, \frac{-5}{11}, \frac{-8}{9}$

Note: The rational numbers also include the natural numbers, whole numbers and integers.

PROPERTIES OF RATIONAL NUMBER

1. Equivalent rational number.

If $\frac{a}{b}$ is a rational number and m is a nonzero integer then $\frac{a}{b}=\frac{a\times m}{b\times m}$.

eg: $\frac{-3}{4}=\frac{-3\times 2}{4\times 2}=\frac{-3\times 3}{4\times 3}=\frac{-3\times 4}{4\times 4}$.....

$\frac{-3}{4}=\frac{-6}{8}=\frac{-9}{12}=\frac{-12}{16}$.....

2. Standard form of a rational number.

If $\frac{a}{b}$ is a rational number and m is a common divisor of a & b, then $\frac{a}{b} = \frac{a\div m}{b\div m}$

eg: $\frac{-32}{40} = \frac{-32\div 8}{40\div 8} = \frac{-4}{5} \Rightarrow \frac{15}{21} = \frac{15\div 3}{21\div 3} = \frac{5}{7}$

3. Let $\frac{a}{b}$ and $\frac{c}{d}$ be 2 rational number. Then $\frac{a}{b} \times \frac{c}{d} \Rightarrow a \times d = b \times c$

eg: $\frac{-7}{21} = \frac{3}{-9} \Rightarrow -7 \times (-9) = 21 \times 3$

COMPARING RATIONAL NUMBER

ILLUSTRATION

1. Which of number $\frac{3}{-4}$ and $\frac{-5}{6}$ is greater?

Sol. LCM of 4 and 6 = 12 $= \frac{-3}{4}\times\frac{3}{3} = \frac{-9}{12}$ and $\frac{-5}{6}\times\frac{2}{2} = \frac{-10}{12} \Rightarrow \frac{-9}{12} > \frac{-10}{12}$

Hence $\frac{-3}{4} > \frac{-5}{6}$

PRACTICE QUESTION - 1

1. Arrange the following in ascending order:

a. $\frac{4}{-9}, \frac{-5}{12}, \frac{7}{-18}, \frac{-2}{3}$ ***b.*** $\frac{-3}{7}, \frac{-9}{14}, \frac{13}{-28}, \frac{-23}{42}$

2. Arrange in descending order:

a. $-2, \frac{-13}{6}, \frac{8}{-3}, \frac{1}{3}$ ***b.*** $\frac{-10}{11}, \frac{-19}{22}, \frac{-23}{33}, \frac{-39}{44}$

3. Fill in the blanks with correct symbol:

a. $\frac{-3}{7}$ _____ $\frac{6}{-13}$ **b.** $\frac{-8}{9}$ _____ $\frac{-9}{10}$

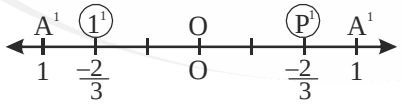
c. -2 _____ $\frac{-13}{5}$ ***d.*** $\frac{+9}{-13}$ _____ $\frac{7}{-12}$

REPRESENTATION OF RATIONAL NUMBER ON THE REAL LINE

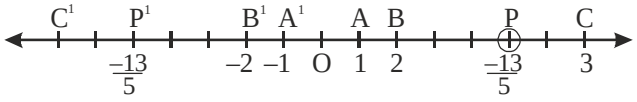
ILLUSTRATION

2. Represent the following on number line:

a. $\frac{2}{3}$ and $\frac{-2}{3}$



b. $\frac{13}{5}$ and $\frac{-13}{5}$



PRACTICE QUESTION - 2

1. Represent the following on number line

a. $5\frac{5}{7}$ ***b.*** $-1\frac{2}{3}$ ***c.*** $-2\frac{7}{8}$ ***d.*** 8

2. Which of the following statements are true or false?

a. $\frac{-3}{5}$ lies on left of 0 an number line. ***b.*** The rational number $\frac{-18}{-13}$ lies on left of 0 on number line.

ADDITION OF RATIONAL NUMBERS

Case I: When Denominators are same $\frac{a}{b}+\frac{c}{b}=\frac{(a+c)}{b}$.

Case II: When Denominators are different $\frac{a}{b}+\frac{c}{b}=\frac{ad+bc}{bd}$.

ILLUSTRATION

3. Find the sum of $\frac{-5}{6}+\frac{4}{9}$

Sol. $\frac{-5}{6}\times\frac{3}{3}=\frac{-15}{18}$ and $\frac{4}{9}\times\frac{2}{2}=\frac{8}{18}$

$=\frac{-15+8}{18}=\frac{-7}{18}$

PROPERTIES OF ADDITION OF RATIONAL NUMBER

1. **Closure Property:** Sum of 2 rational numbers is always a rational number.

2. **Commutative Property:** The addition of rational number is commutative i.e. $\frac{a}{b}+\frac{c}{d}=\frac{c}{d}+\frac{a}{b}$.

3. **Associativity Property:** The addition of rational numbers is associative if $\left[\frac{a}{b}+\frac{c}{d}\right]+\frac{e}{f}=\frac{a}{b}+\left[\frac{c}{d}+\frac{e}{f}\right]$.

ILLUSTRATION

4. Simplify: $\frac{4}{3}+\frac{3}{5}+\frac{-2}{3}+\frac{-11}{5}$.

Sol. We find that out of the four rational numbers to be added, two have the same denominator 3 and the remaining two have the same denominator 5. So, we re-arrange and group them in such a way that each group contains a pair of numbers with a common denomiator.

$\therefore\ \frac{4}{3}+\frac{3}{5}+\frac{-2}{3}+\frac{-11}{5}=\left(\frac{4}{3}+\frac{-2}{3}\right)+\left(\frac{3}{5}+\frac{-11}{5}\right)$

$=\frac{4+(-2)}{3}+\frac{3+(-11)}{5}$

$=\frac{2}{3}+\frac{-8}{5}$

$=\frac{2\times5}{3\times5}+\frac{(-8)\times3}{5\times3}$ $\left[\begin{array}{l}\therefore \text{LCM of } 3 \text{ and } 5 \text{ is } 15\\ \because \text{Each rational number is expressed with denominator } 15\end{array}\right]$

$=\frac{10}{15}+\frac{-24}{15}=\frac{10+(-24)}{15}=\frac{-14}{15}$

5. Simplify: $\frac{3}{8}+\frac{7}{2}+\frac{-3}{5}+\frac{9}{8}+\frac{-3}{2}+\frac{6}{5}$.

Sol. Re-arranging and grouping the numbers in pairs in such a way that each group contains a pair of rational numbers with a common denominator, we have

$$\frac{3}{8}+\frac{7}{2}+\frac{-3}{5}+\frac{9}{8}+\frac{-3}{2}+\frac{6}{5} = \left(\frac{3}{8}+\frac{9}{8}\right) + \left(\frac{7}{2}+\frac{-3}{2}\right) + \left(\frac{-3}{5}+\frac{6}{5}\right)$$

$$= \frac{3+9}{8}+\frac{7+(-3)}{2}+\frac{(-3)+6}{5} \qquad = \frac{12}{8}+\frac{4}{2}+\frac{3}{5} \qquad = \frac{3}{2}+2+\frac{3}{5}$$

$$= \frac{3\times5}{2\times5}+\frac{2\times10}{1\times10}+\frac{3\times2}{5\times2} = \frac{15}{10}+\frac{20}{10}+\frac{6}{10} = \frac{15+20+6}{10} = \frac{41}{10}$$

Additive Identity: Sum of rational numbers and zero (0) is the number itself $\frac{a}{b}+0=\frac{a}{b}$.

