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CHAPTER 1

RATIONAL NUMBERS

EXERCISE 1.1

1. Using appropriate properties find:

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

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

Sol :

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

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

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

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

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

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

$=-\frac{1}{2}+\frac{5}{2}=-\frac{1+5}{2}$

$=\frac{4}{2}=2$

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

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

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

$=\frac{2}{5}\times\left(-\frac{6+1}{14}\right)-\frac{3}{12}$

$=\frac{2}{5}\times-\frac{5}{14}-\frac{1}{4}$

$=-\frac{1}{7}-\frac{1}{4}=-\frac{4-7}{28}=-\frac{11}{28}$

PRACTICE :

1. Using appropriate properties find:

(i) $-\frac{2}{9}\times\frac{9}{5}+\frac{5}{4}-\frac{6}{5}\times\frac{1}{12}$

(ii) $\frac{4}{5}\times\left(-\frac{3}{7}\right)-\frac{1}{6}\times\frac{3}{2}+\frac{1}{14}\times\frac{2}{5}$

Ans :

(i) $\frac{3}{4}$ (ii) $\frac{-78}{140}$

2. Write the additive inverse of each of the following :

(i) $\frac{2}{8}$ (ii) $\frac{-5}{9}$ (iii) $\frac{-6}{-5}$

(iv) $\frac{2}{-9}$ (v) $\frac{19}{-6}$

Sol :

(i) The additive inverse of $\frac{2}{8}$ $=\frac{-2}{8}$

(ii) The additive inverse of $\frac{-5}{9}$ $=\frac{5}{9}$

(iii) The additive inverse of $\frac{-6}{-5}$ $=\frac{-6}{5}$

(iv) The additive inverse of $\frac{2}{-9}$ $=\frac{2}{9}$

(v) The additive inverse of $\frac{19}{-6}$ $=\frac{19}{6}$

PRACTICE :

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

(i) $\frac{3}{8}$ (ii) $\frac{-4}{9}$ (iii) $\frac{-7}{-5}$

(iv) $\frac{4}{-9}$ (v) $\frac{-21}{8}$

Ans :

(i) $\frac{-3}{8}$ (ii) $\frac{4}{9}$ (iii) $\frac{-7}{5}$

(iv) $\frac{4}{9}$ (v) $\frac{21}{8}$

2. Write the additive inverse of each of the following:

(i) $\frac{5}{8}$ (ii) $\frac{-7}{9}$ (iii) $\frac{-10}{-3}$

(iv) $\frac{2}{-7}$ (v) $\frac{11}{-6}$

Ans :

(i) $\frac{-5}{8}$ (ii) $\frac{7}{9}$ (iii) $\frac{-10}{3}$

(iv) $\frac{2}{7}$ (v) $\frac{11}{6}$

3. Verify that $-(-x)=x$ for (i) $x=\frac{11}{15}$ (ii) $x=-\frac{13}{17}$

Sol :

(i) $x=\frac{11}{15}\Rightarrow -x=\frac{-11}{15}$

Now, $-(-x) = -\left(\frac{-11}{15}\right) = \frac{11}{15} = x$ verified

(ii) $x = \frac{-13}{17} \Rightarrow -x = \frac{13}{17}$

Now, $-(-x) = -\left(\frac{13}{17}\right) = \frac{-13}{17} = x$ verified

PRACTICE :

1. Verify that $-(-x) = x$ for (i) $x = \frac{13}{15}$ (ii) $x = -\frac{15}{17}$

2. Verify that $-(-x) = x$ for (i) $x = \frac{9}{15}$ (ii) $x = -\frac{11}{17}$

4. Find the multiplicative inverse of the following :

(i) -13 (ii) $\frac{-13}{19}$

(iii) $\frac{1}{5}$ (iv) $\frac{-5}{8} \times \frac{-3}{7}$

(v) $-1 \times \frac{-2}{5}$ (vi) -1

Sol :

(i) The multiplicative inverse of $-13 = \frac{-1}{13}$

(ii) The multiplicative inverse of $\frac{-13}{19} = \frac{-19}{13}$

(iii) The multiplicative inverse of $\frac{1}{5} = \frac{5}{1} = 5$

(iv) The multiplicative inverse of $\frac{-5}{8} \times \frac{-3}{7} = \frac{15}{56}$, $= \frac{56}{15}$

