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It gives me great pride and pleasure in bringing to you **Sura's Mathematics Guide** for **Full Year** for **8th Standard**. It is prepared as per the New Syllabus and New Textbook.

This guide encompasses all the requirements of the students to comprehend the text and the evaluation of the textbook.

- Additional questions have been provided exhaustively for clear understanding of the units under study.
- Chapter-wise Unit Test are given.

In order to learn effectively, I advise students to learn the subject section-wise and practice the exercises given. It will be a teaching companion to teachers and a learning companion to students.

Though these salient features are available in this Guide, I cannot negate the indispensable role of the teachers in assisting the student to understand the subject thoroughly.

I sincerely believe this guide satisfies the needs of the students and bolsters the teaching methodologies of the teachers.

I pray the almighty to bless the students for consummate success in their examinations.

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AUGUST	3	Algebra	3.1 - 3.4
	5	Geometry	5.1 - 5.4
	7	Instrumental Processing	7.1 - 7.3
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QUARTERLY EXAM (August, September)			
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	6	Statistics	6.4
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III MID TERM TEST (January, February)			
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APRIL	**ANNUAL EXAM (All Portions)**		

1 NUMBERS

POINTS TO REMEMBER

- A number that can be expressed in the form $\frac{a}{b}$ where a and b are integers and b≠0 is called a rational number.
- All natural numbers, whole numbers, integers and fractions are rational numbers.
- Every rational number can be represented on a number line.
- 0 is neither a positive nor a negative rational number.
- A rational number $\frac{a}{b}$ is said to be in the standard form, if its denominator b is a positive integer and HCF $(a,b)=1$
- There are unlimited numbers of rational numbers between two rational numbers.
- Subtracting two rational numbers is the same as adding the additive inverse of the second number to the first rational number.
- Multiplying two rational numbers is the same as multiplying their numerators and denominators separately and then writing the product in the standard form.
- Dividing a rational number by another rational number is the same as multiplying the first rational number by the reciprocal of the second rational number.
- The following table is about the properties of rational numbers($\mathbb{Q}$).

$\mathbb{Q}$	Closure	Commutative	Associative	Multiplication is distributive over +/–
+	✓	✓	✓	✓
–	✓	×	×	✓
×	✓	✓	✓	–
÷	×	×	×	–

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- 0 and 1 are respectively the additive and the multiplicative identities of rational numbers.
- The additive inverse for $\frac{a}{b}$ is $\frac{-a}{b}$ and vice – versa.
- The reciprocal or the multiplicative inverse of a rational number $\frac{a}{b}$ is $\frac{b}{a}$ since $\frac{a}{b}\times\frac{b}{a}=1$.
- A natural number n is called a square number, if we can find another natural number m such that $n = m^2$.
- The square root of a number n, written as $\sqrt{n}$ (or) $n^{\frac{1}{2}}$, is the number that gives n when multiplied by itself.
- The number of times a prime factor occurs in the square is equal to twice the number of times it occurs in the prime factorization of the number.
- For any two positive numbers a and b. we have

  (i) $\sqrt{ab} = \sqrt{a}\times\sqrt{b}$ and (ii) $\sqrt{\frac{a}{b}}=\frac{\sqrt{a}}{\sqrt{b}}\ (b\neq 0)$
- If you multiply a number by itself and then by itself again, the result is a cube number.
- The cube root of a number is the value that when cubed gives the original number.
- An expression that represents repeated multiplication of the same factor is called a power.
- The exponent corresponds to the number of times the base is used as a factor.
- Laws of Exponents: (i) $a^m \times a^n = a^{m+n}$ (ii) $\frac{a^m}{a^n} = a^{m-n}$ (iii) $(a^m)^n = a^{mn}$
- Other results: (i) $a^0 = 1$ (ii) $a^{-m} = \frac{1}{a^m}$ (iii) $a^m \times b^m = (ab)^m$ (iv) $\frac{a^m}{b^m}=\left(\frac{a}{b}\right)^m$

RECAP

Page No. 3

1. **The simplest form of $\frac{125}{200}$ is _____.** [*Ans:* $\frac{5}{8}$]

Sol.

$$\frac{125}{200} = \frac{125 \div 25}{200 \div 25} = \frac{5}{8}$$

2. **Which of the following is not an equivalent fraction of $\frac{8}{12}$?**

(A) $\frac{2}{3}$ (B) $\frac{16}{24}$ (C) $\frac{32}{60}$ (D) $\frac{24}{36}$

[*Ans:* (C) $\frac{32}{60}$]

Sol.

$$\frac{8}{12} = \frac{8 \div 4}{12 \div 4} = \frac{2}{3}$$

$$\frac{8}{12} = \frac{8 \times 2}{12 \times 2} = \frac{16}{24}$$

$$\frac{8}{12} = \frac{8 \times 3}{12 \times 3} = \frac{24}{36}$$

But $\frac{32}{60} = \frac{32 \div 5}{60 \div 5} = \frac{6.4}{12}$

$\therefore$ $\frac{32}{60}$ is not an equivalent fraction of $\frac{8}{12}$.

3. **Which is bigger : $\frac{4}{5}$ or $\frac{8}{9}$?**

Sol. LCM of 5 and 9 = 45

$$\frac{4}{5} = \frac{4 \times 9}{5 \times 9} = \frac{36}{45}$$

$$\frac{8}{9} = \frac{8 \times 5}{9 \times 5} = \frac{40}{45}$$

$$\therefore \quad \frac{40}{45} > \frac{36}{45}$$

$$\therefore \quad \frac{8}{9} > \frac{4}{5}$$

$\Rightarrow$ $\frac{8}{9}$ is bigger than $\frac{4}{5}$.

4. **Add the fractions : $\frac{3}{5}+\frac{5}{8}+\frac{7}{10}$.**

Sol.

$$\text{LCM of } 5, 8, 10 = 5 \times 2 \times 4 = 40$$

$$\frac{3}{5}+\frac{5}{8}+\frac{7}{10} = \frac{(3\times8)+(5\times5)+(7\times4)}{40} = \frac{24+25+28}{40} = \frac{77}{40} = 1\frac{37}{40}$$

Hint:

5	5, 8, 10
2	1, 8, 2
4	1, 4, 1
	1, 1, 1

5. **Simplify : $\frac{1}{8}-\left(\frac{1}{6}-\frac{1}{4}\right)$.**

Sol.

$$\frac{1}{8}-\left(\frac{1}{6}-\frac{1}{4}\right) = \frac{1}{8}-\left[\frac{(1\times2)-(1\times3)}{12}\right] \quad [\because \text{LCM of } 6, 4 = 12]$$

$$= \frac{1}{8}-\left(\frac{2-3}{12}\right)$$

$$= \frac{1}{8}-\left(-\frac{1}{12}\right)$$

$$= \frac{1}{8}+\frac{1}{12} = \frac{(1\times3)+(1\times2)}{24} \quad [\because \text{LCM of } 8, 12 = 24]$$

$$= \frac{3+2}{24} = \frac{5}{24}$$

6. **Multiply : $2\frac{3}{5}$ and $1\frac{4}{7}$.**

Sol.

$$2\frac{3}{5}\times1\frac{4}{7} = \frac{13}{5}\times\frac{11}{7} = \frac{143}{35} = 4\frac{3}{35}$$

7. **Divide : $\frac{7}{36}$ by $\frac{35}{81}$.**

Sol.

$$\frac{7}{36}\div\frac{35}{81} = \frac{7}{36}\times\frac{81}{35} = \frac{9}{20}$$

8. **Fill in the boxes : $\frac{\square}{66}=\frac{70}{\square}=\frac{28}{44}=\frac{\square}{121}=\frac{7}{\square}$.**

Sol.

$$\frac{28}{44} = \frac{28\div4}{44\div4} = \frac{7}{11}$$

$$\frac{7}{11} = \frac{7\times4=28}{11\times4=44} = \frac{7\times6=42}{11\times6=66} = \frac{7\times10=70}{11\times10=110} = \frac{7\times11=77}{11\times11=121}$$

$$\therefore \quad \frac{\boxed{42}}{66} = \frac{70}{\boxed{110}} = \frac{28}{44} = \frac{\boxed{77}}{121} = \frac{7}{\boxed{11}}.$$

9. **In a city $\frac{7}{20}$ of the population are women and $\frac{1}{4}$ are children. Find the fraction of the population of men.**

Sol. Let the total population = 1

$$\text{Population of men} = \text{Total population} - \text{Women} - \text{Children}$$

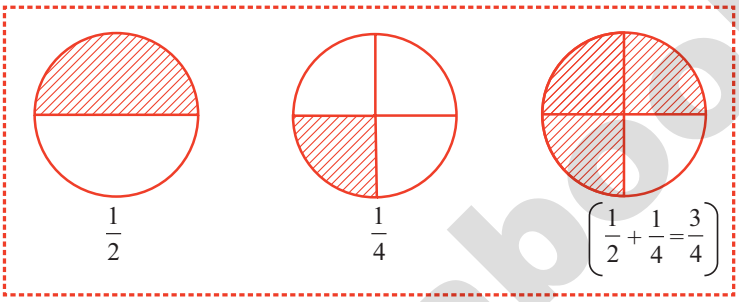
$$= 1 - \frac{7}{20} - \frac{1}{4} = \frac{20}{20} - \frac{7}{20} - \frac{5}{20}$$

$$= \frac{20-7-5}{20} = \frac{8}{20} = \frac{2}{5}$$

$$\text{Population of men} = \frac{2}{5}$$

10. **Represent $\left(\frac{1}{2}+\frac{1}{4}\right)$ by a diagram.**

Sol.



TRY THESE

Page No. 3

1. **Is the number – 7 a rational number ? Why?**

Sol. Yes – 7 is a rational number. Because $-7 = \frac{-14}{2} = \frac{p}{q}$

2. **Write any 6 rational numbers between 0 and 1.**

Sol. $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{7}$

TRY THESE

Page No. 5

Write the decimal forms of the following rational numbers:

1. $\frac{4}{5}$ **2.** $\frac{6}{25}$ **3.** $\frac{486}{1000}$ **4.** $\frac{1}{9}$ **5.** $3\frac{1}{4}$ **6.** $-2\frac{3}{5}$

Sol. **1.** $\frac{4}{5} = \frac{4\times 20}{5\times 20} = \frac{80}{100} = 0.80$

2. $\frac{6}{25} = \frac{6\times 4}{25\times 4} = \frac{24}{100} = 0.24$

3. $\frac{486}{1000} = 0.486$

4. $\frac{1}{9} = 0.11\ldots$

$$9\overline{)\,10}\ 0.11\ldots$$
$$\underline{9}$$
$$10$$
$$\underline{9}$$
$$1$$

5. $3\frac{1}{4} = \frac{13}{4} = 3.25$

$$4\overline{)\,13}\ 3.25$$
$$\underline{12}$$
$$10$$
$$\underline{8}$$
$$20$$
$$\underline{20}$$
$$0$$

6. $-2\frac{3}{5} = \frac{-13}{5} = -2.6$

$$5\overline{)\,13}\ 2.6$$
$$\underline{10}$$
$$30$$
$$\underline{30}$$
$$0$$

TRY THESE Page No. 6

1. $\frac{7}{3} = \frac{?}{9} = \frac{49}{?} = \frac{-21}{?}$

$$\frac{7}{3} = \frac{7\times3}{3\times3} = \frac{21}{9}$$
$$\frac{7}{3} = \frac{7\times7}{3\times7} = \frac{49}{21}$$
$$\frac{7}{3} = \frac{7\times(-3)}{3\times(-3)} = \frac{-21}{-9}$$
$$\therefore \frac{7}{3} = \frac{21}{9} = \frac{49}{21} = \frac{-21}{-9}$$