Additive Inverse: The additive inverse is written $\frac{a}{b}=\frac{-a}{b}$; $\frac{-c}{d}=\frac{c}{d}$.

PRACTICE QUESTION - 3

1. Write the additive inverse of each of the following rational numbers:

a. $\frac{4}{9}$ b. $\frac{-13}{7}$ c. $\frac{-11}{-14}$

2. Rearrange suitably and find the sum of the following:

a. $\frac{3}{5}+\frac{-7}{6}+\frac{2}{5}+\frac{-5}{6}$ b. $\frac{-4}{7}+\frac{7}{6}+\frac{2}{7}+3+\frac{-11}{6}$

c. $\frac{4}{7}+0+\frac{-8}{9}+\frac{-13}{7}+\frac{17}{21}$ d. $\frac{1}{8}+\frac{5}{12}+\frac{2}{7}+\frac{7}{12}+\frac{9}{7}+\frac{-5}{16}$

3. Verify associativity of addition of rational numbers i.e., (x + y) + z = x + (y + z), when:

a. $x=\frac{1}{2}, y=\frac{2}{3}, z=-\frac{1}{2}$ b. $x=\frac{-2}{5}, y=\frac{4}{3}, z=\frac{-7}{10}$

c. $x=\frac{-7}{11}, y=\frac{2}{-5}, z=\frac{-3}{22}$ d. $x=-2, y=\frac{3}{5}, z=\frac{-4}{3}$

SUBTRACTION OF RATIONAL NUMBER

ILLUSTRATION

6. Subtract $\frac{3}{4}$ from $\frac{5}{6}$.

Sol. The additive inverse of $\frac{3}{4}$ is $\frac{-3}{4}$.

$$\therefore \frac{5}{6}-\frac{3}{4}=\frac{5}{6}+\frac{-3}{4}=\frac{5\times2}{6\times2}+\frac{-3\times3}{4\times3}=\frac{10}{12}+\frac{-9}{12}=\frac{10+(-9)}{12}=\frac{1}{21}.$$

7. Subtract $\frac{-3}{8}$ from $\frac{-5}{7}$.

Sol. The additive inverse of $\frac{-3}{8}$ is $\frac{3}{8}$.

$\therefore \quad \frac{-5}{7}-\left(\frac{-3}{8}\right)=\frac{-5}{7}+\frac{3}{8}$ $\qquad \left[\because -\left(\frac{-3}{8}\right)=\frac{3}{8}\right]$

$= \frac{(-5)\times 8+3\times 7}{56}=\frac{-40+21}{56}=-\frac{19}{56}$

8. What should be subtracted from $\frac{-3}{4}$ to as ro get $\frac{5}{6}$?

Sol. Suppose x is the rational number to be subtracted from $\frac{-3}{4}$ to get $\frac{5}{6}$. Then,

$\frac{-3}{4}-x=\frac{5}{6}$

$\Rightarrow \quad \frac{-3}{4}-\frac{5}{6}=x$ $\qquad \left[\text{Transposing x to RHS and } \frac{5}{6} \text{ to LHS}\right]$

$\Rightarrow \quad x=\frac{-3}{4}-\frac{5}{6}$

$\Rightarrow \quad x=\frac{-3}{4}+\frac{-5}{6}$

$\Rightarrow \quad x=\frac{(-3)\times 3+(-5)\times 2}{12}$ $\qquad [\because$ LCM of 4 and 6 is 12]

$\Rightarrow \quad x=\frac{(-9)+(-10)}{12}=\frac{-19}{12}$

PROPERTIES OF SUBTRACTION

1. **Closure:** If $\frac{a}{b}\&\frac{c}{d}$ are rational number then $\frac{a}{b}-\frac{c}{d}$ is a rational number.

2. **Commutativity:** Subtraction of rational number is not always commutative.

3. **Associativity:** Subtraction of rational number is not associative.

ILLUSTRATION

9. Find: $\frac{3}{7}+\left(-\frac{6}{11}\right)+\frac{8}{21}+\left(\frac{-5}{22}\right)$

Sol. We have, $\frac{3}{7}+\left(-\frac{6}{11}\right)+\frac{8}{21}+\left(\frac{-5}{22}\right)$

$= \frac{3}{7}+\frac{-6}{11}+\frac{8}{21}+\frac{-5}{22}$ $\qquad \left[\because -\frac{6}{11}=\frac{-6}{11}\right]$

$= \frac{(3\times 66)+((-6)+42)+(8\times 22)+((-5)\times 21)}{462}$

7	7,	11,	21,	22
11	1,	11,	3,	22
3	1,	1,	3,	2
2	1,	1,	1,	2
	1,	1,	1,	1

$= \frac{198+(-252)+176+(-105)}{462}$

$\therefore$ LCM of 7, 11, 21, 22 is $7 \times 11 \times 3 \times 2 = 462$

$= \frac{374\times 357}{462} = \frac{17}{462}$

10. Find: $\frac{-7}{4}+\frac{5}{3}+\frac{-5}{6}+\frac{1}{3}+\frac{-1}{2}$

Sol. LCM of 4, 3, 6, 3 and 2 is 12

2	4,	3,	6,	2
2	2,	3,	3,	1
3	1,	3,	3,	1
	1,	1,	1,	1

$\therefore \frac{-7}{4}+\frac{5}{3}+\frac{-5}{6}+\frac{1}{3}+\frac{-1}{2}$

$= \frac{((-7)\times 3)+(5\times 4)+((-5)\times 2)+(1\times 4)+((-1)\times 6)}{12}$

$\therefore$ LCM of 4, 3, 6, 3, 2 is $2 \times 2 \times 3 = 12$

$= \frac{(-21)+20+(-10)+4+(-6)}{12}$

$= \frac{(-21)+20+(-10)+4+(-6)}{12} = \frac{(-37)+24}{12} = \frac{-13}{12}$

11. Find: $\frac{3}{4}+\left(\frac{-3}{5}\right)+\left(\frac{-2}{3}\right)+\frac{5}{8}+\left(\frac{-4}{15}\right)$

4	4,	5,	3,	15,	8
5	1,	5,	3,	15,	2
3	1,	1,	3,	3,	2
2	1,	1,	1,	1,	2
	1,	1,	1,	1,	1

Sol. LCM of 4, 5, 3, 8, 15 is 120

$\therefore \frac{3}{4}+\left(\frac{-3}{5}\right)+\left(\frac{-2}{3}\right)+\frac{5}{8}+\left(\frac{-4}{15}\right)$

$= \frac{3\times 30+(-3)\times 24+(-2)\times 40+5\times 15+(-4)\times 8}{120}$

$\therefore$ LCM = $4 \times 5 \times 3 \times 2 = 120$

$= \frac{90+(-72)+(-80)+75+(-32)}{120} = \frac{(-184)+165}{120} = \frac{-19}{120}$.