(v) The multiplicative inverse of $-1 \times \frac{-2}{5} = \frac{2}{5} = \frac{5}{2}$

(vi) The multiplicative inverse of -1, $= \frac{1}{-1} = -1$

PRACTICE :

1. Find the multiplicative inverse of the following :

(i) -12 (ii) $\frac{-14}{19}$ (iii) $\frac{2}{5}$

(iv) $\frac{-10}{8} \times \frac{-3}{14}$ (v) $-1 \times \frac{-4}{5}$ (vi) -2

Ans :

(i) $\frac{-1}{12}$ (ii) $\frac{-19}{14}$ (iii) $\frac{5}{2}$

(iv) $\frac{112}{30}$ (v) $\frac{5}{4}$ (vi) $\frac{-1}{2}$

2. Find the multiplicative inverse of the following :

(i) -26 (ii) $\frac{-10}{19}$ (iii) $\frac{3}{5}$

(iv) $\frac{-5}{8} \times \frac{-2}{7}$ (v) $-1 \times \frac{-3}{5}$ (vi) -4

Ans :

(i) $\frac{-1}{26}$ (ii) $\frac{-19}{10}$ (iii) $\frac{5}{3}$

(iv) $\frac{56}{10}$ (v) $\frac{5}{3}$ (vi) $\frac{-1}{4}$

5. Name the property under multiplication used in each of the following:

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

(ii) $-\frac{13}{17} \times \frac{-2}{7} = \frac{-2}{7} \times \frac{-13}{17}$

(iii) $\frac{-19}{29} \times \frac{29}{-19} = 1$

Sol :

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

Here, the property of multiplicative identity 1 is shown.

(ii) $\frac{-13}{17} \times \frac{-2}{7} = \frac{-2}{7} = \frac{-2}{7} \times \frac{-13}{17}$

Here, the property of commutativity is shown.

(iii) $\frac{-19}{29} \times \frac{29}{-19} = 1$

Here, the property of multiplicative inverse is shown.

PRACTICE :

1. Name the property under multiplication used in each of the following:

(i) $\frac{-12}{5} \times 1 = 1 \times \frac{-12}{5} = \frac{-12}{5}$

(ii) $-\frac{13}{17} \times \frac{-4}{7} = \frac{-4}{7} \times \frac{-13}{17}$

(iii) $\frac{-10}{29} \times \frac{29}{-10} = 1$

Ans :

(i) Multiplicative Identity
(ii) Commutative
(iii) Multiplication inverse

2. Name the property under multiplication used in each of the following:

(i) $\frac{-16}{5} \times 1 = 1 \times \frac{-16}{5} = -\frac{16}{5}$

(ii) $-\frac{26}{17} \times \frac{-2}{7} = \frac{-2}{7} \times \frac{-26}{17}$

(iii) $\frac{-5}{29} \times \frac{29}{-5} = 1$

Ans :

(i) Multiplicative Identity
(ii) Commutative
(iii) Multiplication inverse

6. Multiply $\frac{6}{13}$ by the reciprocal of $\frac{-7}{16}$.

Sol :

The reciprocal of $\frac{-7}{16}$ is $\frac{16}{-7}$.

Thus, the reciprocal of $\frac{-7}{16} \times \frac{6}{13}$,

$= \frac{16}{-7} \times \frac{6}{13} = -\frac{96}{91}$

PRACTICE :

1. Multiply $\frac{7}{13}$ by the reciprocal of $\frac{-7}{16}$
   Ans : $\frac{-16}{13}$
2. Multiply $\frac{12}{13}$ by the reciprocal of $\frac{-9}{16}$
   Ans : $\frac{-64}{39}$

7. Tell what property allows you to complete $\frac{1}{3} \times \left(6 \times \frac{4}{3}\right)$ as $\left(\frac{1}{3} \times 6\right) \times \frac{4}{3}$.

Sol :

We have $\frac{1}{3} \times \left(6 \times \frac{4}{3}\right) = \left(\frac{1}{3} \times 6\right) \times \frac{4}{3}$

This shows associative property of rational numbers.