2. $\frac{-2}{5} = \frac{?}{10} = \frac{6}{?} = \frac{-8}{?}$

$$\frac{-2}{5} = \frac{-2\times2}{5\times2} = \frac{-4}{10}$$
$$\frac{-2}{5} = \frac{-2\times-3}{5\times-3} = \frac{6}{-15}$$
$$\frac{-2}{5} = \frac{-2\times4}{5\times4} = \frac{-8}{20}$$
$$\therefore \frac{-2}{5} = \frac{-4}{10} = \frac{6}{-15} = \frac{-8}{20}$$

TRY THESE Page No. 7

1. **Which of the following pairs represents equivalent rational numbers?**

(i) $\frac{-6}{4}, \frac{18}{-12}$ **(ii)** $\frac{-4}{-20}, \frac{1}{-5}$

(iii) $\frac{-12}{-17}, \frac{60}{85}$

(i) $\frac{-6}{4} = \frac{-6\times-3}{4\times-3} = \frac{18}{-12}$

$\therefore \frac{-6}{4}$ equivalent to $\frac{18}{-12}$

(ii) $\frac{-4}{-20} = \frac{-4\div(-4)}{-20\div(-4)} = \frac{1}{5} \neq -\frac{1}{5}$

$\therefore \frac{-4}{-20}$ not equivalent to $\frac{1}{-5}$

(iii) $\frac{-12}{-17} = \frac{-12\times-5}{-17\times-5} = \frac{60}{85}$

$\therefore \frac{-12}{-17}$ equivalent to $\frac{60}{85}$

2. **Find the standard form of :**

(i) $\frac{36}{-96}$ **(ii)** $\frac{-56}{-72}$ **(iii)** $\frac{27}{18}$

(i) $\frac{36}{-96} = \frac{36\div12}{-96\div12} = \frac{3}{-8} = -\frac{3}{8}$

(ii) $\frac{-56}{-72} = \frac{-56\div(-8)}{-72\div(-8)} = \frac{7}{9}$

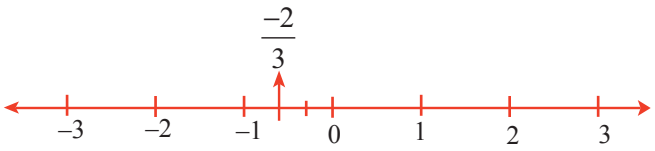
(iii) $\frac{27}{18} = \frac{27\div9}{18\div9} = \frac{3}{2}$

3. Mark the following rational numbers on a number line.

(i) $\frac{-2}{3}$ **(ii)** $\frac{-8}{-5}$ **(iii)** $\frac{5}{-4}$

Sol. (i) $-\frac{2}{3} = -0.666...$ $\therefore \frac{-2}{3}$ lies between 0 and –1.

The unit part between 0 and –1 is divided into 3 equal parts and second part is taken.



(ii) $\frac{-8}{-5} = \frac{8}{5} = 1\frac{3}{5}$

$1\frac{3}{5}$ lies between 1 and 2. The unit part between 1 and 2 is divided into 5 equal parts and the third part is taken.

(iii) $\frac{5}{-4} = -\frac{5}{4} = -1\frac{1}{4}$

$-1\frac{1}{4}$ lies between –1 and –2. The unit part between –1 and –2 is divided into four equal parts and the first part is taken.

THINK

Page No. 10

Are there any rational numbers between $\frac{-7}{11}$ and $\frac{6}{-11}$?

Sol. $\frac{-7\times10}{11\times10} = \frac{-70}{110}; \frac{6\times10}{-11\times10} = \frac{-60}{110}$

$\therefore \frac{-61}{110}, \frac{-62}{110}$ .... $\frac{-69}{110}$ are there in between $\frac{-60}{110}$ and $\frac{-69}{110}$

$\therefore$ There are many rational numbers between $\frac{-7}{11}$ and $\frac{6}{-11}$

Exercise 1.1

1. Fill in the blanks:

(i) $\frac{-19}{5}$ lies between the integers _____ and _____. [*Ans:* **–4 and –3**]

(ii) The decimal form of the rational number $\frac{15}{-4}$ is _____. [*Ans:* **–3.75**]

(iii) The rational numbers $\frac{-8}{3}$ and $\frac{8}{3}$ are equidistant from _____. [*Ans:* **0**]

(iv) The next rational number in the sequence $\frac{-15}{24}, \frac{20}{-32}, \frac{-25}{40}$ is _____. [*Ans:* $\frac{30}{-48}$]

(v) The standard form of $\frac{58}{-78}$ is _____. [*Ans:* $\frac{-29}{39}$] *(QY-2023)*

2. Say True or False.

(i) 0 is the smallest rational number. [*Ans:* **False**]

(ii) $\frac{-4}{5}$ lies to the left of $\frac{-3}{4}$ [*Ans:* **True**]

(iii) $\frac{-19}{5}$ is greater than $\frac{15}{-4}$ [*Ans:* **False**]

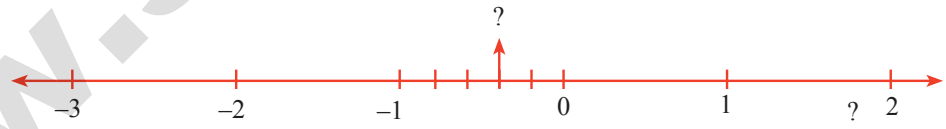
(iv) The average of two rational numbers lies between them. [*Ans:* **True**]

(v) There are an unlimited number of rational numbers between 10 and 11. [*Ans:* **True**]

3. Find the rational numbers represented by each of the question marks marked on the following number lines.

(i)

(ii)



(iii)

Sol. **(i)** The number lies between –3 and –4. The unit part between –3 and –4 is divided into 3 equal parts and the second part is taken.

$\therefore$ The required number is $-3\frac{2}{3} = -\frac{11}{3}$.

(ii) The required number lies between 0 and –1. The unit part between 0 and –1 is divided into 5 equal parts, and the second part is taken.

$\therefore$ The required number is $-\frac{2}{5}$

(iii) The required number lies between 1 and 2. The unit part between 1 and 2 is divided into 4 equal parts and the third part is taken.

$\therefore$ The required number is $1\frac{3}{4} = \frac{7}{4}$

4. The points S, Y, N, C, R, A, T, I and O on the number line are such that CN=NY=YS and RA=AT=TI=IO. Find the rational numbers represented by the letters Y, N, A, T and I.

Sol.

$$Y = -2 + \frac{1}{3} = \frac{-6+1}{3} = \frac{-5}{3}$$

$$N = \frac{-5}{3} + \frac{1}{3} = \frac{-5+1}{3} = \frac{-4}{3}$$

$$RA = AT = TI = IO = \frac{1}{4}$$

$$A = 2 + \frac{1}{4} = \frac{8+1}{4} = \frac{9}{4}$$

$$T = \frac{9}{4} + \frac{1}{4} = \frac{9+1}{4} = \frac{10}{4}$$

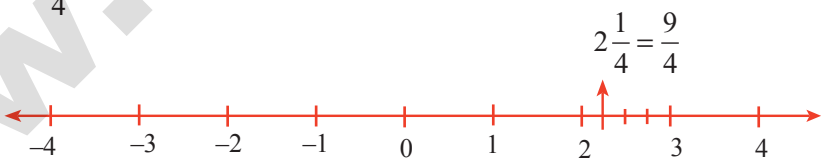
$$I = \frac{10}{4} + \frac{1}{4} = \frac{10+1}{4} = \frac{11}{4}$$

5. Draw the number line and represent the following rational numbers on it.

(i) $\frac{9}{4}$ **(ii)** $\frac{-8}{3}$ **(iii)** $\frac{-17}{-5}$ **(iv)** $\frac{15}{-4}$

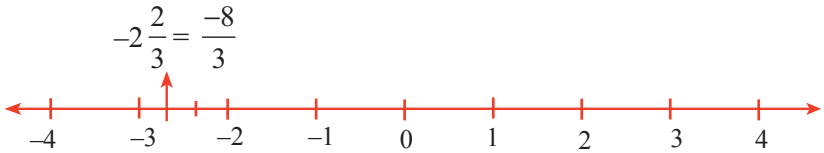
Sol. (i) $\frac{9}{4} = 2\frac{1}{4}$

$\therefore \frac{9}{4}$ lies between 2 and 3.



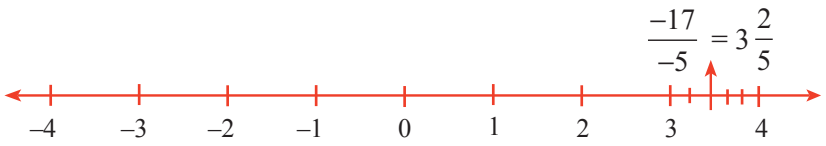
(ii) $\frac{-8}{3} = -2\frac{2}{3}$ *(QY-2023)*

$-2\frac{2}{3}$ lies between –2 and –3.



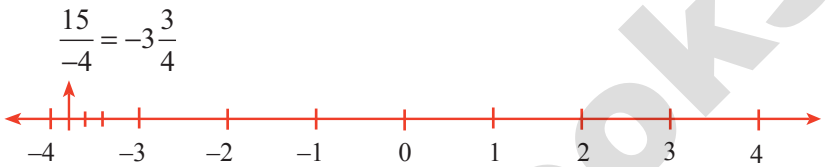
(iii) $\frac{-17}{-5} = 3\frac{2}{5}$

$3\frac{2}{5}$ lies between 3 and 4 in the number line.



(iv) $\frac{15}{-4} = -3\frac{3}{4}$

$-3\frac{3}{4}$ lies between –3 and –4.



6. Write the decimal form of the following rational numbers.

(i) $\frac{1}{11}$ **(ii)** $\frac{13}{4}$ **(iii)** $\frac{-18}{7}$ **(iv)** $1\frac{2}{5}$

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

Sol. **(i)** $\frac{1}{11} = 0.0909...$

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

(ii) $\frac{13}{4} = 3.25$

$$
\begin{array}{r|l}
4 & 3.25 \\
\hline
 & 13 \\
 & 12 \\
\hline
 & 10 \\
 & 8 \\
\hline
 & 20 \\
 & 20 \\
\hline
 & 0
\end{array}
$$

(iii) $\frac{-18}{7} = -2.571428571428...$

$$\begin{array}{r} 2.571428 \\ 7\overline{)\,18} \\ \underline{14} \\ 40 \\ \underline{35} \\ 50 \\ \underline{49} \\ 10 \\ \underline{7} \\ 30 \\ \underline{28} \\ 20 \\ \underline{14} \\ 60 \\ \underline{56} \\ 4 \end{array}$$

(iv) $1\frac{2}{5} = \frac{7}{5} = 1.4$ *(HY-2023)*

$$\begin{array}{r} 1.4 \\ 5\overline{)\,7} \\ \underline{5} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

(v) $-3\frac{1}{2} = -\frac{7}{2} = -3.5$

$$\begin{array}{r} 3.5 \\ 2\overline{)\,7} \\ \underline{6} \\ 10 \\ \underline{10} \\ 0 \end{array}$$

7. List any five rational numbers between the given rational numbers.

(i) –2 and 0 **(ii)** $\frac{-1}{2}$ **and** $\frac{3}{5}$ **(iii)** $\frac{1}{4}$ **and** $\frac{7}{20}$ **(iv)** $\frac{-6}{4}$ **and** $\frac{-23}{10}$

Sol. **(i)** –2 and 0

i.e. $\frac{-2}{1}$ and $\frac{0}{1}$

$$\frac{-2}{1} = \frac{-2\times10}{1\times10} = \frac{-20}{10}$$

$$\frac{0}{1} = \frac{0\times10}{1\times10} = \frac{0}{10}$$

$\therefore$ Five rational numbers between $\frac{-20}{10}$ $(= -2)$ and $\frac{0}{10}$ $(= 0)$ are

$$\frac{-20}{10}, \frac{-19}{10}, \frac{-18}{10}, \frac{-7}{10}, \frac{-6}{10}, \frac{-5}{10}, \frac{0}{10} (= 0).$$