12. Simplify: a. $\frac{-2}{3}+\frac{5}{9}-\frac{-7}{6}$ b. $\frac{5}{12}+\frac{-5}{18}-\frac{7}{24}$

Sol. a. We have, $\frac{-2}{3}+\frac{5}{9}-\frac{-7}{6} = \frac{-2}{3}+\frac{5}{9}+\frac{7}{6}$ $\left[\because -\left(\frac{-7}{6}\right)=\frac{7}{6}\right]$

$= \frac{(-2)\times 6+5\times 2+7\times 3}{18}$ [$\because$ LCM of 3, 9 and 6 is 18]

$= \frac{30+(-20)+(-21)}{72} = \frac{30+(-41)}{72} = \frac{-11}{72}$.

b. $\frac{5}{12}+\frac{-5}{18}-\frac{7}{24}$ LCM = 144

$= \frac{12\times5-5\times8-7\times6}{144}$

$= \frac{60-40-42}{144}$

$= \frac{60-82}{144}$

$= \frac{22}{144}=\frac{11}{72}$.

PRACTICE QUESTION - 4

1. Simplify each of the following and write as a rational number of the form $\frac{p}{q}$:

a. $\frac{-11}{2}+\frac{7}{6}+\frac{-5}{8}$ b. $\frac{5}{3}+\frac{3}{-2}+\frac{-7}{3}+3$

2. Express each of the following as a rational number of the form:

a. $\frac{-7}{4}+\frac{5}{3}+\frac{-1}{2}+\frac{-5}{6}+2$ b. $\frac{6}{7}+1+\frac{-7}{9}+\frac{19}{21}+\frac{-12}{7}$

3. Simplify:

a. $\frac{-3}{2}+\frac{5}{4}-\frac{7}{4}$ b. $\frac{5}{3}-\frac{7}{6}+\frac{-2}{3}$ c. $\frac{5}{4}-\frac{7}{6}-\frac{-2}{3}$ d. $\frac{3}{8}-\frac{-2}{9}+\frac{-5}{36}$

MULTIPLICATION OF RATIONAL NUMBER

$\frac{a}{b}\times\frac{c}{d}=\frac{\text{a}\times\text{c}}{\text{b}\times\text{d}}$

ILLUSTRATION

13. Multiply:

a. $\frac{3}{4}$ by $\frac{5}{7}$ b. $\left(\frac{-5}{9}\right)$ by 4 c. $\frac{-5}{9}\times\frac{72}{-125}$ d. $\frac{-22}{9}+\frac{-51}{-88}$

Sol. a. $\frac{3}{4}\times\frac{5}{7}=\frac{3\times5}{4\times7}=\frac{15}{28}$ b. $\left(\frac{-5}{9}\right)\times4=\frac{-5}{9}\times\frac{4}{1}=\frac{(-5)\times4}{9\times1}=\frac{-20}{9}$

c. $\frac{-5}{9}\times\frac{72}{-125}=\frac{(-5)\times72}{9\times(-125)}=\frac{-1\times8}{1\times-25}=\frac{-8}{-25}=\frac{8}{25}$ d. $\frac{-22}{9}\times\frac{-51}{-88}=\frac{-22}{9}\times\frac{51}{88}$

PROPERTIES OF MULTIPLICATION OF RATIONAL NUMBER

1. **Closure:** Product of multiplication of any two rational number is always a rational number.
2. **Commutativity:** The multiplication of rational number is commutative.
3. **Associativity:** The multiplication of rational numbers is associative. That is, if $\frac{a}{b}, \frac{c}{d} \& \frac{e}{f}$ are three rational number, then $\left(\frac{a}{b}\times\frac{c}{d}\right)\times\frac{e}{f}=\frac{a}{b}\times\left(\frac{c}{d}\times\frac{e}{f}\right)$.
4. **Multiplicative Identity:** If $\frac{a}{b}$ is any rational number, then $\frac{a}{b}\times 1=\frac{a}{b}=1\times\frac{a}{b}$. 1 is called the multiplicative identity for rational numbers.
5. **Multiplication By 0:** Every rational number when multiplied with 0 gives 0. $\frac{a}{b}\times 0=0=0\times\frac{a}{b}$.
6. **Multiplication Inverse:** For every non-zero rational $\frac{a}{b}$ there exists a rational number $\frac{c}{d}$ such that $\frac{a}{b}\times\frac{c}{d}=1=\frac{c}{d}\times\frac{a}{b}$.
7. **Distributivity of Multiplication Over Addition:** The multiplication of rational numbers is distributive over their addition. That is, if $\frac{a}{b}, \frac{c}{d} and \frac{e}{f}$ are any three rational numbers, then $\frac{a}{b}\times\left(\frac{c}{d}+\frac{e}{f}\right)=\frac{a}{b}\times\frac{c}{d}+\frac{a}{b}\times\frac{e}{f}$.

ILLUSTRATION

14. Simpliy:

a. $\frac{-22}{9}\times\frac{-51}{-88}$ b. $\left(\frac{-7}{18}\times\frac{15}{-7}\right)-\left(1\times\frac{1}{4}\right)+\left(\frac{1}{2}\times\frac{1}{4}\right)$ c. $\frac{3}{4}\times\frac{5}{7}$

Sol. a. $\frac{-22}{9}\times\frac{-51}{-88}=\frac{-1\times17}{3\times4}=\frac{-17}{12}$

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

$=\frac{-7\times15}{18\times-7}-\frac{1\times1}{1\times4}+\frac{1\times1}{2\times4}=\frac{1\times5}{6\times1}-\frac{1\times1}{1\times4}+\frac{1\times1}{2\times4}=\frac{5}{6}-\frac{1}{4}+\frac{1}{8}=\frac{5}{6}+\frac{-1}{4}+\frac{1}{8}$

$=\frac{5\times4+(-1)\times6+1\times3}{24}=\frac{20+(-6)+3}{24}=\frac{17}{24}$

c. $\frac{3\times5}{4\times7}=\frac{15}{28}$ and $\frac{5}{7}\times\frac{3}{4}=\frac{5\times3}{7\times4}=\frac{15}{28}$