PRACTICE :

1. Tell what property allows you to complete $\frac{1}{3} \times \left(12 \times \frac{4}{6}\right)$ as $\left(\frac{1}{3} \times 12\right) \times \frac{4}{6}$.
   Ans : Associative property
2. Tell what property allows you to complete $\frac{1}{2} \times \left(6 \times \frac{4}{3}\right)$ as $\left(\frac{1}{2} \times 6\right) \times \frac{4}{3}$.
   Ans : Associative property

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

Sol :

Here, $-1\frac{1}{8} \times \frac{8}{9} = \frac{-9}{8} \times \frac{8}{9}$

$= -1 \neq 1$

Thus, $\frac{8}{9}$ is not the multiplicative inverse of $-1\frac{1}{8}$, because their product is not 1:

PRACTICE :

1. Is $\frac{8}{11}$ the multiplicative inverse of $-1\frac{2}{8}$? Why or why not ?
   Ans : No
2. Is $\frac{8}{-17}$ the multiplicative inverse of $-2\frac{1}{8}$? Why or why not ?
   Ans : Yes

9. Is 0.3 the multiplicative inverse of $3\frac{1}{3}$? Why or why not?

Sol :

Here $3\frac{1}{3} \times 0.3 = \frac{10}{3} \times \frac{3}{10} = 1$

Thus, 0.3 is the multiplicative inverse of $3\frac{1}{3}$ because their product is 1.

PRACTICE :

1. Is 0.15 the multiplicative inverse of $6\frac{2}{3}$? Why or why not?
   Ans : Multiplicative inverse
2. Is 0.7 the multiplicative inverse of $1\frac{1}{3}$? Why or why not?
   Ans : Multiplicative inverse

10. Write:
(i) The rational number that does not have a reciprocal.
(ii) The rational numbers that are equal to their reciprocals.
(iii) The rational number that is equal to its negative.

Sol :

(i) Zero
(ii) 1 and -1
(iii) Zero

11. Fill in the blanks:
(i) Zero has ..... reciprocal.
(ii) The numbers ..... and ..... are their own reciprocals.
(iii) The reciprocal of -5 is .....
(iv) Reciprocal of $\frac{1}{x}$, where $x \neq 0$ is .....
(v) The product of two rational numbers is always a .....
(vi) The reciprocal of a positive rational number is .....

Sol :

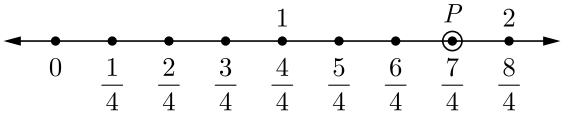
(i) no (ii) 1, -1
(iii) $\frac{-1}{5}$ (iv) x
(v) rational number (vi) positive

EXERCISE 1.2

1. Represent these numbers on the number line :
(i) $\frac{7}{4}$ (ii) $\frac{-5}{6}$

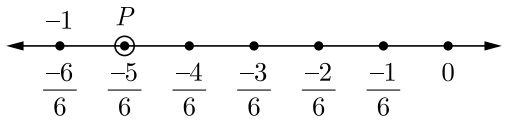
Sol :

(i) For representing $\frac{7}{4}$ on the number line, we will make 7 markings of distance $\frac{1}{4}$ each on the right of zero from which the seventh marking will show $\frac{7}{4}$



The point P on the number line represents $\frac{7}{4}$.

(ii) For representing $\frac{-5}{6}$ on the number line, we will make 5 markings of distance $\frac{1}{6}$ each on the left of zero from which the fifth marking will show $\frac{-5}{6}$



The point P on the number line represents $\frac{-5}{6}$

PRACTICE :

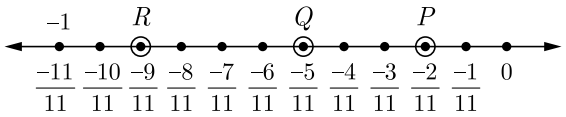
1. Represent these numbers on the number line :
(i) $\frac{5}{4}$ (ii) $\frac{-3}{6}$

2. Represent these numbers on the number line :
(i) $\frac{3}{4}$ (ii) $\frac{-1}{6}$

2. Represent $\frac{-2}{11}, \frac{-5}{11}, \frac{-9}{11}$ on the number line.

Sol :

For representing the given rational numbers on the number line, we make markings of equal distance $\frac{1}{11}$ on the left of zero as shown in the figure.