(ii) $\frac{-1}{2}$ and $\frac{3}{5}$

LCM of 2 and 5 $= 2 \times 5 = 10$

$$-\frac{1}{2} = \frac{-1\times5}{2\times5} = \frac{-5}{10}$$

$$\frac{3}{5} = \frac{3\times2}{5\times2} = \frac{6}{10}$$

$\therefore$ Five rational numbers between $\frac{-1}{2}\left(=\frac{-5}{10}\right)$ and $\frac{3}{5}\left(=\frac{6}{10}\right)$ are $\frac{-3}{10}, \frac{-1}{10}, 0, \frac{1}{10}, \frac{2}{10}, \frac{5}{10}$

(iii) $\frac{1}{4}$ and $\frac{7}{20}$

$$\frac{1}{4} = \frac{1\times15}{4\times15} = \frac{15}{60}$$

$$\frac{7}{20} = \frac{7\times3}{20\times3} = \frac{21}{60}$$

$\therefore$ Five rational numbers between $\frac{1}{4}\left(=\frac{15}{60}\right)$ and $\frac{7}{20}\left(=\frac{21}{60}\right)$ are $\frac{16}{60}, \frac{17}{60}, \frac{18}{60}, \frac{19}{60}, \frac{20}{60}$

(iv) $\frac{-6}{4}$ and $\frac{-23}{10}$

$$\frac{-6}{4} = \frac{-6\times5}{4\times5} = \frac{-30}{20}$$

$$\frac{-23}{10} = \frac{23\times2}{10\times2} = \frac{-46}{20}$$

$\therefore$ Five rational numbers between $\frac{-6}{4}\left(=\frac{-30}{20}\right)$ and $\frac{-23}{10}\left(=\frac{-46}{20}\right)$ are $\frac{-31}{20}, \frac{-32}{20}, \frac{-33}{20}, \frac{-34}{20}, \frac{-35}{20}$.

8. Use the method of averages to write 2 rational numbers between $\frac{14}{5}$ and $\frac{16}{3}$.

Sol. The average of a and b is $\frac{1}{2}(a+b)$

The average of $\frac{14}{5}$ and $\frac{16}{3}$ is $C_1 = \frac{1}{2}\left(\frac{14}{5}+\frac{16}{3}\right)$

$$C_1 = \frac{1}{2}\left(\frac{42+80}{15}\right)$$

$$C_1 = \frac{122}{30}$$

$$C_1 = \frac{61}{15}$$

$$\therefore \frac{14}{5} < \frac{61}{15} < \frac{16}{3} \qquad \text{.....(1)}$$

The average of $\frac{14}{5}$ and $\frac{61}{15}$ is $C_2 = \frac{1}{2}\left(\frac{14}{5}+\frac{61}{15}\right)$

$$C_2 = \frac{1}{2}\times\left(\frac{42+61}{15}\right)$$

$$C_2 = \frac{1}{2}\times\frac{103}{15} = \frac{103}{30}$$

$$\therefore \quad \frac{14}{5} < \frac{103}{30} < \frac{61}{15} \qquad \text{....(2)}$$

From (1), (2) we get, $\frac{14}{5} < \frac{103}{30} < \frac{61}{15} < \frac{16}{3}$

9. Compare the following pairs of rational numbers.

(i) $\frac{-11}{5}, \frac{-21}{8}$ **(ii)** $\frac{3}{-4}, \frac{-1}{2}$ **(iii)** $\frac{2}{3}, \frac{4}{5}$

Sol. **(i)** $\frac{-11}{5}, \frac{-21}{8}$

LCM of 5, 8 is 40

$$\frac{-11}{5} = \frac{-11\times 8}{5\times 8} = \frac{-88}{40}$$

$$\frac{-21}{8} = \frac{-21\times 5}{8\times 5} = \frac{-105}{40}$$

$$\frac{-105}{40} < \frac{-88}{40}$$

$$\therefore \quad \frac{-21}{8} < \frac{-11}{5}$$

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

LCM of 4 and 2 = 4

$$\frac{3}{-4} = \frac{-3}{4}$$

$$\frac{-1}{2} = \frac{-1\times 2}{2\times 2} = \frac{-2}{4}$$

$$\frac{3}{-4} < \frac{-2}{4}$$

$$\therefore \quad -\frac{3}{4} < \frac{-1}{2}$$

(iii) $\frac{2}{3}, \frac{4}{5}$ *(April-2023)*

LCM of 3 and 5 is 15.

$$\frac{2}{3} = \frac{2\times 5}{3\times 5} = \frac{10}{15}$$

$$\frac{4}{5} = \frac{4\times 3}{5\times 3} = \frac{12}{15}$$

$$\frac{10}{15} < \frac{12}{15}$$

$$\therefore \quad \frac{2}{3} < \frac{4}{5}$$

10. Arrange the following rational numbers in ascending and descending order.

(i) $\frac{-5}{12}, \frac{-11}{8}, \frac{-15}{24}, \frac{-7}{-9}, \frac{12}{36}$ *(April-2024)* **(ii)** $\frac{-17}{10}, \frac{-7}{5}, 0, \frac{-2}{4}, \frac{-19}{20}$ *(HY-2023)*

Sol. (i) $\frac{-5}{12}, \frac{-11}{8}, \frac{-15}{24}, \frac{-7}{-9}, \frac{12}{36}$

Hint:

4	12, 8, 24, 9, 36
3	3, 2, 6, 9, 9
2	1, 2, 2, 3, 3
3	1, 1, 1, 3, 3
	1, 1, 1, 1, 1

LCM of 12, 8, 24, 9, 36 is $4 \times 3 \times 2 \times 3 = 72$

$$\frac{-5}{12} = \frac{-5\times6}{12\times6} = \frac{-30}{72}$$
$$\frac{-11}{8} = \frac{-11\times9}{8\times9} = \frac{-99}{72}$$
$$\frac{-15}{24} = \frac{-15\times3}{24\times3} = \frac{-45}{72}$$
$$\frac{-7}{-9} = \frac{7\times8}{9\times8} = \frac{56}{72}$$
$$\frac{12}{36} = \frac{12\times2}{36\times2} = \frac{24}{72}$$

Now comparing the numerators $-30, -99, -45, 56, 24$ we get $56 > 24 > -30 > -45 > -99$

i.e $\frac{56}{72} > \frac{24}{72} > \frac{-30}{72} > \frac{-45}{72} > \frac{-99}{72}$ and so $\frac{-7}{-9} > \frac{12}{36} > \frac{-5}{12} > \frac{-15}{24} > \frac{-11}{8}$

$\therefore$ Descending order $\frac{-7}{-9} > \frac{12}{36} > \frac{-5}{12} > \frac{-15}{24} > \frac{-11}{8}$

$\therefore$ Ascending order $\frac{-11}{8} < \frac{-15}{24} < \frac{-5}{12} < \frac{12}{36} < \frac{-7}{-9}$

(ii) $\frac{-17}{10}, \frac{-7}{5}, 0, \frac{-2}{4}, \frac{-19}{20}$ *(QY-2023)*

Hint:

5	10, 5, 4, 20
2	2, 1, 4, 4
2	1, 1, 2, 2
	1, 1, 1, 1

LCM of 10, 5, 4, 20 is $5 \times 2 \times 2 = 20$

$$\frac{-17}{10} = \frac{-17\times2}{10\times2} = \frac{-34}{20}$$
$$\frac{-7}{5} = \frac{-7\times4}{5\times4} = \frac{-28}{20}$$
$$\frac{-2}{4} = \frac{-2\times5}{4\times5} = \frac{-10}{20}$$
$$\frac{-19}{20} = \frac{-19}{20}$$

Negative numbers are less then zero.

$\therefore$ Arranging the numerators we get $-34 < -28 < -19 < -10 < 0$

$\therefore \frac{-34}{20} < \frac{-28}{20} < \frac{-19}{20} < \frac{-10}{20} < 0$

$\therefore$ Ascending order $= \frac{-17}{10} < \frac{-7}{5} < \frac{-19}{20} < \frac{-2}{4} < 0$

$\therefore$ Descending order $= 0 > \frac{-2}{4} > \frac{-19}{20} > \frac{-7}{5} > \frac{-17}{10}$

Objective Type Questions

11. The number which is subtracted from $\frac{-6}{11}$ to get $\frac{8}{9}$ is _____.

(A) $\frac{34}{99}$ (B) $\frac{-142}{99}$ (C) $\frac{142}{99}$ (D) $\frac{-34}{99}$

[*Ans:* **(B)** $\frac{-142}{99}$]

Hint:

Let x be the number to be subtracted

$$\frac{-6}{11} - x = \frac{8}{9}$$

$$\frac{-6}{11} - \frac{8}{9} = x$$

$$x = \frac{(-6\times 9)+(-8\times 11)}{11\times 9} = \frac{-54+(-88)}{99} = \frac{-142}{99}$$

12. Which of the following pairs is equivalent?

(A) $\frac{-20}{12}, \frac{5}{3}$ (B) $\frac{16}{-30}, \frac{-8}{15}$ (C) $\frac{-18}{36}, \frac{-20}{44}$ (D) $\frac{7}{-5}, \frac{-5}{7}$

[*Ans:* **(B)** $\frac{16}{-30}, \frac{-8}{15}$]

Hint:

$$\frac{-20}{12} = \frac{-20\div 4}{12\div 4} = \frac{-5}{3} \neq \frac{5}{3}$$

$$\frac{16}{-30} = \frac{-16\div 2}{30\div 2} = \frac{-8}{15}$$

$$\frac{-18}{36} = \frac{-18\div 9}{36\div 9} = \frac{-2}{4} = \frac{-2\times 11}{4\times 11} = \frac{-22}{44} \neq \frac{-20}{44}$$

$$\frac{7}{-5} = \frac{-7\times 7}{5\times 7} = \frac{-49}{35}$$

$$\frac{-5}{7} = \frac{-5\times 5}{7\times 5} = \frac{-25}{35} \therefore \frac{-49}{35} \neq \frac{-25}{35}$$

$\therefore \frac{16}{-30}$ and $\frac{-8}{15}$ are equivalent fraction.

13. $\frac{-5}{4}$ is a rational number which lies between_____. *(April-2024)*

(A) 0 and $\frac{-5}{4}$ (B) –1 and 0 (C) –1 and –2 (D) –4 and –5

[*Ans:* **(C) –1 and –2**]

Hint:

$$\frac{-5}{4} = -1\frac{1}{4}$$

$\therefore \frac{-5}{4}$ lies between –1 and –2.

14. Which of the following rational numbers is the greatest?

(A) $\frac{-17}{24}$ (B) $\frac{-13}{16}$ (C) $\frac{7}{-8}$ (D) $\frac{-31}{32}$

[*Ans:* **(A)** $\frac{-17}{24}$]

Hint: LCM of 24, 16, 8, 32 = 8 × 2 × 3 × 2 = 96

$$\frac{-17}{24} = \frac{-17\times4}{24\times4} = \frac{-68}{96}$$

$$\frac{-13}{16} = \frac{-13\times6}{16\times6} = \frac{-78}{96}$$

$$\frac{7}{-8} = \frac{-7\times12}{8\times12} = \frac{-84}{96}$$

$$\frac{-31}{32} = \frac{-31\times3}{32\times3} = \frac{-93}{96}$$

8	24, 16, 8, 32
2	3, 2, 1, 4
3	3, 1, 1, 2
2	1, 1, 1, 2
	1, 1, 1, 1

Arranging in ascending order: $\frac{-93}{96} < \frac{-84}{96} < \frac{-78}{96} < \frac{-68}{96}$

$\Rightarrow \frac{-31}{32} < \frac{7}{-8} < \frac{-13}{16} < \frac{-17}{24}$

$\therefore \frac{-17}{24}$ is the greatest number.