$\therefore\ \frac{3}{4}\times\frac{5}{7}=\frac{5}{7}\times\frac{3}{4}$

15. a. Simplify: $\frac{3}{11}\times\frac{-5}{6}\times\left(-\frac{22}{9}\right)\times\left(-\frac{9}{5}\right)$

b. $\frac{2}{3}\times\left(\frac{-3}{5}+\frac{7}{10}\right)$

Sol. a. We have, $\frac{3}{11}\times\frac{-5}{6}\times\left(\frac{-22}{9}\right)\times\left(\frac{-9}{5}\right) = \frac{3}{11}\times\frac{-5}{6}\times\frac{-22}{9}\times\frac{-9}{5}$

$= \frac{3\times-5\times-22\times-9}{11\times6\times9\times5} = \frac{-(3\times5\times22\times9)}{11\times6\times9\times5} = \frac{-(1\times1\times2\times1)}{1\times2\times1\times1} = \frac{-2}{2} = -1$

b. $\frac{2}{3}\times\left(\frac{-3\times2+7}{10}\right) = \frac{2}{2}\times\left(\frac{-6+7}{10}\right) = \frac{2}{3}\times\frac{1}{10} = \frac{2\times1}{3\times10} = \frac{1}{15}$ and, $\frac{2}{3}\times\frac{-3}{5}+\frac{2}{3}\times\frac{7}{10}$

$= \frac{2\times-3}{3\times5}+\frac{2\times7}{3\times10}$

$= \frac{2\times-1}{1\times5}+\frac{1\times7}{3\times5} = \frac{-2}{5}+\frac{7}{15} = \frac{-2\times3+7}{15} = \frac{-6+7}{15} = \frac{1}{15}$

$\therefore\ \frac{2}{3}\times\left(\frac{-2}{5}+\frac{7}{10}\right) = \frac{2}{3}\times\frac{-3}{5}+\frac{2}{3}\times\frac{7}{10}$

PRACTICE QUESTION - 5

1. Simplify

a. $\frac{3}{5}\times\frac{-7}{8}$ b. $\frac{-6}{11}\times\frac{-5}{3}$ c. $\frac{-12}{5}\times\frac{10}{-3}$ d. $\frac{16}{-21}\times\frac{14}{5}$

e. $\frac{-7}{6}\times24$ f. $\frac{7}{24}\times(-48)$ g. $\frac{-13}{5}\times(-10)$

2. Verify each of the following:

a. $\frac{3}{7}\times\frac{-5}{9}=\frac{-5}{9}\times\frac{3}{7}$ b. $\frac{-8}{7}\times\frac{13}{9}=\frac{13}{9}\times\frac{-8}{7}$ c. $\frac{-12}{5}\times\frac{7}{-36}=\frac{7}{-36}\times\frac{-12}{5}$

3. Verify each of the following:

a. $\left(\frac{5}{7}\times\frac{12}{13}\right)\times\frac{7}{18}=\frac{5}{7}\times\left(\frac{12}{13}\times\frac{7}{8}\right)$ b. $\left(\frac{-9}{5}\times\frac{-10}{3}\right)\times\frac{21}{-4}=\frac{-9}{5}\times\left(\frac{-10}{3}\times\frac{21}{-4}\right)$

4. Verify the following:

a. $\frac{3}{7}\times\left(\frac{5}{6}+\frac{12}{13}\right)=\left(\frac{3}{7}\times\frac{5}{6}\right)+\left(\frac{3}{7}\times\frac{12}{13}\right)$ b. $\frac{-15}{4}\times\left(\frac{3}{7}+\frac{-12}{5}\right)=\left(\frac{-15}{4}\times\frac{3}{7}\right)+\left(\frac{-15}{4}\times\frac{-12}{5}\right)$

c. $\left(\frac{-8}{3}+\frac{-13}{12}\right)\times\frac{5}{6}=\left(\frac{-8}{3}\times\frac{5}{6}\right)+\left(\frac{-13}{12}\times\frac{5}{6}\right)$ d. $\frac{-16}{7}\times\left(\frac{-8}{9}+\frac{-7}{6}\right)=\left(\frac{-16}{7}\times\frac{-8}{9}\right)+\left(\frac{-3}{4}\times\frac{7}{8}\right)$

5. Find the multiplicative inverse (i.e., reciprocal of):

a. $\frac{13}{25}$ b. –16 c. $\frac{-3}{-5}$ d. –1 e. $\frac{2}{-5}$ f. $\frac{-1}{8}$

6. Find the value of:

a. $\left(\frac{5}{8}\right)^{-1}$ b. $\left(\frac{-4}{9}\right)^{-1}$ c. $(-7)^{-1}$ d. $\left(\frac{1}{-3}\right)^{-1}$

DIVISION OF RATIONAL NUMBER

If $\frac{a}{b}$ & $\frac{c}{d}$ are two rational numbers such that $\frac{c}{d} \neq 0$ then $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \left(\frac{c}{d}\right)^{-1} = \frac{a}{b} \times \frac{d}{c}$

Note: Division by 0 (Zero) is not defined.

PROPERTIES OF DIVISION OF RATIONAL NUMBERS

1. If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers such that $\frac{c}{d} \neq 0$, then $\frac{a}{b} \div \frac{c}{d}$ is always a rational number. That is, the set of all non-zero rational numbers is closed under division.

2. For any rational number $\frac{a}{b}$, we have $\frac{a}{b} \div 1 = \frac{a}{b}$ and $\frac{a}{b} \div (-1) = -\frac{a}{b} = \frac{-a}{b}$.

3. For every non-zero rational number $\frac{a}{b}$, we have $\frac{a}{b} \div \frac{a}{b} = 1$.

Note: Division of rational number is neither commutative nor associative.

ILLUSTRATION

16. Divide:

a. $\frac{3}{5}$ by $\frac{4}{25}$ b. $\frac{-8}{9}$ by $\frac{4}{3}$ c. $\frac{-16}{21}$ by $\frac{-4}{3}$ d. $\frac{-8}{13}$ by $\frac{3}{-26}$

Sol. a. $\frac{3}{5} \div \frac{4}{25} = \frac{3}{5} \times \frac{25}{4} = \frac{3 \times 25}{5 \times 4} = \frac{3 \times 5}{1 \times 4} = \frac{15}{4}$ b. $\frac{-8}{9} \div \frac{4}{3} = \frac{-8}{9} \times \frac{3}{4} = \frac{-8 \times 3}{9 \times 4} = \frac{-2 \times 1}{3 \times 1} = \frac{-2}{3}$

c. $\frac{-16}{21} \div \frac{-4}{3} = \frac{-16}{21} \times \frac{3}{-4} = \frac{-15 \times 3}{21 \times (-4)} = \frac{4 \times 1}{7 \times 1} = \frac{4}{7}$

d. $\frac{-8}{13} \div \frac{3}{-26} = \frac{-8}{13} \times \frac{-26}{3} = \frac{(-8) \times (-26)}{13 \times 3} = \frac{8 \times 26}{13 \times 3} = \frac{8 \times 2}{1 \times 3} = \frac{16}{3}$

17. The product of two rational numbers is $\frac{-28}{81}$. If one of the number is $\frac{14}{27}$, find the order.

Sol. We have,

Product of two numbers = $\frac{-28}{81}$, One number = $\frac{14}{27}$

So, the other number is obtained by dividing the product by the given number.