The point P on the number line represents $\frac{-2}{11}$

The point Q on the number line represents $\frac{-5}{11}$

The point R on the number line represents $\frac{-9}{11}$

PRACTICE :

1. Represent $\frac{-10}{11}, \frac{-7}{11}, \frac{-3}{11}$ on the number line.

2. Represent $\frac{-4}{11}, \frac{-1}{11}, \frac{-0}{11}$ on the number line.

3. Write five rational numbers which are smaller than 2.

Sol :

Five rational numbers smaller than 2 are : 1, $\frac{1}{2}$, 0, -1, and $-\frac{1}{2}$.

PRACTICE :

1. Write six rational numbers which are smaller than 3.

Ans : 2, 1, $\frac{1}{2}$, 0, -1, $-\frac{3}{2}$ (and many more)

2. Write seven rational numbers which are smaller than 4.

Ans : 3, $\frac{5}{2}$, 2, 1, $\frac{1}{2}$, 0, -1, (and many more)

4. Find ten rational numbers between $\frac{-2}{5}$ and $\frac{1}{2}$.

Sol :

By converting the given rational numbers to rational numbers with the same denominators :

$$\frac{-2}{5} = \frac{-2 \times 4}{5 \times 4} = \frac{-8}{20}$$

and $$\frac{1}{2} = \frac{1 \times 10}{2 \times 10} = \frac{10}{20}$$

We know that,

$$-8 < -7 < -6.... < 9 < 10$$

$$\frac{-8}{20} < \frac{-7}{20} < \frac{-6}{20}.... < \frac{9}{20} < \frac{10}{20}$$

$$\frac{-2}{5} < \frac{-7}{20} < \frac{-6}{20}... < \frac{9}{20} < \frac{1}{2}$$

Thus, ten rational numbers between $\frac{-2}{5}$ and $\frac{1}{2}$,

$$\frac{-7}{20}, \frac{-6}{20}, \frac{-5}{20}, \frac{-4}{20}, \frac{-3}{20}, \frac{-1}{20}, 0, \frac{1}{20}, \frac{2}{20}, \frac{3}{20}$$

Please note that there are infinite rational number between any two rational number. Here we have choose only 10 number.

PRACTICE :

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

Ans : $\frac{-12}{8}, \frac{-11}{8}, \frac{-10}{8}, \frac{-9}{8}, \frac{-8}{8}, \frac{-7}{8}$
$\frac{-6}{8}, \frac{-5}{8}, \frac{-4}{8}, \frac{-3}{8},$

2. Find twelve rational numbers between $\frac{-3}{5}$ and $\frac{1}{3}$.

Ans : $\frac{-9}{15}, \frac{-8}{15}, \frac{-7}{15}, \frac{-6}{15}, \frac{-5}{15}, \frac{-4}{15}, \frac{-3}{15}, \frac{-2}{15}, \frac{-1}{15},$
$0, \frac{1}{15}, \frac{2}{15}$

5. Find five rational numbers between:
(i) $\frac{2}{3}$ and $\frac{4}{5}$ (ii) $\frac{-3}{2}$ and $\frac{5}{3}$
(iii) $\frac{1}{4}$ and $\frac{1}{2}$

Sol :

(i) By converting the given rational numbers to rational numbers with the same denominators :

$$\frac{2}{3} = \frac{2 \times 20}{3 \times 20} = \frac{40}{60}$$

and $$\frac{4}{5} = \frac{4 \times 12}{5 \times 12} = \frac{48}{60}$$

we know that

$$40 < 41 < 42 < 43 < 44 < 45 < 46 < 47 < 48$$

$$\frac{40}{60} < \frac{41}{60} < \frac{42}{60} < \frac{43}{60} < \frac{44}{60} < \frac{45}{60} < \frac{46}{60} < \frac{47}{60} < \frac{48}{60}$$

$$\frac{2}{3} < \frac{41}{60} < \frac{42}{60} < \frac{43}{60} < \frac{44}{60} < \frac{45}{60} < \frac{46}{60} < \frac{47}{60} < \frac{4}{5}$$

