

3.1 Addition and Subtraction

3.1.1 Addition and Subtraction of two fractions with different denominators

In addition and subtraction of fractions with different denominators, we have to make denominators of fractions equal. For this we need to find just the LCM of denominators.

For example we add $\frac{1}{2}$ and $\frac{1}{3}$

The LCM of 2 and 3 is 6.

Change the denominator 2 of $\frac{1}{2}$ to 6 by multiplying denominator and numerator by 3.

$$\frac{1 \times 3}{2 \times 3} = \frac{3}{6}$$

Change the denominator 3 of $\frac{1}{3}$ to 6 by multiplying denominator and numerator by 2.

$$\frac{1 \times 2}{3 \times 2} = \frac{2}{6}$$

$$\begin{aligned}\text{So, } \frac{1}{2} + \frac{1}{3} &= \frac{3}{6} + \frac{2}{6} \\ &= \frac{3+2}{6} = \frac{5}{6}\end{aligned}$$

Similarly subtraction is done in the same way

$$\begin{aligned}\frac{1}{2} - \frac{1}{3} &= \frac{3}{6} - \frac{2}{6} \\ &= \frac{3-2}{6} \\ &= \frac{1}{6}\end{aligned}$$

Let us take following examples:

Solve: $\frac{3}{5} + \frac{2}{9}$

The LCM of 5 and 9 is 45.

$$\frac{3}{5} = \frac{3 \times 9}{5 \times 9} = \frac{27}{45} \quad \left| \quad \frac{2}{9} = \frac{2 \times 5}{9 \times 5} = \frac{10}{45}$$

$$\begin{aligned} \text{So, } \frac{3}{5} + \frac{2}{9} &= \frac{27}{45} + \frac{10}{45} \\ &= \frac{27 + 10}{45} \\ &= \frac{37}{45} \end{aligned}$$

Solve: $\frac{6}{11} - \frac{3}{22}$

The LCM of 11 and 22 is 22.

$$\begin{aligned} \text{So, } \frac{6}{11} - \frac{3}{22} \\ &= \frac{6 \times 2}{11 \times 2} - \frac{3 \times 1}{22 \times 1} \\ &= \frac{12}{22} - \frac{3}{22} \\ &= \frac{12 - 3}{22} = \frac{9}{22} \end{aligned}$$

Exercise 3.1

Solve:

- | | | | | | | | |
|-----|--------------------------------|-----|---------------------------------|-----|-------------------------------|-----|-------------------------------|
| 1. | $\frac{1}{6} + \frac{2}{9}$ | 2. | $\frac{2}{9} + \frac{4}{15}$ | 3. | $\frac{5}{9} + \frac{2}{11}$ | 4. | $\frac{7}{24} + \frac{5}{36}$ |
| 5. | $\frac{2}{3} + \frac{1}{5}$ | 6. | $\frac{5}{13} + \frac{1}{26}$ | 7. | $\frac{7}{8} + \frac{5}{32}$ | 8. | $\frac{1}{14} + \frac{2}{21}$ |
| 9. | $\frac{3}{20} + \frac{4}{30}$ | 10. | $\frac{1}{2} - \frac{1}{3}$ | 11. | $\frac{5}{6} - \frac{2}{9}$ | 12. | $\frac{5}{13} - \frac{3}{26}$ |
| 13. | $\frac{3}{4} - \frac{1}{3}$ | 14. | $\frac{15}{17} - \frac{25}{34}$ | 15. | $\frac{5}{13} - \frac{5}{26}$ | 16. | $\frac{3}{7} - \frac{1}{8}$ |
| 17. | $\frac{7}{10} - \frac{13}{20}$ | 18. | $\frac{7}{20} - \frac{7}{30}$ | | | | |

- **Addition and Subtraction of more than two fractions with different denominators**

The addition and subtraction of more than two fractions is similar to the process of addition and subtraction of two fractions.

Example 1

Solve $\frac{1}{2} + \frac{1}{3} + \frac{1}{4}$

Solution

The LCM of 2, 3 and 4 is 12 the denominator of each fraction must be 12.

$$\begin{aligned} \text{So, } \frac{1}{2} + \frac{1}{3} + \frac{1}{4} &= \frac{1 \times 6}{2 \times 6} + \frac{1 \times 4}{3 \times 4} + \frac{1 \times 3}{4 \times 3} \\ &= \frac{6}{12} + \frac{4}{12} + \frac{3}{12} \\ &= \frac{6 + 4 + 3}{12} \\ &= \frac{13}{12} = 1\frac{1}{12} \end{aligned}$$

Example 2

Solve $\frac{2}{3} + \frac{3}{4} + \frac{4}{5}$

Solution

The LCM of 3, 4 and 5 is 60.