15. The sum of the digits of the denominator in the simplest form of $\frac{112}{528}$ is _____.

(A) 4 (B) 5 (C) 6 (D) 7 **[*Ans:* (C) 6]**

Hint: $\frac{112}{528} = \frac{112\div8}{528\div8} = \frac{14}{66} = \frac{14\div2}{66\div2} = \frac{7}{33}$ *(April, QY -2023)*

Sum of digits in the denominator = 3 + 3 = 6

THINK

Page No. 15 & 16

Is zero a rational number? If so, what is its additive inverse?

Sol. Yes, zero is a rational number. Additive inverse of zero is zero.

What is the multiplicative inverse of 1 and –1?

Sol. Multiplicative inverse of 1 is 1 and –1 is –1.

TRY THESE

Page No. 16

Divide : (i) $\frac{-7}{3}$ by 5 (ii) 5 by $\frac{-7}{3}$ (iii) $\frac{-7}{3}$ by $\frac{35}{6}$

Sol. **(i)** $\frac{-7}{3} \div 5 = \frac{-7}{3} \div \frac{5}{1} = \frac{-7}{3}\times\frac{1}{5} = \frac{-7}{15}$

(ii) $5 \div \left(\frac{-7}{3}\right) = \frac{5}{1}\times\frac{3}{-7} = \frac{15}{-7} = -2\frac{1}{7}$

(iii) $\frac{-7}{3} \div \frac{35}{6} = \frac{-\cancel{7}}{\cancel{3}_{1}}\times\frac{\cancel{6}^{2}}{\cancel{35}_{5}} = -\frac{2}{5}$

Exercise 1.2

1. Fill in the blanks:

(i) The value of $\frac{-5}{12}+\frac{7}{15}=$ _____. [*Ans:* $\frac{1}{20}$]

(ii) The value of $\left(\frac{-3}{6}\right)\times\left(\frac{18}{-9}\right)$ is _____. [*Ans:* 1]

(iii) The value of $\left(\frac{-15}{23}\right)\div\left(\frac{30}{-46}\right)$ is _____. [*Ans:* 1]

(iv) The rational number _____ does not have a reciprocal. *(April-2024)* [*Ans:* 0]

(v) The multiplicative inverse of –1 is _____. [*Ans:* –1]

2. Say True or False.

(i) All rational numbers have an additive inverse. [*Ans:* True] *(QY-2023)*

(ii) The rational numbers that are equal to their additive inverses are 0 and –1. [*Ans:* False]

(iii) The additive inverse of $\frac{-11}{-17}$ is $\frac{11}{17}$. [*Ans:* False]

(iv) The rational number which is its own reciprocal is –1. [*Ans:* True] *(April-2023)*

(v) The multiplicative inverse exists for all rational numbers. [*Ans:* False]

3. Find the sum :

(i) $\frac{7}{5}+\frac{3}{5}$ **(ii)** $\frac{7}{5}+\frac{5}{7}$ **(iii)** $\frac{6}{5}+\left(\frac{-14}{15}\right)$ **(iv)** $-4\frac{2}{3}+7\frac{5}{12}$

Sol. **(i)** $\frac{7}{5}+\frac{3}{5}=\frac{7+3}{5}=\frac{10}{5}=2$

(ii) $\frac{7}{5}+\frac{5}{7}=\frac{(7\times7)+(5\times5)}{35}=\frac{49+25}{35}=\frac{74}{35}$

(iii) $\frac{6}{5}+\left(\frac{-14}{15}\right)=\frac{(6\times3)+(-14)}{15}=\frac{18+(-14)}{5}=\frac{4}{5}$

(iv) $-4\frac{2}{3}+7\frac{5}{12}=\frac{14}{3}+\frac{89}{12}=\frac{(-14\times4)+89}{12}=\frac{-56+89}{12}=\frac{\cancel{33}^{11}}{\cancel{12}_{4}}=\frac{11}{4}=2\frac{3}{4}$

4. Subtract : $\frac{-8}{44}$ from $\frac{-17}{11}$.

Sol. $\frac{-17}{11}-\left(\frac{-8}{44}\right)=\frac{-17}{11}+\frac{8}{44}=\frac{(-17\times4)+8}{44}=\frac{-68+8}{44}=\frac{\cancel{-60}^{15}}{\cancel{44}_{11}}=\frac{-15}{11}$

5. **Evaluate : (i)** $\frac{9}{132}\times\frac{-11}{3}$ **(ii)** $\frac{-7}{27}\times\frac{24}{-35}$

Sol. **(i)** $\frac{\cancel{9}^{3}}{\cancel{132}_{44}}\times\frac{\cancel{-11}}{\cancel{3}}=\frac{-1}{4}$ **(ii)** $\frac{\cancel{-7}}{\cancel{27}_{9}}\times\frac{\cancel{24}^{8}}{\cancel{-35}_{5}}=\frac{8}{45}$

6. **Divide : (i)** $\frac{-21}{5}$ **by** $\frac{-7}{-10}$ **(ii)** $\frac{-3}{13}$ **by** -3 **(iii)** -2 **by** $\frac{-6}{15}$

Sol. **(i)** $\frac{-21}{5}\div\frac{-7}{-10}=\frac{\cancel{-21}^{3}}{\cancel{5}}\times\frac{\cancel{10}^{2}}{\cancel{7}}=-6$ *(QY, HY-2023)*

(ii) $\frac{-3}{13}\div-3=\frac{-3}{13}\times\frac{-1}{3}=\frac{-3\times-1}{13\times3}=\frac{\cancel{3}^{1}}{\cancel{39}_{13}}=\frac{1}{13}$

(iii) $-2\div\frac{-6}{15}=-2\times\frac{15}{-6}=\frac{-2\times15}{-6}=\frac{\cancel{-30}^{5}}{\cancel{-6}}=5$

7. **Find** $(a+b)\div(a-b)$ **if (i)** $a=\frac{1}{2},b=\frac{2}{3}$ **(ii)** $a=\frac{-3}{5},b=\frac{2}{15}$

Sol. **(i)** $a+b=\frac{1}{2}+\frac{2}{3}=\frac{(1\times3)+(2\times2)}{6}=\frac{3+4}{6}=\frac{7}{6}$

$a-b=\frac{1}{2}-\frac{2}{3}=\frac{(1\times3)-(2\times2)}{6}=\frac{3-4}{6}=\frac{-1}{6}$

$\therefore (a+b)\div(a-b)=\frac{7}{6}\div\frac{-1}{6}=\frac{7}{\cancel{6}}\times\frac{\cancel{6}}{-1}=-7$

(ii) $a+b=\frac{-3}{5}+\frac{2}{15}=\frac{(-3\times3)+2}{15}=\frac{-9+2}{15}=\frac{-7}{15}$

$a-b=\frac{-3}{5}-\frac{2}{15}=\frac{(-3\times3)-2}{15}=\frac{-9-2}{15}=\frac{-11}{15}$

$\therefore (a+b)\div(a-b)=\frac{-7}{15}\div\frac{-11}{15}=\frac{-7}{\cancel{15}}\times\frac{\cancel{15}}{-11}=\frac{7}{11}$

8. **Simplify :** $\frac{1}{2}+\left(\frac{3}{2}-\frac{2}{5}\right)\div\frac{3}{10}\times3$ **and show that it is a rational number between 11 and 12.**

Sol. $\frac{1}{2}+\left(\frac{3}{2}-\frac{2}{5}\right)\div\frac{3}{10}\times3=\frac{1}{2}+\left(\frac{15-4}{10}\right)\div\frac{3}{10}\times3=\frac{1}{2}+\frac{11}{\cancel{10}}\times\frac{\cancel{10}}{\cancel{3}}\times\cancel{3}$

$=\frac{1}{2}+11=11\frac{1}{2}=\frac{23}{2}$

The average of 11 and 12 is $\frac{11+12}{2}=\frac{23}{2}$

$\Rightarrow \frac{23}{2}$ is a rational number between 11 and 12

9. **Simplify :**

(i) $\left[\frac{11}{8}\times\left(\frac{-6}{33}\right)\right]+\left[\frac{1}{3}+\left(\frac{3}{5}\div\frac{9}{20}\right)\right]-\left[\frac{4}{7}\times\frac{-7}{5}\right]$ **(ii)** $\left[\frac{4}{3}\div\left(\frac{8}{-7}\right)\right]-\left[\frac{3}{4}\times\frac{4}{3}\right]+\left[\frac{4}{3}\times\left(\frac{-1}{4}\right)\right]$

Sol. **(i)** $\left[\frac{11}{8}\times\left(\frac{-6}{33}\right)\right]+\left[\frac{1}{3}+\left(\frac{3}{5}\div\frac{9}{20}\right)\right]-\left[\frac{4}{7}\times\frac{-7}{5}\right]=\frac{11\times(-6)}{8\times 33}+\left[\frac{1}{3}+\left(\frac{3}{5}\times\frac{20}{9}\right)\right]-\left[\frac{4\times-7}{7\times5}\right]$

$=-\frac{1}{4}+\left[\frac{1}{3}+\frac{4}{3}\right]-\left(\frac{-4}{5}\right)=-\frac{1}{4}+\frac{5}{3}+\frac{4}{5}=\frac{-15+100+48}{60}=\frac{133}{60}$

(ii) $\left[\frac{4}{3}\div\left(\frac{8}{-7}\right)\right]-\left[\frac{3}{4}\times\frac{4}{3}\right]+\left[\frac{4}{3}\times\left(\frac{-1}{4}\right)\right]=\left[\frac{4}{3}\times\frac{-7}{8}\right]-\left[\frac{3}{4}\times\frac{4}{3}\right]+\left[\frac{4\times(-1)}{3\times4}\right]$

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

10. **A student had multiplied a number by $\frac{4}{3}$ instead of dividing it by $\frac{4}{3}$ and got 70 more than the correct answer. Find the number.**

Sol.

Let the number be a

$(a\times\frac{4}{3})-(a\div\frac{4}{3}) = 70$

$(a\times\frac{4}{3})-(a\times\frac{3}{4}) = 70$

$a\left[\frac{4}{3}-\frac{3}{4}\right] = 70$

$a\left[\frac{4\times4-3\times3}{12}\right] = 70$

$a\left[\frac{16-9}{12}\right] = 70$

$a\left[\frac{7}{12}\right] = 70$

$a = 70\times\frac{12}{7}=120$

$a = 120$

$\therefore$ The number is 120.

Objective Type Questions

11. **The standard form of the sum $\frac{3}{4}+\frac{5}{6}+\left(\frac{-7}{12}\right)$ is _____.** *(HY-2023)*

(A) 1 (B) $\frac{-1}{2}$ (C) $\frac{1}{12}$ (D) $\frac{1}{22}$ [***Ans:*** **(A) 1**]

Hint: $\frac{3}{4}+\frac{5}{6}+\left(\frac{-7}{12}\right)=\frac{(3\times3)+(5\times2)+(-7)}{12}=\frac{9+10+(-7)}{12}=\frac{19-7}{12}=\frac{12}{12}=1$

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

(A) $\frac{15}{64}$ (B) 1 (C) $\frac{5}{8}$ (D) $\frac{1}{16}$ [*Ans:* **(C)** $\frac{5}{8}$]

Hint: $\left(\frac{3}{4}-\frac{5}{8}\right)+\frac{1}{2} = \left(\frac{(3\times2)-5}{8}\right)+\frac{1}{2}=\frac{6-5}{8}+\frac{1}{2}=\frac{1}{8}+\frac{1}{2}$

$= \frac{1+(1\times4)}{8}=\frac{1+4}{8}=\frac{5}{8}$

13. $\frac{3}{4}\div\left(\frac{5}{8}+\frac{1}{2}\right)=$ _____.