$\therefore$ Other number = $\frac{-28}{81} \div \frac{14}{27} = \frac{-28}{81} \times \frac{27}{14} = \frac{-28 \times 27}{81 \times 14} = \frac{-(28 \times 27)}{81 \times 14} = \frac{-(2 \times 1)}{3 \times 1} = \frac{-2}{3}$

Let the other number be *x*. Then, $\frac{14}{24} \times x = \frac{-28}{81} \Rightarrow x = \frac{-28}{81} \div \frac{14}{27}$

$\Rightarrow x = \frac{-28}{81} \times \frac{27}{14} = \frac{-28 \times 27}{81 \times 14} = \frac{-(28 \times 27)}{81 \times 14} = \frac{-(2 \times 1)}{3 \times 1} = \frac{-2}{3}$

18. By what number should we multiply $\frac{3}{-14}$, so that the product may be $\frac{5}{12}$.

Sol. We have,

Product of two numbers = $\frac{5}{12}$, One number = $\frac{3}{-14}$

$\therefore$ The other number = $\frac{5}{12} \div \frac{3}{-14} = \frac{5}{12} \times \frac{-14}{3} = \frac{5 \times (-14)}{12 \times 3} = \frac{-(5 \times 14)}{12 \times 3} = \frac{-(5 \times 7)}{6 \times 3} = \frac{-35}{18}$

Let the required number be x. Then, $x = \frac{3}{-14} = \frac{5}{12}$

$\Rightarrow x = \frac{5}{12} \div \frac{3}{-14}$ $\Rightarrow x = \frac{5}{12} \times \frac{-14}{3}$ $\Rightarrow x = \frac{5 \times -14}{12 \times 3} = \frac{-(5 \times 14)}{12 \times 3} = \frac{-(5 \times 7)}{6 \times 3} = \frac{-35}{18}$

Hence, required number is $\frac{-35}{18}$.

PRACTICE QUESTION - 6

1. Divide:

a. 1 by $\frac{1}{2}$ b. 5 by $\frac{-5}{7}$ c. $\frac{-3}{4}$ by $\frac{9}{-16}$ d. $\frac{-7}{8}$ by $\frac{-21}{16}$

e. $\frac{7}{-4}$ by $\frac{63}{64}$ f. 0 by $\frac{-7}{5}$ g. $\frac{-3}{4}$ by -6 h. $\frac{-3}{13}$ by $\frac{-4}{65}$

2. Find the value and express as a rational number in standard from:

a. $\frac{2}{5} \div \frac{26}{15}$ b. $\frac{10}{3} \div \frac{-35}{12}$ c. $\frac{-22}{27} \div \frac{-110}{18}$ d. $\frac{-36}{125} \div \frac{-3}{75}$

e. $-6 \div \left(\frac{-8}{17}\right)$ f. $\frac{-40}{99} \div (-20)$

3. The product of two rational numbers is 15. If one of the numbers is –10, find the other.

4. By what number should we multiply $\frac{-1}{6}$ so that the product may be $\frac{-23}{9}$?

5. By what number should $\frac{-3}{4}$ be multiplied in order to produce $\frac{2}{3}$?

6. By what number should we multiply $\frac{-15}{28}$ so that the product may be $\frac{-5}{7}$?

7. By what number should we multiply $\frac{-8}{13}$ so that the product may be 24?

8. By what number should $\frac{-33}{16}$ be divided to get $\frac{-11}{4}$?

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

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

11. Divide the sum of $\frac{-13}{5}$ and $\frac{12}{7}$ by the product of $\frac{-31}{7}$ and $\frac{-1}{2}$.

12. Divide the sum of $\frac{65}{12}$ and $\frac{12}{7}$ by their difference.

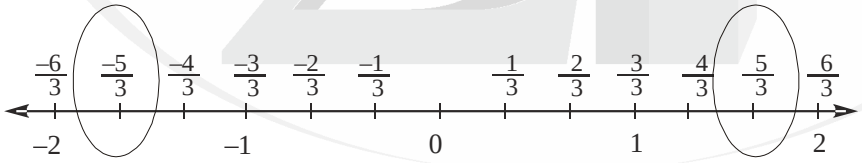
13. Find (x + y) ÷ (x – y), if : a. $x=\frac{5}{4}, y=\frac{-1}{3}$ b. $x=\frac{1}{4}, y=\frac{3}{2}$

REPRESENTATION OF RATIONAL NUMBER ON NUMBER LINE

ILLUSTRATION

20. Represent $\frac{5}{3}$ and $\frac{-5}{3}$ on the number line.

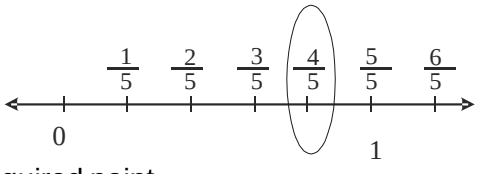
Sol. In order to represent $\frac{5}{3}$ and $\frac{-5}{3}$ on the number line, we first draw a number line and mark a point O on it to represent zero. Now, mark 1, 2 on right of it at equal distances and -1, -2 on left of it at equal distances. Divide each point difference into 3 equal parts and mark them as shown in Figure.



The circled points are the required points.

21. Represent $\frac{4}{5}$ on a number line.

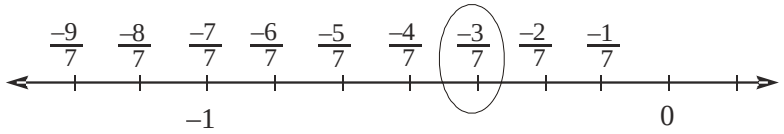
Sol. To represent $\frac{4}{5}$ on the number line, draw a number line and mark a point 0 and 1 on it. Divide point 0 and 1 into 5 equal parts and mark them as shown in the figure.



The circled point is the required point.

22. Represent $\frac{-3}{7}$ on a number line.

Sol. To represent $\frac{-3}{7}$ on the number line, draw a number line and mark a point 0 and –1 on it. Divide point 0 and –1 into 7 equal parts and mark them as shown in the figure.



The circled point is the required point.