$$\begin{aligned} \text{So, } \frac{2}{3} + \frac{3}{4} + \frac{4}{5} &= \frac{2 \times 20}{3 \times 20} + \frac{3 \times 15}{4 \times 15} + \frac{4 \times 12}{5 \times 12} \\ &= \frac{40}{60} + \frac{45}{60} + \frac{48}{60} \\ &= \frac{40 + 45 + 48}{60} \\ &= \frac{133}{60} \\ &= 2\frac{13}{60} \end{aligned}$$

Example 3

Solve $\frac{1}{2} - \frac{1}{5} - \frac{1}{4}$

Solution

The LCM of 2, 4 and 5 is 20.

$$\begin{aligned} \text{So, } \frac{1}{2} - \frac{1}{5} - \frac{1}{4} &= \frac{1 \times 10}{2 \times 10} - \frac{1 \times 4}{5 \times 4} - \frac{1 \times 5}{4 \times 5} \\ &= \frac{10}{20} - \frac{4}{20} - \frac{5}{20} \\ &= \frac{10 - 4 - 5}{20} \\ &= \frac{1}{20} \end{aligned}$$

Exercise 3.2

Solve:

1. $\frac{1}{2} + \frac{1}{4} + \frac{1}{6}$

2. $\frac{1}{2} - \frac{1}{4} - \frac{1}{6}$

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

4. $\frac{2}{3} - \frac{1}{4} - \frac{1}{6}$

5. $\frac{1}{7} + \frac{1}{3} + \frac{1}{6}$

6. $\frac{5}{8} - \frac{1}{4} - \frac{1}{6}$

7. $\frac{2}{3} + \frac{4}{5} + \frac{1}{9}$

8. $\frac{9}{10} - \frac{1}{2} - \frac{1}{5}$

9. $\frac{3}{10} + \frac{1}{4} + \frac{5}{6}$

10. $\frac{13}{14} - \frac{1}{3} - \frac{1}{5}$

11. $\frac{4}{5} + \frac{5}{6} + \frac{1}{3}$

12. $\frac{6}{7} - \frac{1}{3} - \frac{1}{2}$

3.1.2 Verification of Commutative property of Addition of fractions with same denominators

Example 1

Verify that: $\frac{1}{3} + \frac{2}{3} = \frac{2}{3} + \frac{1}{3}$

Solution

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

L.H.S = $\frac{1}{3} + \frac{2}{3}$

$$= \frac{1+2}{3} = \frac{\cancel{3}}{\cancel{3}}$$

$$= 1 \quad \text{.....(i)}$$

R.H.S = $\frac{2}{3} + \frac{1}{3}$

$$= \frac{2+1}{3} = \frac{\cancel{3}}{\cancel{3}}$$

$$= 1 \quad \text{.....(ii)}$$

From (i) and (ii)

L.H.S = R.H.S

So, $\frac{1}{3} + \frac{2}{3} = \frac{2}{3} + \frac{1}{3}$

Example 2

Verify that: $\frac{2}{3} + \frac{4}{3} = \frac{4}{3} + \frac{2}{3}$

Solution

$$\frac{2}{3} + \frac{4}{3} = \frac{4}{3} + \frac{2}{3}$$

L.H.S = $\frac{2}{3} + \frac{4}{3}$

$$= \frac{2+4}{3} = \frac{\cancel{6}^2}{\cancel{3}_1}$$

$$= 2 \quad \text{.....(i)}$$

R.H.S = $\frac{4}{3} + \frac{2}{3}$

$$= \frac{4+2}{3} = \frac{\cancel{6}^2}{\cancel{3}_1}$$

$$= 2 \quad \text{.....(ii)}$$

From (i) and (ii)

L.H.S = R.H.S

So, $\frac{2}{3} + \frac{4}{3} = \frac{4}{3} + \frac{2}{3}$

3.1.3 Verification of the Associative Property of Addition of Fractions with same Denominators

Example Verify that: $\left(\frac{1}{8} + \frac{2}{8}\right) + \frac{4}{8} = \frac{1}{8} + \left(\frac{2}{8} + \frac{4}{8}\right)$

Solution $\left(\frac{1}{8} + \frac{2}{8}\right) + \frac{4}{8} = \frac{1}{8} + \left(\frac{2}{8} + \frac{4}{8}\right)$

$$\begin{aligned} \text{L.H.S} &= \left(\frac{1}{8} + \frac{2}{8}\right) + \frac{4}{8} \\ &= \left(\frac{1+2}{8}\right) + \frac{4}{8} \\ &= \frac{3}{8} + \frac{4}{8} \\ &= \frac{3+4}{8} \\ &= \frac{7}{8} \quad \text{.....(i)} \end{aligned}$$

$$\begin{aligned} \text{R.H.S} &= \frac{1}{8} + \left(\frac{2}{8} + \frac{4}{8}\right) \\ &= \frac{1}{8} + \left(\frac{2+4}{8}\right) \\ &= \frac{1}{8} + \frac{6}{8} \\ &= \frac{1+6}{8} \\ &= \frac{7}{8} \quad \text{.....(ii)} \end{aligned}$$