Thus, five rational numbers between $\frac{2}{3}$ and $\frac{4}{5}$,

$$\frac{41}{60}, \frac{42}{60}, \frac{43}{60}, \frac{44}{60}, \frac{45}{60}$$

(ii) By converting the given rational numbers to rational numbers with same denominators :

$$\frac{-3}{2} = \frac{-3 \times 3}{2 \times 3} = \frac{-9}{6}$$

and $$\frac{5}{3} = \frac{5 \times 2}{3 \times 2} = \frac{10}{6}$$

We know that

$$-9 < -8 < -7 ..... < 8 < 9 < 10$$

$$\frac{-9}{6} < \frac{-8}{6} < \frac{-7}{6} ..... < \frac{8}{6} < \frac{9}{6} < \frac{10}{6}$$

$$\frac{-3}{2} < \frac{-8}{6} < \frac{-7}{6} ..... < \frac{8}{6} < \frac{9}{6} < \frac{5}{3}$$

Thus, five rational numbers between $\frac{-3}{2}$ and $\frac{5}{3}$

$$\frac{-8}{6}, \frac{-7}{6}, -1, 0, \frac{1}{6}$$

(iii) By converting the given rational numbers to rational numbers with same denominators :

$$\frac{1}{4} = \frac{1 \times 8}{4 \times 8} = \frac{8}{32}$$

and $$\frac{1}{2} = \frac{1 \times 16}{2 \times 16} = \frac{16}{32}$$

We know that

$$8 < 9 < 10 < 11 < 12 < 13 < 14 < 15 < 16$$

$$\frac{8}{32} < \frac{9}{32} < \frac{10}{32} < \frac{11}{32} < \frac{12}{32} < \frac{13}{32} < \frac{14}{32} < \frac{15}{32} < \frac{16}{32}$$

$$\frac{1}{4} < \frac{9}{32} < \frac{10}{32} < \frac{11}{32} < \frac{12}{32} < \frac{13}{32} < \frac{14}{32} < \frac{15}{32} < \frac{1}{2}$$

Thus, five rational numbers between $\frac{1}{4}$ and $\frac{1}{2}$

$$\frac{9}{32}, \frac{10}{32}, \frac{11}{32}, \frac{12}{32}, \frac{13}{32}$$

PRACTICE :

1. Find five rational numbers between:

(i) $\frac{2}{3}$ and $\frac{4}{5}$ (ii) $\frac{-3}{2}$ and $\frac{5}{3}$

(iii) $\frac{1}{4}$ and $\frac{1}{2}$

Ans : $\frac{-12}{8}, \frac{-11}{8}, \frac{-10}{8}, \frac{-9}{8}, \frac{-8}{8}, \frac{-7}{8}$

$\frac{-6}{8}, \frac{-5}{8}, \frac{-4}{8}, \frac{-3}{8},$

6. Write five rational numbers greater than -2.

Sol :

Five rational numbers greater than -2 are, $\frac{-3}{2}$ $-1, \frac{-1}{2}$, 0 and $\frac{1}{2}$

PRACTICE :

1. Write six rational numbers greater than -4.

Ans : $-3, -2, \frac{-3}{2}$ $-1, 1,$ and $\frac{5}{2}$ (and many more)

2. Write six rational numbers greater than -4.

Ans : $-3, -2, \frac{-3}{2}$ $-1, 1,$ and $\frac{5}{2}$ (and many more)

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

Sol :

By converting the given rational numbers to rational numbers with same denominators :

$$\frac{3}{5} = \frac{3 \times 20}{5 \times 20} = \frac{60}{100}$$

and $$\frac{3}{4} = \frac{3 \times 25}{4 \times 25} = \frac{75}{100}$$

We know that

$$60 < 61 < 62 ..... < 73 < 74 < 75$$

$$\frac{60}{100} < \frac{61}{100} < \frac{62}{100} .... < \frac{73}{100} < \frac{74}{100} < \frac{75}{100}$$

$$\frac{3}{5} < \frac{61}{100} < \frac{62}{100} .... < \frac{73}{100} < \frac{74}{100} < \frac{3}{4}$$

Thus, ten rational numbers between $\frac{3}{5}$ and $\frac{3}{4}$

$$= \frac{61}{100}, \frac{62}{100}, \frac{63}{100}, \frac{64}{100}, \frac{65}{100}, \frac{66}{100}, \frac{67}{100}, \frac{68}{100}, \frac{69}{100}, \frac{70}{100}$$