(A) $\frac{13}{10}$ (B) $\frac{2}{3}$ (C) $\frac{3}{2}$ (D) $\frac{5}{8}$ [*Ans:* **(B)** $\frac{2}{3}$]

Hint: $\frac{3}{4}\div\left(\frac{5}{8}+\frac{1}{2}\right) = \frac{3}{4}\div\left(\frac{5+(1\times4)}{8}\right)=\frac{3}{4}\div\left(\frac{5+4}{8}\right)=\frac{3}{4}\div\frac{9}{8}=\frac{\cancel{3}}{\cancel{4}}\times\frac{\cancel{8}^{2}}{\cancel{9}_{3}}=\frac{2}{3}$

14. $\frac{3}{4}\times\left(\frac{5}{8}\div\frac{1}{2}\right)=$ _____.

(A) $\frac{5}{8}$ (B) $\frac{2}{3}$ (C) $\frac{15}{32}$ (D) $\frac{15}{16}$ [*Ans:* **(D)** $\frac{15}{16}$]

Hint: $\frac{3}{4}\times\left(\frac{5}{8}\div\frac{1}{2}\right) = \frac{3}{4}\times\left(\frac{\cancel{5}}{\cancel{8}_{4}}\times\frac{\cancel{2}}{1}\right)=\frac{3}{4}\times\frac{5}{4}=\frac{3\times5}{4\times4}=\frac{15}{16}$

15. Which of these rational numbers which have additive inverse?

(A) 7 (B) $\frac{-5}{7}$ (C) 0 (D) all of these

[*Ans:* **(D) all of these**]

Hint: Additive inverse of 7 is –7.

Additive inverse of $\frac{-5}{7}$ is $\frac{5}{7}$.

Additive inverse of 0 is 0.

TRY THESE

Page No. 20

The closure property on integers holds for subtraction and not for division. What about rational numbers? Verify.

Sol. Let 0 and $\frac{1}{2}$ be two rational numbers. Then, $0-\frac{1}{2}=-\frac{1}{2}$ is a rational number

∴ Closure property for subtraction holds for rational numbers.

But consider the two rational number $\frac{5}{2}$ and 0.

$$\frac{5}{2}\div0 = \frac{5}{2\times0}=\frac{5}{0}$$

Here denominator = 0 and it is not a rational number.

∴ Closure property is not true for division of rational numbers.

Operations	Fill in the blanks in the table given below of properties of Integers. (If a, b, c are integers, then $-a, -b, -c$ are also integers)					
	Closure	**Commutative**	**Associative**	**Identity**	**Inverse**	**Distributive**
Addition	$a+b$ is in $\mathbb{Z}$ E.g. $5+(-3)=2$ $\Rightarrow 2$ is in $\mathbb{Z}$	$a+b=b+a$ E.g. $5+(-3)=(-3)+5$ $\Rightarrow 2=2$	$(a+b)+c$ $=a+(b+c)$ E.g. $(2+3)+(-4)=1$ $2+[3+(-4)]=1$	$a+0$ $=0+a=a$ E.g. $(-4)+0$ $=0+(-4)=-4$	$a+(-a)$ $=(-a)+a=0$ E.g. $5+(-5)$ $=(-5)+5=0$	$a\times(b+c)$ $=(a\times b)+(a\times c)$ E.g. $2\times[3+(-5)]=-4$ $(2\times 3)+[2\times(-5)]$ $=6-10=-4$
Multiplication	ab is in $\mathbb{Z}$ E.g. $2\times 3=6$ $\Rightarrow 6$ is in $\mathbb{Z}$	$a\times b=b\times a$ E.g. $2\times 3=3\times 2$ $\Rightarrow 6=6$	$(a\times b)\times c$ $=a\times(b\times c)$ E.g. $(2\times 3)\times(-6)=-36$ $2\times[3\times(-6)]=-36$	$a\times 1$ $=1\times a=a$ E.g. $1\times 7=7$ $7\times 1=7$	Does not exist	Not Applicable
Subtraction	$a-b$ is in $\mathbb{Z}$ E.g. $7-2=5$ $\Rightarrow 5$ is in $\mathbb{Z}$	Fails $a-b\neq b-a$ E.g. $7-2\neq 2-7$ $5\neq -5$	Fails $(a-b)-c$ $\neq a-(b-c)$ E.g. $(7-2)-5\neq 7-(2-5)$ $5-5\neq 7-(-3)$ $0\neq 10$	Fails $a-0\neq 0-a$ E.g. $5-0=0-5$ $5=-5$ $5\neq -5$	Fails $a-(-a)$ $\neq(-a)-a$ E.g. $2-(-2)=4$ $(-2)-2=-4$ $4\neq -4$	$a\times(b-c)$ $=(a\times b)-(a\times c)$ E.g. $7\times(5-2)$ $(7\times 5)-(7\times 2)$ $=35-14$ $=21$ $7\times(5-2)=7\times 3=21$
Division	Fails $a\div b$ is not in $\mathbb{Z}$ E.g. $3\div 5=\frac{3}{5}$ does not belong to $\mathbb{Z}$	Fails	Fails	Fails	Fails	Not applicable

TRY THESE

Page No. 22

(i) Is $\frac{3}{5}-\frac{7}{8}=\frac{7}{8}-\frac{3}{5}$?

Sol.

$$\text{LHS} = \frac{3}{5}-\frac{7}{8}=\frac{(3\times8)-(7\times5)}{40}=\frac{24-35}{40}=\frac{-11}{40}$$

$$\text{RHS} = \frac{7}{8}-\frac{3}{5}=\frac{(7\times5)-(3\times8)}{40}=\frac{35-24}{40}=\frac{11}{40}$$

$$\Rightarrow \text{LHS} \neq \text{RHS}$$

$$\therefore \frac{3}{5}-\frac{7}{8} \neq \frac{7}{8}-\frac{3}{5}$$

$\therefore$ Subtraction of rational numbers is not commutative.

(ii) Is $\frac{3}{5}\div\frac{7}{8}=\frac{7}{8}\div\frac{5}{3}$? So, what do you conclude?

Sol.

$$\text{LHS} = \frac{3}{5}\div\frac{7}{8}=\frac{3}{5}\times\frac{8}{7}=\frac{24}{35}$$

$$\text{RHS} = \frac{7}{8}\div\frac{5}{3}=\frac{7}{8}\times\frac{3}{5}=\frac{21}{40}$$

$$\Rightarrow \text{LHS} \neq \text{RHS}$$

$$\therefore \frac{3}{5}\div\frac{7}{8} \neq \frac{7}{8}\div\frac{5}{3}$$

$\therefore$ $\Rightarrow$ Commutative property does not hold good for division of rational numbers.

Check whether associative property holds for subtraction and division.

Sol. Consider the rational numbers $\frac{2}{3}, \frac{1}{2}$ and $\frac{3}{4}$

To verify $\left(\frac{2}{3}-\frac{1}{2}\right)-\frac{3}{4} = \frac{2}{3}-\left(\frac{1}{2}-\frac{3}{4}\right)$

$$\text{LHS} = \left(\frac{2}{3}-\frac{1}{2}\right)-\frac{3}{4}=\left(\frac{(2\times2)-(1\times3)}{6}\right)-\frac{3}{4}$$

$$= \left(\frac{4-3}{6}\right)-\frac{3}{4}=\frac{1}{6}-\frac{3}{4}=\frac{(1\times2)-(3\times3)}{12}=\frac{2-9}{12}=\frac{-7}{12}$$

$$\text{RHS} = \frac{2}{3}-\left(\frac{1}{2}-\frac{3}{4}\right)=\frac{2}{3}-\left(\frac{2-3}{4}\right)=\left(\frac{2}{3}-\left(\frac{-1}{4}\right)\right)$$

$$= \frac{2}{3}+\frac{1}{4}=\frac{(2\times4)+(1\times3)}{12}=\frac{8+3}{12}=\frac{11}{12}$$

$$\text{LHS} \neq \text{RHS}$$

$$\therefore \left(\frac{2}{3}-\frac{1}{2}\right)-\frac{3}{4} \neq \frac{2}{3}-\left(\frac{1}{2}-\frac{3}{4}\right)$$

$\therefore$ Associative property not holds for subtraction of rational numbers

Also to verify $\left(\frac{2}{3}\div\frac{1}{2}\right)\div\frac{3}{4} = \frac{2}{3}\div\left(\frac{1}{2}\div\frac{3}{4}\right)$

$$\text{LHS} = \left(\frac{2}{3}\div\frac{1}{2}\right)\div\frac{3}{4} = \left(\frac{2}{3}\times\frac{2}{1}\right)\div\frac{3}{4}$$

$$= \frac{4}{3}\div\frac{3}{4} = \frac{4}{3}\times\frac{4}{3} = \frac{16}{9}$$

$$\text{RHS} = \frac{2}{3}\div\left(\frac{1}{2}\div\frac{3}{4}\right) = \frac{2}{3}\div\left(\frac{1}{2}\times\frac{4}{3}\right) = \frac{2}{3}\div\left(\frac{2}{3}\right)$$

$$= \frac{2}{3}\times\frac{3}{2} = 1$$

$$\text{LHS} \neq \text{RHS}$$

i.e. $\left(\frac{2}{3}\div\frac{1}{2}\right)\div\frac{3}{4} \neq \frac{2}{3}\div\left(\frac{1}{2}\div\frac{3}{4}\right)$

$\therefore$ Associative property does not hold good for division of rational numbers.

Exercise 1.3

1. Verify the closure property for addition and multiplication for the rational numbers $\frac{-5}{7}$ and $\frac{8}{9}$.

Sol. Closure property for addition.

Let $a = \frac{-5}{7}$ and $b = \frac{8}{9}$ be the given rational numbers.

$$a+b = \frac{-5}{7}+\frac{8}{9}$$

$$= \frac{(-5\times9)+(8\times7)}{7\times9}$$

$$= \frac{-45+56}{63} = \frac{11}{63} \text{ is in Q.}$$

i.e $a+b = \frac{-5}{7}+\frac{8}{9} = \frac{11}{63}$ is in Q.

$\therefore$ Closure property is true for addition of rational numbers.

Closure property for multiplication

$$\text{Let } a = \frac{-5}{7} \text{ and } b = \frac{8}{9}$$

$$a\times b = \frac{-5}{7}\times\frac{8}{9} = \frac{-40}{63} \text{ is in Q.}$$

$\therefore$ Closure property is true for multiplication of rational numbers.

2. Verify the commutative property for addition and multiplication for the rational numbers $\frac{-10}{11}$ and $\frac{-8}{33}$.

Sol. Let $a = \frac{-10}{11}$ and $b = \frac{-8}{33}$ be the given rational numbers.

$$\text{Now } a+b = \frac{-10}{11}+\left(\frac{-8}{33}\right) = \frac{(-10\times 3)+(-8\times 1)}{33} = \frac{-30+(-8)}{33}$$

$$\therefore\ a+b = \frac{-38}{33} \quad \text{.....(1)}$$

$$b+a = \frac{-8}{33}+\left(\frac{-10}{11}\right) = \frac{(-8\times 1)+((-10)\times 3)}{33} = \frac{-8+(-30)}{33}$$

$$\therefore\ b+a = \frac{-38}{33} \quad \text{....(2)}$$

From (1) and (2)

$a + b = b + a$ and hence addition is commutative for rational numbers.

$$\text{Further } a\times b = \frac{-10}{11}\times\left(\frac{-8}{33}\right) = \frac{80}{363}$$

$$\therefore\ a\times b = \frac{80}{363} \quad \text{.....(3)}$$

$$b\times a = \frac{-8}{33}\times\left(\frac{-10}{11}\right) = \frac{80}{363}$$

$$\therefore\ b\times a = \frac{80}{363} \quad \text{.... (4)}$$

From (3) and (4) $a \times b = b \times a$

Hence multiplication is commutative for rational numbers.