RATIONAL NUMBER BETWEEN TWO RATIONAL NUMBER

1. **Having Same Denominator:** We wish to find two rational number between $\frac{3}{7}$ and $\frac{6}{7}$. Since these two numbers have the same denominator. So, we choose their numerators 3 and 6. Integers between 3 and 6 are 4 & 5. Therefore, $\frac{4}{7}$ and $\frac{5}{7}$ are two rational numbers between $\frac{3}{7}$ and $\frac{6}{7}$ such that $\frac{3}{7}<\frac{4}{7}<\frac{5}{7}<\frac{6}{7}$

2. **Having Different Denominator:** Let the numbers be $\frac{1}{4}$ and $\frac{2}{3}$ and we wish to find two rational numbers between these two. First we find equivalent rational numbers having a common denominator equal to the LCM of the denominators 4 and 3 i.e., 12. Thus, we write $\frac{1}{4}=\frac{3}{12}$ and $\frac{2}{3}=\frac{8}{12}$.

Now, we choose integers between the numerators 3 and 8 of these equivalent rational numbers. Clearly, 4, 5, 6 and 7 are four integers between 3 and 8. Therefore, $\frac{4}{12},\frac{5}{12},\frac{6}{12}$ and $\frac{7}{12}$ are rational numbers between $\frac{3}{12}$ and $\frac{8}{12}$ such that $\frac{3}{12}<\frac{4}{12}<\frac{5}{12}<\frac{6}{12}<\frac{7}{12}<\frac{8}{12}$

i.e., $\frac{1}{4}<\frac{4}{12}<\frac{5}{12}<\frac{6}{12}<\frac{7}{12}<\frac{2}{3}$

ILLUSTRATION

23. Write any three rational numbers between –2 and 0.

Sol. We can write –2 = $\frac{-2}{1}=\frac{-2\times5}{1\times5}=\frac{-10}{5}$ and $0=\frac{0}{5}$

Integers between –10 and 0 are –9, –8, –7, –6, –5, ..., –1.

$\therefore$ $\frac{-9}{5},\frac{-8}{5},\frac{-7}{5},....,\frac{-2}{5},\frac{-1}{5}$ are rational numbers between –2 and 0.

24. Find four rational numbers between $\frac{2}{3}$ and $\frac{4}{5}$.

Sol. First we convert given rational numbers to rational numbers with the same denominator equal to the LCM of their denominators. The LCM of denominators 3 and 5 is 15.

$\therefore$ $\frac{2}{3}=\frac{2\times5}{3\times5}=\frac{10}{15}$ and $\frac{4}{5}=\frac{4\times3}{5\times3}=\frac{12}{15}$

Between the numerators 10 and 12 of these equivalent rational numbers there is only one integer. So, we replace these numbers by equivalent rational numbers having a sufficiently large common denominator.

We write, $\frac{2}{3}=\frac{10}{15}=\frac{40}{60}$ and $\frac{4}{5}=\frac{12}{15}=\frac{48}{60}$

Between 40 and 48 there are seven integers 41, 42, 43, ..., 47. Therefore, $\frac{41}{60},\frac{42}{60},...,\frac{47}{60}$ are seven rational numbers between $\frac{40}{60}\left(=\frac{2}{3}\right)$ and $\frac{48}{60}\left(=\frac{4}{5}\right)$. We can take any four of these rational numbers.

25. Find five rational numbers between $\frac{-3}{2}$ and $\frac{5}{3}$.

Sol. The LCM of denominators 2 and 3 is 6. Converting given rational numbers to equivalent rational numbers having common denominator 6, we get $\frac{-3}{2}=\frac{-3\times3}{2\times3}=\frac{-9}{6}$ and $\frac{5}{3}=\frac{5\times2}{3\times2}=\frac{10}{6}$.

Clearly, –8, –7, ..., 7, 8, 9 are integers between numerators –9 and 10 of these equivalent rational numbers. Thus, we have $\frac{-8}{6},\frac{-7}{6},\frac{-6}{6},\frac{-5}{6},...,\frac{7}{6},\frac{8}{6},\frac{9}{6}$ as rational numbers between $\frac{-9}{6}\left(=\frac{-3}{2}\right)$ and $\frac{10}{6}\left(=\frac{5}{3}\right)$.

We can take any four of these as required rational numbers.

26. Find a rational number between –2 and 6.

Sol. We know that between two rational numbers x and y such that x < y there is a rational number $\frac{x+y}{2}$.

i.e., x < $\frac{x+y}{2}$ < y

So, a rational number between –2 and 6 is $\frac{-2+6}{2}=\frac{4}{2}=2$

Thus, we have –2 < 2 < 6.

PRACTICE QUESTION - 7

1. Find a rational number between –3 and 1.

2. Find two rational numbers between $\frac{-2}{9}$ and $\frac{5}{9}$.

3. Find ten rational numbers between $\frac{1}{4}$ and $\frac{1}{2}$.

4. Find ten rational numbers between $\frac{3}{5}$ and $\frac{3}{4}$.

5. Draw a number line and represent the following on it. a. $\frac{-7}{8}$ b. $\frac{-11}{6}$

6. Find any 5 rational numbers between $\frac{1}{4}$ and $\frac{2}{4}$.

EXERCISE

1. Write the additive inverse of each of the following rational numbers :

i. $\frac{-2}{17}$ **ii.** $\frac{3}{-11}$ **iii.** $\frac{-17}{6}$

iv. $\frac{-11}{-25}$ **v.** 0 **vi.** $\frac{1}{3}$

vii. –18 **vii.** $\frac{a}{b}$

ix. Is $\frac{8}{9}$ the multiplicative inverse of $-1\frac{1}{8}$? Why or why not?

2. Using commutativity and associativity of addition of rational numbers, express each of the following as a rational number :

i. $\frac{2}{5} + \frac{7}{3} + \frac{-4}{5} + \frac{-1}{3}$

ii. $\frac{3}{7} + \frac{-4}{9} + \frac{-11}{7} + \frac{7}{9}$

iii. $\frac{2}{5} + \frac{8}{3} + \frac{-11}{15} + \frac{4}{5} + \frac{-2}{3}$

iv. $\frac{4}{7} + 0 + \frac{-8}{9} + \frac{-13}{7} + \frac{17}{21}$

v. $\frac{4}{3} + \frac{-4}{5} + \frac{-2}{3} + \frac{7}{5} - 2$ **vi.** $\frac{3}{5} + \frac{7}{3} + \frac{-11}{5} + \frac{-2}{3}$

3. Re-arrange suitably and find the sum in each of the following :

i. $\frac{11}{12} + \frac{-17}{3} + \frac{11}{2} + \frac{-25}{2}$

ii. $\frac{-6}{7} + \frac{-5}{6} + \frac{-4}{9} + \frac{-15}{7}$

iii. $\frac{4}{13} + \frac{-5}{8} + \frac{-8}{13} + \frac{9}{13}$

iv. $\frac{1}{8} + \frac{5}{12} + \frac{2}{7} + \frac{9}{7} + \frac{-5}{16}$

v. $4\frac{1}{5} + \left(-5\frac{3}{10}\right) + 1\frac{1}{2}$

vi. $\frac{4}{3} + \frac{3}{5} + \frac{-2}{3} + \frac{-11}{5}$

vii. $\frac{-4}{7} + \frac{7}{6} + \frac{2}{7} + 3 + \frac{-11}{6}$

viii. $\frac{2}{3} + \frac{-4}{5} + \frac{1}{3} + \frac{2}{5}$

4. Write the smallest rational no in the pair $\frac{-2}{3}$, 0. Give reason.

5. The sum of two numbers is –4/3. If one of the numbers is –5, find the other.

6. What should be added to $\frac{-7}{8}$ to get $\frac{5}{9}$?

7. The product of two rational numbers is $\frac{5}{8}$. If one of them is $\frac{-3}{20}$. Find the other.

8. What should be subtracted from $\frac{3}{7}$ to get $\frac{5}{4}$?

9. What should be added to $\left(\frac{1}{2} + \frac{1}{3} + \frac{1}{5}\right)$ to get 3?

10. What should be subtracted from $\frac{-5}{7}$ to get –1?

11. What should be added to $\left(\frac{2}{3} + \frac{3}{5}\right)$ to get $\frac{-2}{15}$?

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

13. The sum of two rational numbers is –5, if of them is –13/6, find the other.

14. Express each of the following as a rational number of the form p/q:

i. $\frac{-8}{3} + \frac{-1}{4} + \frac{-11}{6} + \frac{3}{8} - 3$

ii. $\frac{6}{7} + 1 + \frac{-7}{9} + \frac{19}{21} + \frac{-12}{7}$

iii. $\frac{15}{2} + \frac{9}{8} + \frac{-11}{3} + 6 + \frac{-7}{6}$

iv. $\frac{-7}{4} + 0 + \frac{-9}{5} + \frac{19}{10} + \frac{11}{14}$

v. $\frac{4}{7} + \frac{-8}{9} + \frac{-5}{21} + \frac{1}{3}$ **vi.** $\frac{5}{3} + \frac{3}{-2} + \frac{-7}{3} + 3$

vii. $\frac{-9}{10} + \frac{22}{15} + \frac{13}{-20}$

15. Simplify :

i. $\frac{5}{3} - \frac{7}{3} + \frac{-2}{3}$ **ii.** $\frac{5}{4} - \frac{7}{6} - \frac{-2}{3}$

iii. $\frac{-2}{3} + \frac{5}{9} - \frac{-7}{6}$ **iv.** $\frac{5}{6} + \frac{-2}{5} - \frac{-2}{15}$

v. $\frac{-2}{5} - \frac{-3}{10} - \frac{-4}{7}$ **vi.** $\frac{6}{7} - 2 + \frac{-7}{9} + \frac{19}{21}$

16. Simplify :

i. $\left(\frac{25}{8} \times \frac{2}{5}\right) - \left(\frac{3}{5} \times \frac{-10}{9}\right)$

ii. $\left(\frac{1}{2} \times \frac{1}{4}\right) + \left(\frac{1}{2} \times 6\right)$

iii. $\left(\frac{-9}{4} \times \frac{5}{3}\right) + \left(\frac{13}{2} \times \frac{5}{6}\right)$

iv. $\left(\frac{13}{5} \times \frac{8}{3}\right) - \left(\frac{-5}{2} \times \frac{11}{3}\right)$

v. $\left(\frac{13}{7} \times \frac{11}{26}\right) - \left(\frac{-4}{3} \times \frac{5}{6}\right)$

vi. $\left(\frac{8}{5} \times \frac{-3}{2}\right) - \left(\frac{-3}{10} \times \frac{11}{16}\right)$

17. Simplify :

i. $\left(\frac{3}{2} \times \frac{1}{6}\right) + \left(\frac{5}{3} \times \frac{7}{2}\right) - \left(\frac{13}{8} \times \frac{4}{3}\right)$

ii. $\left(\frac{1}{4} \times \frac{2}{7}\right) + \left(\frac{5}{14} \times \frac{-2}{3}\right) + \left(\frac{3}{7} \times \frac{9}{2}\right)$

iii. $\left(\frac{13}{9} \times \frac{-15}{2}\right) + \left(\frac{7}{3} \times \frac{8}{5}\right) + \left(\frac{3}{5} \times \frac{1}{2}\right)$

iv. $\left(\frac{3}{11} \times \frac{5}{6}\right) - \left(\frac{9}{12} \times \frac{4}{3}\right) + \left(\frac{5}{13} \times \frac{6}{15}\right)$

v. $\left(\frac{-5}{9} \times \frac{72}{-125}\right) - \left(\frac{11}{17} \times \frac{34}{55}\right) + \left(\frac{28}{-13} \times \frac{-52}{21}\right)$

18. Find the multiplicative inverse (reciprocal) of each of the following rational numbers :

i. –7 **ii.** $\frac{12}{5}$ **iii.** $\frac{-5}{8} \times \frac{16}{15}$

iv. $-2 \times \frac{-3}{5}$ **v.** $\frac{0}{3}$ **vi.** 1

vii. $\frac{-3}{5}$ **viii.** $\frac{0}{2}$ **ix.** $\frac{-5}{6} \times \frac{36}{20}$

x. $\frac{-3}{-5}$

19. Simplify using appropriate properties :

i. $\frac{-2}{3} \times \frac{3}{5} + \frac{5}{2} - \frac{3}{5} \times \frac{1}{6}$

ii. $\frac{-4}{3} \times \frac{2}{7} - \frac{2}{3} \times \frac{5}{7} + \frac{2}{7} \times \frac{3}{4}$

iii. $\frac{2}{5} \times \frac{-3}{7} - \frac{1}{14} \times \frac{4}{7} - \frac{3}{7} \times \frac{3}{5}$

iv. $-\frac{3}{4} \times \frac{2}{3} + \frac{4}{3} \times \frac{5}{2} - \frac{3}{4} \times \frac{-5}{6}$

v. $\frac{6}{-10} \times \frac{1}{4} - \frac{1}{2} \times \frac{1}{8} - \frac{6}{-10} \times \frac{-3}{4}$

vi. $\frac{2}{5} \times \left(\frac{-3}{7}\right) - \frac{1}{6} \times \frac{3}{2} + \frac{1}{14} \times \frac{2}{5}$