3. Verify the associative property for addition and multiplication for the rational numbers $\frac{-7}{9}, \frac{5}{6}$ and $\frac{-4}{3}$.

Sol. Let $a = \frac{-7}{9}, b = \frac{5}{6}, c = \frac{-4}{3}$ be the given rational numbers.

$$(a+b)+c = \left(\frac{-7}{9}+\frac{5}{6}\right)+\left(\frac{-4}{3}\right) = \left(\frac{(-7\times 2)+(5\times 3)}{18}\right)+\left(\frac{-4}{3}\right)$$

$$= \left(\frac{-14+15}{18}\right)+\left(\frac{-4}{3}\right) = \frac{1}{18}+\left(\frac{-4}{3}\right)$$

$$= \frac{1+((-4)\times 6)}{18} = \frac{1+(-24)}{18} = \frac{-23}{18} \quad \text{...(1)}$$

$$a+(b+c) = -\frac{7}{9}+\left(\frac{5}{6}+\frac{(-4)}{3}\right) = \frac{-7}{9}+\left(\frac{5+((-4)\times 2)}{6}\right)$$

$$= \frac{-7}{9}+\left(\frac{5+(-8)}{6}\right) = -\frac{7}{9}+\left(\frac{-3}{6}\right) = -\frac{7}{9}+\left(\frac{-1}{2}\right)$$

$$= \frac{(-7\times 2)+((-1)\times 9)}{18} = \frac{-14+(-9)}{18} = \frac{-23}{18} \quad \text{... (2)}$$

From (1) and (2), $(a+b)+c = a+(b+c)$ is true for rational numbers.

Now $(a\times b)\times c = \left(\frac{-7}{9}\times\frac{5}{6}\right)\times\left(\frac{-4}{3}\right) = \left(\frac{-7\times5}{9\times6}\right)\times\left(\frac{-4}{3}\right)$

$$= \frac{-35}{54}\times\frac{-4}{3} = \frac{-35\times\overset{2}{\cancel{(-4)}}}{\underset{27}{\cancel{54}}\times3} = \frac{70}{81} \quad \ldots (3)$$

$$a\times(b\times c) = \frac{-7}{9}\times\left(\frac{5}{\cancel{6}_{3}}\times\frac{\overset{2}{\cancel{-4}}}{3}\right) = \frac{-7}{9}\times\frac{5\times(-2)}{3\times3}$$

$$= \frac{-7}{9}\times\frac{(-10)}{9} = \frac{70}{81} \quad \ldots (4)$$

From (3) and (4) $(a\times b)\times c = a\times(b\times c)$ is true for rational numbers.

Thus associative property holds true for addition and multiplication for the rational numbers.

4. Verify the distributive property $a\times(b+c)=(a\times b)+(a\times c)$ for the rational numbers $a=\frac{-1}{2}$, $b=\frac{2}{3}$ and $c=\frac{-5}{6}$.

Sol. Given the rational number $a=\frac{-1}{2}$; $b=\frac{2}{3}$ and $c=\frac{-5}{6}$

$$a\times(b+c) = \frac{-1}{2}\times\left(\frac{2}{3}+\left(\frac{-5}{6}\right)\right) = \frac{-1}{2}\times\left(\frac{(2\times2)+(-5\times1)}{6}\right)$$

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

$$a\times(b+c) = \frac{1}{12} \quad \ldots..(1)$$

$$(a\times b)+(a\times c) = \left(\frac{-1}{2}\times\frac{2}{3}\right)+\left(\frac{-1}{2}\times\left(\frac{-5}{6}\right)\right)$$

$$= \frac{-2}{6}+\frac{5}{12} = \frac{(-2\times2)+(5\times1)}{12} = \frac{-4+5}{12}$$

$$(a\times b)+(a\times c) = \frac{1}{12} \quad \ldots..(2)$$

From (1) and (2) we have $a\times(b+c) = (a\times b)+(a\times c)$.

Hence multiplication is distributive over addition for rational numbers.

5. Verify the identity property for addition and multiplication for the rational numbers $\frac{15}{19}$ and $\frac{-18}{25}$.

Sol.

$$\frac{15}{19}+0 = \frac{15}{19}+\frac{0}{19} = \frac{15+0}{19} = \frac{15}{19}$$

$$\frac{-18}{25}+0 = \frac{-18}{25}+\frac{0}{25} = \frac{-18+0}{25} = \frac{-18}{25}$$

Identify property for addition of rational numbers are verified.

$$\frac{15}{19}\times 1 = \frac{15\times 1}{19} = \frac{15}{19}\ ;\ \frac{-18}{25}\times 1 = \frac{-18\times 1}{25} = \frac{-18}{25}$$

Identify property for multiplication of rational numbers are verified.

6. Verify the additive and multiplicative inverse property for the rational numbers $\frac{-7}{17}$ and $\frac{17}{27}$.

Sol.

$$\frac{-7}{17}+\frac{7}{17} = \frac{-7+7}{17} = \frac{0}{17} = 0$$

$$\frac{17}{27}+\left(-\frac{17}{27}\right) = \frac{17+(-17)}{27} = \frac{0}{27} = 0$$

$\therefore$ Additive inverse for rational numbers are verified.

$$\frac{-7}{17}\times\frac{17}{-7} = \frac{\cancel{-7}\times\cancel{17}}{\cancel{17}\times(\cancel{-7})} = 1$$

$$\frac{17}{27}\times\frac{27}{17} = \frac{\cancel{17}\times\cancel{27}}{\cancel{27}\times\cancel{17}} = 1$$

$\therefore$ Multiplicative inverse for rational numbers are verified.

Objective Type Questions

7. Closure property is not true for division of rational numbers because of the number *(QY-2023)*

(A) 1 (B) -1 (C) 0 (D) $\frac{1}{2}$ **[*Ans:* (C) 0]**

8. $\frac{1}{2}-\left(\frac{3}{4}-\frac{5}{6}\right)\neq\left(\frac{1}{2}-\frac{3}{4}\right)-\frac{5}{6}$ illustrates that subtraction does not satisfy the _____ property for rational numbers.

(A) commutative (B) closure (C) distributive (D) associative

[*Ans:* (D) associative]

9. Which of the following illustrates the inverse property for addition?

(A) $\frac{1}{8}-\frac{1}{8}=0$ (B) $\frac{1}{8}+\frac{1}{8}=\frac{1}{4}$ (C) $\frac{1}{8}+0=\frac{1}{8}$ (D) $\frac{1}{8}-0=\frac{1}{8}$

[*Ans:* (A) $\frac{1}{8}-\frac{1}{8}=0$]

10. $\frac{3}{4}\times\left(\frac{1}{2}-\frac{1}{4}\right)=\frac{3}{4}\times\frac{1}{2}-\frac{3}{4}\times\frac{1}{4}$ illustrates that multiplication is distributive over.

(A) addition (B) subtraction (C) multiplication (D) division

[*Ans:* (B) subtraction]

Think

Page No. 25

1. Observe that, $\frac{1}{1.2}+\frac{1}{2.3}=\frac{2}{3}$; $\frac{1}{1.2}+\frac{1}{2.3}+\frac{1}{3.4}=\frac{3}{4}$; $\frac{1}{1.2}+\frac{1}{2.3}+\frac{1}{3.4}+\frac{1}{4.5}=\frac{4}{5}$. Use your reasoning skills, to find the sum of the first 7 numbers in the pattern given above.

Sol. $\frac{1}{1.2}+\frac{1}{2.3}+\frac{1}{3.4}+\frac{1}{4.5}+\frac{1}{5.6}+\frac{1}{6.7}+\frac{1}{7.8}=\frac{7}{8}$

THINK

Page No. 26

1. Is the square of a prime number, prime?

Sol. No, the square of a prime number 'P' has at least 3 divisors 1, P and P^2. But a prime number is a number which has only two divisors, 1 and the number itself. So square of a prime number is not prime.

2. Will the sum of two perfect squares always be a perfect square? What about their difference and their product?

Sol. The sum of two perfect squares, need not be always a perfect square. Also the difference of two perfect squares need not be always a perfect square. But the product of two perfect square is a perfect square.

TRY THESE

Page No. 26

1. Which among 256, 576, 960, 1025, 4096 are perfect square numbers? (Hint: Try to extend the table of squares already seen).

Sol.
$$256 = (16)^2$$
$$576 = (24)^2$$
$$4096 = (64)^2$$
$\therefore$ 256, 576 and 4096 are perfect squares

2. One can judge just by look, that each of the following numbers 82, 113, 1972, 2057, 8888, 24353 is not a perfect square. Explain why?

Sol. Because the unit digit of a perfect square will be 0, 1, 4, 5, 6, 9. But the given numbers have unit digits 2, 3, 7, 8. So they are not perfect squares.

THINK

Page No. 27

1. Consider the claim: "Between the squares of the consecutive numbers n and (n+1), there are 2n non-square numbers". Can it be true? How many non-square numbers are there between 2500 and 2601? Verify the claim.

Sol. If $n = 50 \Rightarrow n^2 = (50)^2 = 2500$

$n + 1 = 51 \Rightarrow (n + 1)^2 = (51)^2 = 2601$

Non-square numbers of 2500 and 2601 = $100 = 2 \times 50 = 2n$

So it is true that between the classes of successive numbers n, $n + 1$, there are non-square numbers of $2n$.

THINK

Page No. 29

1. In this case, if we want to find the smallest factor with which we can multiply or divide 108 to get a square number, what should we do?

Sol.
$$108 = 2 \times 2 \times 3 \times 3 \times 3 = 2^2 \times 3^2 \times 3$$

2	108
2	54
3	27
3	9
3	3
	1

If we multiply the factors by 3, then we get

$$2^2 \times 3^2 \times 3 \times 3 \Rightarrow 2^2 \times 3^2 \times 3^2 = (2 \times 3 \times 3)^2$$

Which is perfect square.

$\therefore$ Again if we divide by 3 then we get $2^2 \times 3^2 \Rightarrow (2 \times 3)^2$, a perfect square.

$\therefore$ We have to multiply or divide 108 by 3 to get a perfect square.

TRY THESE

Page No. 32

Find the square root by long division method.

(1) 400 (2) 1764 (3) 9801

Sol. (1) 400

	2	0
2	4	00
	4	↓
40	0	00
	0	00
		0

(×2)

$\sqrt{400} = 20$

(2) 1764

	4	2
4	17	64
	16	↓
82	1	64
	1	64
		0

(×2)

$\sqrt{1764} = 42$

(3) 9801

	9	9
9	98	01
	81	↓
189	17	01
	17	01
		0

(×2)

$\sqrt{9801} = 99$

TRY THESE

Page No. 32

1. Without calculating the square root, guess the number of digits in the square root of the following numbers: (1) 14400 (2) 390625 (3) 100000000

Sol. (1) $\sqrt{14400} = \sqrt{1\ 44\ 0\ 0}$ = 3 bars have used

$\therefore$ No. of digits in $\sqrt{14400} = 3$

(2) $\sqrt{390625} = \sqrt{39\ 06\ 25}$ = 3 bars have used

$\therefore$ No. of digits in $\sqrt{390625} = 3$

(3) $\sqrt{100000000} = \sqrt{1\ 00\ 00\ 00\ 00}$ = 5 bars have used

$\therefore$ No. of digits in $\sqrt{100000000} = 5$

TRY THESE

Page No. 33

1. Find the square root of

Sol. **(1) 5.4756 (2) 19.36 (3) 116.64**

	2.	34
2	5	47 56
	4	↓
43	1	47
	1	29
464		18 56
		18 56
		0

(×2, ×2)

$\therefore \sqrt{5.4756} = 2.34$

	4	. 4
4	19	36
	16	↓
84	3	36
	3	36
		0

(×2)

$\therefore \sqrt{19.36} = 4.4$

	10	. 8
1	1	16 64
	1	↓
20	0	16
		00
208		16 64
		16 64
		0

(×2, ×2)

$\therefore \sqrt{116.64} = 10.8$

THINK

Page No. 33

Try to fill in the blanks using $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$.