20. The product of two rational numbers is 15. If one of the numbers is –10, find the other.

21. By what number should we multiply –1/6 so that the product may be –23/9 ?

22. By what number should be multiply –8/13 so that the product may be 24?

23. By what number should we multiply –15/28 so that the product may be –5/7.

24. By what number should –33/8 be divided to get –11/2?

25. Divide the sum of $\frac{13}{5}$ and $\frac{-12}{7}$ by the product of $\frac{-31}{7}$ and $\frac{1}{-2}$.

26. Divide the sum of $\frac{65}{12}$ and $\frac{8}{3}$ by their difference.

27. Find 2 rational numbers between –2/9 and 5/9.

28. Find ten rational numbers between 1/4 & 1/2.

29. Find ten rational numbers between 3/5 & 3/4.

30. Find a rational number between –1/3 and 1/2.

31. Find two rational number between –3 and –2.

32. Find a rational number between $\frac{-2}{3}$ and $\frac{1}{4}$.

33. Find any five rational numbers less than 2.

34. Represent following numbers on a number line:

$\frac{7}{3}, \frac{16}{3}, \frac{9}{4}, \frac{11}{13}, \frac{12}{5}, -\frac{10}{3}, -\frac{13}{4}, -\frac{5}{8}, \frac{-19}{5}$

PRACTICE ANSWERS

PRACTICE QUESTION - 1

1. a. $\frac{-2}{3}, \frac{-4}{9}, \frac{-5}{12}, \frac{-7}{18}$ **b.** $\frac{-9}{14}, \frac{-23}{42}, \frac{-13}{6}, \frac{-8}{3}$

2. a. $\frac{1}{3}, -2, \frac{-13}{6}, \frac{-8}{3}$ **b.** $\frac{-23}{33}, \frac{-19}{22}, \frac{-39}{44}, \frac{-10}{11}$

3. a. $\frac{-3}{7} > \frac{6}{-13}$ **b.** $\frac{-8}{9} > \frac{-9}{10}$

c. $-2 < \frac{-13}{5}$ **d.** $\frac{+9}{-13} < \frac{7}{-12}$

PRACTICE QUESTION - 2

2. a. True b. False

PRACTICE QUESTION - 3

1. a. $\frac{-4}{9}$ **b.** $\frac{13}{7}$ **c.** $\frac{-11}{14}$

2. a. **–1** **b.** $\frac{43}{21}$ **c.** $\frac{-86}{63}$ **d.** $\frac{267}{112}$

PRACTICE QUESTION - 4

1. a. $\frac{-119}{24}$ **b.** $\frac{5}{6}$

2. a. $\frac{-121}{140}$ **b.** $\frac{17}{63}$

3. a. –2 **b.** $\frac{-1}{6}$ **c.** $\frac{3}{4}$ **d.** $\frac{11}{24}$

PRACTICE QUESTION - 5

1. a. $\frac{-21}{40}$ **b.** $\frac{30}{33}$ c. 8 d. $\frac{-40}{147}$

e. –28 **f.** –14 **g.** 36

5. a. $\frac{25}{13}$ **b.** $\frac{-1}{16}$ **c.** $\frac{5}{3}$ **d.** –1

e. $\frac{-5}{2}$ **f.** –8

6. a. $\frac{8}{5}$ **b.** $\frac{-9}{4}$ **c.** $\frac{-1}{7}$ **d.** –3

PRACTICE QUESTION - 6

1. a. 2 **b.** –7 **c.** $\frac{4}{3}$ **d.** $\frac{2}{3}$

e. $\frac{-16}{9}$ **f.** $\frac{1}{8}$ **g.** $\frac{1}{8}$

2. a. $\frac{3}{13}$ **b.** $\frac{-8}{7}$ **c.** $\frac{2}{15}$ **d.** $\frac{36}{5}$

e. $\frac{51}{4}$ **f.** $\frac{-2}{99}$

3. $\frac{-3}{2}$ **4.** $\frac{46}{3}$ **5.** $\frac{-8}{9}$ **6.** $\frac{4}{3}$

7. –39 **8.** $\frac{3}{4}$ **9.** Rs. $1\frac{61}{92}$ **10.** $\frac{9}{4}$ m

11. $\frac{-2}{5}$ **12.** $\frac{97}{33}$ **13. a.** $\frac{11}{19}$ **b.** $\frac{-7}{5}$

PRACTICE QUESTION - 7

1. –1 **2.** $\frac{-1}{9}, 0, \frac{1}{9}, \frac{2}{9}$ **3.** $\frac{21}{80}, \frac{22}{80}, \frac{23}{80} \ldots \frac{39}{80}$

4. $\frac{61}{100}, \frac{62}{100} \ldots . \frac{74}{100}$ **6.** $\frac{11}{40}, \frac{12}{40}, \frac{13}{40}, \frac{15}{40}, \frac{18}{40}$

EXERCISE ANSWERS

1. i. 2/17 **ii.** 3/11 **iiii.** 17/6 **iv.** –11/25

v. 0 **vi.** $-\frac{1}{3}$ **vii.** 18 **viii.** $-\frac{a}{b}$

ix. no

2. i. 8/5 **ii.** –17/21 **iii.** 37/15 **iv.** –86/63

v. –11/15 **vi.** 1/15

3. i. –141/12 **ii.** –77/18 **iii.** –25/104 **iv.** 267/112

v. 2/5 **vi.** –14/15 **vii.** 43/21 **viii.** 3/5

4. – 2/3 **5.** 11/3 **6.** 103/72 **7.** – 25/6

8. –23/28 **9.** 59/30 **10.** 2/7 **11.** –2/15

12. 1/4 **13.** –17/6

14. i. –59/8 **ii.** 17/63 **iii.** 235/24 **iv.** –121/140

v. –2/9 **vi.** 5/6 **vii.** –1/12

15. i. –4/3 **ii.** 3/4 **iii.** 19/18 **iv.** 17/30

v. 33/70 **vi.** –64/63

16. i. 23/12 **ii.** 25/8 **iii.** 5/3 **iv.** 161/10

v. 239/126 **vi.** –351/160

17. i. 47/12 **ii.** 37/21 **iii.** –2/3 **iv.** –177/286

v. 394/75

18. i. –1/7 **ii.** 5/12 **iii.** –3/2 **iv.** 5/6

v. Does not exist **vi.** 1 **vii.** 5/–3

viii. does not exist **ix.** –3/2 **x.** 5/3

19. i. 2 **ii.** –9/14 **iii.** –22 / 49 **iv.** 83/24

v. –53/80 **vi.** –1/20

20. –3/2 **21.** 46/3 **22.** –39 **23.** 4/3

24. –3/4 **25.** 5/2 **26.** $\frac{97}{33}$ **27.** $\frac{-1}{9}, 0, \frac{1}{9}, \frac{2}{9}$

28. $\frac{21}{80}, \frac{22}{80}, \ldots, \frac{39}{80}$ **29.** $\frac{61}{100}, \frac{62}{100}, \ldots\ldots, \frac{74}{100}$

30. 1/12 **31.** –5/2, –9/4

32. $\frac{-2}{3} < \frac{-5}{24} < \frac{1}{4}$ **33.** 0, 1/5, 2/5, 3/5, 4/5