$\sqrt{36} = 6$	$\sqrt{9} \times \sqrt{4}$ $= 3 \times 2 = 6$	Is $\sqrt{36} = \sqrt{9} \times \sqrt{4}$? Yes	$\sqrt{81} = 9$	$\sqrt{9} \times \sqrt{9}$ $= 3 \times 3 = 9$	Is $\sqrt{81} = \sqrt{9} \times \sqrt{9}$? Yes
$\sqrt{144} = 12$	$\sqrt{9} \times \sqrt{16}$ $= 3 \times 4 = 12$	Is $\sqrt{144} = \sqrt{9} \times \sqrt{16}$? Yes	$\sqrt{144} = 12$	$\sqrt{36} \times \sqrt{4}$ $= 6 \times 2 = 12$	Is $\sqrt{144} = \sqrt{36} \times \sqrt{4}$? Yes
$\sqrt{100} = 10$	$\sqrt{25} \times \sqrt{4}$ $= 5 \times 2 = 10$	Is $\sqrt{100} = \sqrt{25} \times \sqrt{4}$? Yes	$\sqrt{1225}$ $= 35$	$\sqrt{25} \times \sqrt{49}$ $= 5 \times 7 = 35$	Is $\sqrt{1225}$ $= \sqrt{25} \times \sqrt{49}$? Yes

TRY THESE

Page No. 34

Using this method, find the square root of the numbers 1.2321 and 11.9025.

Sol. (i) $\sqrt{1.2321} = \sqrt{\frac{12321}{10000}} = \frac{111}{100} = 1.11$

(ii) $\sqrt{11.9025} = \frac{\sqrt{119025}}{\sqrt{10000}} = \frac{345}{100} = 3.45$

TRY THESE

Page No. 34

Write the numbers in ascending order (1) 4, $\sqrt{14}$, 5 (2) 7, $\sqrt{65}$, 8

Sol. (i) 4, $\sqrt{14}$, 5

Squaring all the numbers we get, 4^2, $(\sqrt{14})^2$, $5^2 = 16, 14, 25$

$\therefore$ Ascending order : 14, 16, 25

$\therefore$ Ascending order : $\sqrt{14}$, 4, 5

(ii) 7, $\sqrt{65}$, 8

Squaring 7, $\sqrt{65}$ and 8 we get, 7^2, $(\sqrt{65})^2$, 8^2 = 49, 65, 64

$\therefore$ Ascending order : 49, 64, 65

$\therefore$ Ascending order : 7, 8, $\sqrt{65}$

Exercise 1.4

1. Fill in the blanks:

(i) The ones digit in the square of 77 is _____ . *(April-2024)* **[Ans: 9]**

(ii) The number of non-square numbers between 24^2 and 25^2 is _____ . **[Ans: 48]**

(iii) The number of perfect square numbers between 300 and 500 is _____ . **[Ans: 5]**

Hint: [$18^2 = 324$, $19^2 = 361$; $20^2 = 400$, $21^2 = 441$; $22^2 = 484$]

(iv) If a number has 5 or 6 digits in it, then its square root will have _____ digits. **[Ans: 3]**

(v) The value of $\sqrt{180}$ lies between integers _____ and _____ . **[Ans: 13, 14]**

Hint: $\sqrt{180} = \sqrt{2 \times 2 \times 3 \times 3 \times 5} = 6\sqrt{5} = 6 \times 2.236 = 13.41$ *(April-2023)*

$\therefore \sqrt{180}$ lies between 13 and 14

2. Say True or False:

(i) When a square number ends in 6, its square root will have 6 in the unit's place. **[Ans: True]**

(ii) A square number will not have odd number of zeros at the end. **[Ans: True]**

(iii) The number of zeros in the square of 91000 is 9. **[Ans: False]**

(iv) The square of 75 is 4925. **[Ans: False]**

(v) The square root of 225 is 15. **[Ans: True]** *(HY-2023)*

3. Find the square of the following numbers. *(April-2023)*

(i) 17 **(ii) 203** **(iii) 1098**

Sol. (i)
$$\begin{array}{r} 17 \times 17 \\ \hline 119 \\ 17 \\ \hline 289 \end{array}$$

(ii)
$$\begin{array}{r} 203 \times 203 \\ \hline 609 \\ 000 \\ 406 \\ \hline 41209 \end{array}$$

(iii)
$$\begin{array}{r} 1098 \times 1098 \\ \hline 8784 \\ 9882 \\ 10980 \\ \hline 1205604 \end{array}$$

4. Examine if each of the following is a perfect square.

(i) 725 **(ii) 190** **(iii) 841** **(iv) 1089**

Sol. (i) 725

$725 = 5 \times 5 \times 29 = 5^2 \times 29$

Here the second prime factor 29 does not have a pair.
Hence 725 is not a perfect square number.

5	725
5	145
29	29
	1

(ii) 190

$190 = 2 \times 5 \times 19$

Here the factors 2, 5 and 9 does not have pairs.
Hence 190 is not a perfect square number.

2	190
5	95
	19

(iii) 841

$841 = 29 \times 29$

$\therefore \sqrt{841} = 29$

Hence 841 is a perfect square

3	1089
3	363
11	121
	11

(iv) 1089

$1089 = 3 \times 3 \times 11 \times 11$

$1089 = 3^2 \times 11^2$

$\sqrt{1089} = 3 \times 11 = 33$

Hence 1089 is a perfect square

5. Find the square root by prime factorisation method.

(i) 144 **(ii) 256** **(iii) 784** **(iv) 1156** **(v) 4761** **(vi) 9025**

Sol. (i) 144

$144 = 2 \times 2 \times 2 \times 2 \times 3 \times 3$

$\therefore \sqrt{144} = 2 \times 2 \times 3 = 12$

2	144
2	72
2	36
2	18
3	9
	3

(ii) 256

$256 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$

$\therefore \sqrt{256} = 2 \times 2 \times 2 \times 2 = 16$

2	256
2	128
2	64
2	32
2	16
2	8
2	4
	2

(iii) 784 *(HY-2023)*

$784 = 2 \times 2 \times 2 \times 2 \times 7 \times 7$

$\therefore \sqrt{784} = 2 \times 2 \times 7 = 28$

2	784
2	392
2	196
2	98
7	49
	7

(iv) 1156

$1156 = 2 \times 2 \times 17 \times 17$

$\therefore \sqrt{1156} = 2 \times 17 = 34$

$\therefore \sqrt{1156} = 34$

2	1156
2	578
17	289
17	17
	1

(v) 4761

$4761 = 3 \times 3 \times 23 \times 23$

$\therefore \sqrt{4761} = 3 \times 23 = 69$

$\therefore \sqrt{4761} = 69$

3	4761
3	1587
23	529
23	23
	1

(vi) 9025

$9025 = 5 \times 5 \times 19 \times 19$

$\sqrt{925} = 5 \times 19 = 95$

$\therefore \sqrt{925} = 95$

5	9025
5	1805
19	361
19	19
	1

6. Find the square root by long division method.

(i) 1764 (ii) 6889 (iii) 11025 (iv) 17956 (v) 418609

Sol. (i) 1764

		4 2
4		17 64
		16 ↓
82		1 64
		1 64
		0

$\therefore \sqrt{1764} = 42$

(ii) 6889

		8 3
8		68 89
		64 ↓
163		4 89
		4 89
		0

$\therefore \sqrt{6889} = 83$

(iii) 11025

		1 0 5
1		1 10 25
		1 ↓
20		0 10
		00 ↓
205		10 25
		10 25
		0

$\therefore \sqrt{11025} = 105$

(iv) 17956

$$\begin{array}{r|l} & 1\ 3\ 4 \\ \hline 1 & 1\ \ 79\ \ 56 \\ & 1 \\ \hline 23 & 0\ \ 79 \\ & \ \ 69 \\ \hline 264 & \ \ \ 10\ \ 56 \\ & \ \ \ 10\ \ 56 \\ \hline & \ \ \ \ \ 0 \end{array}$$

$\therefore \sqrt{17956} = 134$

(v) 418609

$$\begin{array}{r|l} & 6\ 4\ 7 \\ \hline 6 & 41\ \ 86\ \ 09 \\ & 36 \\ \hline 124 & \ \ 5\ 86 \\ & \ \ 4\ 96 \\ \hline 1287 & \ \ \ 90\ 09 \\ & \ \ \ 90\ 09 \\ \hline & \ \ \ \ \ 0 \end{array}$$

$\therefore \sqrt{418609} = 647$

7. Estimate the value of the following square roots to the nearest whole number.

(i) $\sqrt{440}$ (ii) $\sqrt{800}$ (iii) $\sqrt{1020}$

Sol. (i) We have $(20)^2 = 400$

$(21)^2 = 441$

$\therefore \sqrt{440} \simeq 21$

(ii) We have $(28)^2 = 784$

$(29)^2 = 841$

$\therefore \sqrt{800} \simeq 28$

(iii) We have $(31)^2 = 961$

$(32)^2 = 1024$

$\therefore \sqrt{1020} \simeq 32.$

8. Find the square root of the following decimal numbers and fractions.

(i) 2.89 (ii) 67.24 (iii) 2.0164 (iv) $\frac{144}{225}$ (v) $7\frac{18}{49}$

Sol. (i) 2.89

$$\begin{array}{r|l} & 1\ .\ 7 \\ \hline 1 & 2\ .\ 89 \\ & 1 \\ \hline 27 & 1\ \ 89 \\ & 1\ \ 89 \\ \hline & \ \ 0 \end{array}$$

$\therefore \sqrt{2.89} = 1.7$

(ii) 67.24

$$\begin{array}{r|l} & 8\ .\ 2 \\ \hline 8 & 67.\ 24 \\ & 64 \\ \hline 162 & \ \ 3\ 24 \\ & \ \ 3\ 24 \\ \hline & \ \ \ 0 \end{array}$$

$\therefore \sqrt{67.24} = 8.2$

(iii) 2.0164

$$\begin{array}{r|l} & 1\ .\ 4\ \ 2 \\ \hline 1 & 2.\ \ 01\ \ 64 \\ & 1 \\ \hline 24 & 1\ \ 01 \\ & \ \ 96 \\ \hline 282 & \ \ \ 5\ 64 \\ & \ \ \ 5\ 64 \\ \hline & \ \ \ \ \ 0 \end{array}$$

$\therefore \sqrt{2.0164} = 1.42$

(iv) $\frac{144}{225} = \sqrt{\frac{144}{225}} = \frac{12}{15}$

(v) $7\frac{18}{49} = \sqrt{\frac{361}{49}} = \frac{\sqrt{361}}{\sqrt{49}} = \frac{\sqrt{19^2}}{\sqrt{7^2}} = \frac{19}{7} = 2\frac{5}{7}$ $\left[\because \sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}} (b \neq 0)\right]$

9. Find the least number that must be subtracted to 6666 so that it becomes a perfect square. Also, find the square root of the perfect square thus obtained.

Sol. Let us work out the process of finding the square root of 6666 by long division method.

	8 1
8	66 66
	64 ↓
161	2 66
	1 61
	1 05

The remainder in the last step is 105. If 105 be subtracted from the given number the remainder will be zero and the new number will be a perfect square.

$\therefore$ The required number is 6666 – 105 = 6561.

$\therefore \sqrt{6561} = 81$

10. Find the least number by which 1800 should be multiplied so that it becomes a perfect square. Also, find the square root of the perfect square thus obtained.

Sol. We find $1800 = 2 \times 2 \times 3 \times 3 \times 5 \times 5 \times 2$

$= 2^2 \times 3^2 \times 5^2 \times 2$

Here the last factor 2 has no pair. So if we multiply 1800 by 2, then the number becomes a perfect square.

2	1800
2	900
3	450
3	150
5	50
5	10
2	2
	1

$\therefore 1800 \times 2 =$ 3600 is the required perfect square number.

$\therefore 3600 = 1800 \times 2$

$3600 = 2^2 \times 3^2 \times 5^2 \times 2 \times 2$

$3600 = 2^2 \times 3^2 \times 5^2 \times 2^2$

$= (2 \times 3 \times 5 \times 2)^2$

$\sqrt{3600} = \sqrt{(2 \times 3 \times 5 \times 2)^2}$

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

$\therefore \sqrt{3600} = 60.$

Objective Type Questions

11. The square of 43 ends with the digit _____ .

(A) 9 (B) 6 (C) 4 (D) 3 **[Ans: (A) 9]**

Hint: Unit digit = 3 × 3 = 9

12. _____ is added to 24^2 to get 25^2.

(A) 4^2 (B) 5^2 (C) 6^2 (D) 7^2 **[Ans: (A) 7^2]**

Hint: $25^2 = 25 \times 25 = 625$

$24^2 = 24 \times 24 = 576$

$\therefore 49 = 7^2$

625
– 576
49

13. $\sqrt{48}$ is approximately equal to _____. *(April, QY-2023)*

(A) 5 (B) 6 (C) 7 (D) 8 **[Ans: (C) 7]**

Hint: $\sqrt{49} = 7$

14. $\sqrt{128} - \sqrt{98} + \sqrt{18}$ = _____.

(A) $\sqrt{2}$ (B) $\sqrt{8}$ (C) $\sqrt{48}$ (D) $\sqrt{32}$ **[Ans: (D) $\sqrt{32}$]**

Hint: $\sqrt{128} = 8\sqrt{2}$; $\sqrt{98} = 7\sqrt{2}$; $\sqrt{18} = 3\sqrt{2}$

$\therefore \sqrt{128} - \sqrt{98} + \sqrt{18} = 8\sqrt{2} - 7\sqrt{2} + 3\sqrt{2} = 4\sqrt{2} = \sqrt{32}$

15. **The number of digits in the square root of 123454321 is** _____.

(A) 4 (B) 5 (C) 6 (D) 7 **[Ans: (B) 5]**

Hint: $\sqrt{123454321} = \sqrt{\underline{12}\,\underline{34}\,\underline{54}\,\underline{321}}$ = 5 bars have used.

$\therefore$ Number of digits in $\sqrt{\underline{12}\,\underline{34}\,\underline{54}\,\underline{321}}$ = 5

TRY THESE

Page No. 37

Find the ones digit in the cubes of each of the following numbers.

(1) 12 (2) 27 (3) 38 (4) 53 (5) 71 (6) 84

Sol. **(1) 12**

12 ends with 2, so its cube ends with 8 i.e, ones digit in $(12)^3$ is 8.

(2) 27

27 ends with 7, so its cube end with 3. i.e., ones digit in $(27)^3$ is 3.

(3) 38

38 ends with 8, so its cube ends with 2 i.e, ones digit in $(38)^3$ is 2.

(4) 53

53 ends with 3, so its cube ends with 7. i.e, ones digit in $(53)^3$ is 7.

(5) 71

71 ends with 1, so its cube ends with 1. i.e, ones digit in $(71)^3$ is 1

(6) 84

84 ends with 4, so its cube ends with 4. i.e, ones digit in $(84)^3$ is 4.

Exercise 1.5

1. **Fill in the blanks:** *(QY, HY-2023)*

(i) The ones digits in the cube of 73 is_____. **[Ans: 7]**

(ii) The maximum number of digits in the cube of a two digit number is _____. **[Ans: 6]**

(iii) The smallest number to be added to 3333 to make it a perfect cube is _____. **[Ans: 42]**

Hint: $15^3 = 15 \times 15 \times 15 = 3375$ $\therefore$ Required number = 3375 – 3333 = 42

(iv) The cube root of 540 × 50 is _____. **[Ans: 30]**

(v) The cube root of 0.000004913 is _____. **[Ans: 0.017]**

2. **Say True or False.**

(i) The cube of 24 ends with the digit 4. **[Ans: True]**

(ii) Subtracting 10^3 from 1729 gives 9^3. **[Ans: True]**

(iii) The cube of 0.0012 is 0.000001728. **[Ans: False]**

(iv) 79570 is not a perfect cube. **[Ans: True]**

(v) The cube root of 250047 is 63. **[Ans: True]**

3. Show that 1944 is not a perfect cube.

Sol.

$$1994 = 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3 \times 3$$
$$= 2^3 \times 3^3 \times 3 \times 3$$

In order to make 1944 a perfect cube, It must be multiplied by 3.

$\therefore$ 1944 is not a perfect cube.

2	1944
2	972
2	486
3	243
3	81
3	27
3	9
3	3
	1

4. Find the smallest number by which 10985 should be divided so that the quotient is a perfect cube.

Sol.

$$\text{We have } 10985 = 5 \times 13 \times 13 \times 13$$
$$= 5 \times 13^3$$

Here we have a triplet of 13 and we are left over with 5.

If we divide 10985 by 5, the new number will be a perfect cube.

$\therefore$ The required number is 5.

5	10985
13	2197
13	169
13	13
	1

5. Find the smallest number by which 200 should be multiplied to make it a perfect cube.

Sol.

$$\text{We find } 200 = 2 \times 2 \times 2 \times 5 \times 5 = 2^3 \times 5 \times 5$$

Grouping the prime factors of 200 as triplets, we are left with 5×5

We need one more 5 to make it a perfect cube.

So to make 200 a perfect cube multiply both sides by 5.

$$200 \times 5 = (2 \times 2 \times 2 \times 5 \times 5) \times 5$$
$$1000 = 2 \times 2 \times 2 \times 5 \times 5 \times 5$$

Now 1000 is a perfect cube.

$\therefore$ The required number is 5.

2	200
2	100
2	50
5	25
5	5
	1

6. Find the cube root of $24 \times 36 \times 80 \times 25$. *(April-2023 & 2024)*

Sol.

$$24 = 2 \times 2 \times 2 \times 3$$
$$36 = 2 \times 2 \times 3 \times 3$$
$$80 = 2 \times 2 \times 2 \times 2 \times 5$$
$$25 = 5 \times 5$$
$$24 \times 36 \times 80 \times 25 = \overline{2 \times 2 \times 2} \times \overline{2 \times 2 \times 2} \times \overline{3 \times 3 \times 3} \times \overline{2 \times 2 \times 2} \times \overline{5 \times 5 \times 5}$$
$$\therefore \sqrt[3]{24 \times 36 \times 80 \times 25} = 2 \times 2 \times 3 \times 2 \times 5 = 120$$

2	24
2	12
2	6
3	3
	1

2	36
2	18
3	9
3	3
	1

2	80
2	40
2	20
2	10
5	5
	1

7. Find the cube root of 729 and 6859 by prime factorisation.

3	729
3	243
3	81
3	27
3	9
3	3
	1

Sol. (i) $\sqrt[3]{729} = \sqrt[3]{3\times3\times3\times3\times3\times3}$

$= 3 \times 3$

$\therefore \sqrt[3]{729} = 9$

19	6859
19	361
19	19
	1

(ii) $\sqrt[3]{6859} = \sqrt[3]{19\times19\times19}$

$\therefore \sqrt[3]{6859} = 19$

8. What is the square root of cube root of 46656?

Sol. We have to find out $\sqrt{(\sqrt[3]{46656})}$

First we will find $\sqrt[3]{46656}$

2	46656
2	23328
2	11664
2	5832
2	2916
2	1458
3	729
3	243
3	81
3	27
3	9
3	3
	1

$\sqrt[3]{46656} = (2\times2\times2\times2\times2\times2\times3\times3\times3\times3\times3\times3)^{\frac{1}{3}}$

$\sqrt[3]{46656} = (2^3 \times 2^3 \times 3^3 \times 3^3)^{1/3} = 2 \times 2 \times 3 \times 3$

$\sqrt[3]{46656} = 2^2 \times 3^2 = 36$

Now $\sqrt{(\sqrt[3]{46656})} = \sqrt{36} = \sqrt{2^2 \times 3^2} = 2 \times 3 = 6$

$\therefore$ The required number is 6.

9. If the cube of a squared number is 729, find the square root of that number.

Sol. $3\sqrt{729} = (3\times3\times3\times3\times3\times3)^{\frac{1}{3}} = (3^3 \times 3^3)^{\frac{1}{3}}$

$(729)^{\frac{1}{3}} = 3 \times 3 = 9$

$\therefore$ The cube of 9 is 729.

$\therefore 9 = 3 \times 3$ [ie 3 is squared to get 9]

We have to find out $\sqrt{3}$,

	1 . 7	3	2	0
1	3 . 00	00	00	00
	1			
27	2 00			
	1 89			
343	11 00			
	10 29			
3462	0 71	00		
	69	24		
34640	1	76	00	
			0	
	1	76	00	

$\therefore \sqrt{3} = 1.732$

10. Find the two smallest perfect square numbers which when multiplied together gives a perfect cube number.

Sol. Consider the numbers $2^2 = 4$ and $4^2 = 16$

Their product $4 \times 16 = 64$

Here $64 = 4 \times 4 \times 4 = 4^3$

$\therefore$ The required square numbers are 4 and 16

TRY THESE

Page No. 41

Expand the following numbers using exponents:

(1) 8120 (2) 20305 (3) 3652.01 (4) 9426.521

Sol. (1) $8120 = (8 \times 1000) + (1 \times 100) + (2 \times 10) + 0 \times 1$

$= (8 \times 10^3) + (1 \times 10^2) + (2 \times 10^1)$

(2) $20305 = (2 \times 10000) + (0 \times 1000) + (3 \times 100) + (0 \times 10) + (5 \times 1)$

$= (2 \times 10^4) + (3 \times 10^2) + 5$

(3) $3652.01 = 3000 + 600 + 50 + 2 + \frac{0}{10} + \frac{1}{100}$

$= (3 \times 1000) + (6 \times 100) + (5 \times 10) + (2 \times 1) + (1 \times \frac{1}{100})$

$= (3 \times 10^3) + (6 \times 10^2) + (5 \times 10^1) + 2 + (1 \times 10^{-2})$

(4) $9426.521 = (9 \times 1000) + (4 \times 100) + (2 \times 10) + (6 \times 1) + \left(\frac{5}{10}\right) + \left(\frac{2}{100}\right) + \left(\frac{1}{1000}\right)$

$= (9 \times 10^3) + (4 \times 10^2) + (2 \times 10^1) + 6 + (5 \times 10^{-1}) + (2 \times 10^{-2}) + (1 \times 10^{-3})$

TRY THESE

Page No. 42

Verify the following rules (as we did above). Here, *a, b* are non-zero integers and *m, n* are any integers.

1. Product of same powers to power of product rule: $a^m \times b^m = (ab)^m$
2. Quotient of same powers to power of quotient rule: $\frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$
3. Zero exponent rule: $a^0 = 1$.

Verification:

Let $a = 2$; $b = 3$; $m = 2$

1. $a^m \times b^m = 2^2 \times 3^2 = 4 \times 9 = 36 = (2 \times 3)^2$
2. $\frac{a^m}{b^m} = \frac{2^2}{3^2} = \frac{4}{9} = \left(\frac{2}{3}\right)^2$
3. $a^0 = 2^0 = 1$.