From (i) and (ii)
L.H.S = R.H.S

Exercise 3.3

Verify that:

1. $\frac{3}{8} + \frac{4}{8} = \frac{4}{8} + \frac{3}{8}$

2. $\frac{1}{7} + \frac{5}{7} = \frac{5}{7} + \frac{1}{7}$

3. $\frac{3}{14} + \frac{6}{14} = \frac{6}{14} + \frac{3}{14}$

4. $\frac{5}{9} + \frac{3}{9} = \frac{3}{9} + \frac{5}{9}$

5. $\frac{3}{17} + \frac{13}{17} = \frac{13}{17} + \frac{3}{17}$

6. $\frac{11}{20} + \frac{5}{20} = \frac{5}{20} + \frac{11}{20}$

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

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

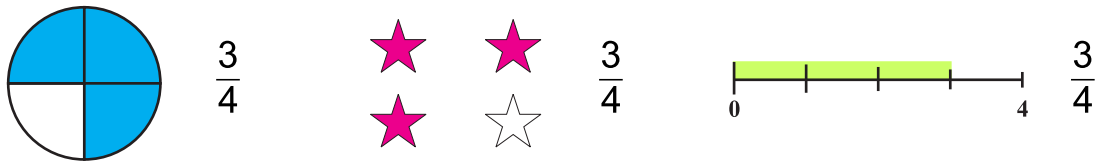
9. $\frac{3}{7} + \left(\frac{1}{7} + \frac{2}{7}\right) = \left(\frac{3}{7} + \frac{1}{7}\right) + \frac{2}{7}$

10. $\frac{3}{19} + \left(\frac{7}{19} + \frac{5}{19}\right) = \left(\frac{3}{19} + \frac{7}{19}\right) + \frac{5}{19}$

3.2 Multiplication

3.2.1 Multiplication of fraction by a number and demonstration with the help of diagrams

A fraction can be represented by many different ways. For example $\frac{3}{4}$ can be represented by following ways.



Multiplication of fraction by a number means number of times addition of that fraction.

Example 1 $\frac{1}{3} \times 4 = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{3}$

Solution $\frac{1}{3} \times 4 = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{3}$

If $\frac{1}{3} = \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array}$ Then

$$\frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array} + \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array} + \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array} + \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array}$$

$$1 + \frac{1}{3} = \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array} + \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array}$$

$$1\frac{1}{3} = \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array} + \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array}$$

Because

$$\begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array} + \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array} + \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array} = \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array}$$

$1\frac{1}{3}$ means one complete figure having three equal parts and one part out of three equal parts of the other figure.


In Multiplication of a fraction by a number, simply multiply the numerator by the number while denominator remains the same.

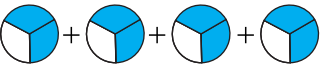
Example 2


Multiply $\frac{2}{3}$ with 4


Solution

$$\frac{2}{3} \times 4 = \frac{2}{3} + \frac{2}{3} + \frac{2}{3} + \frac{2}{3}$$


If $\frac{2}{3} =$  Then

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


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


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


Because




Two whole figures and a 2-third of a figure.


Example 3


Demonstrate multiplication of $\frac{2}{5}$ with 3 using diagram.


Solution

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

If $\frac{2}{5} =$  Then

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


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


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


Exercise 3.4

Multiply the following fractions by the numbers using diagrams.

- | | | | |
|---------------------------|----------------------------|---------------------------|----------------------------|
| 1. $\frac{1}{5} \times 3$ | 2. $\frac{3}{4} \times 6$ | 3. $\frac{2}{8} \times 4$ | 4. $\frac{5}{12} \times 3$ |
| 5. $\frac{2}{7} \times 3$ | 6. $\frac{3}{5} \times 4$ | 7. $\frac{2}{3} \times 2$ | 8. $\frac{2}{3} \times 5$ |
| 9. $\frac{5}{9} \times 8$ | 10. $\frac{1}{3} \times 5$ | | |

3.2.3 Multiplication of two or more fractions (proper, improper and mixed) involving brackets

In multiplication of fractions, we simply multiply the numerator with the numerator and the denominator with the denominator.

Example 1 Solve $\frac{2}{3} \times \frac{1}{3}$

Solution

$$\frac{2}{3} \times \frac{1}{3} = \frac{2 \times 1}{3 \times 3} = \frac{2}{9}$$

Example 2 Solve $\frac{2}{3} \times \frac{1}{5} \times \frac{4}{6}$

Solution

$$\frac{2}{3} \times \frac{1}{5} \times \frac{4}{6} = \frac{2 \times 1 \times 4}{3 \times 5 \times 6} = \frac{8}{90}$$

If brackets are involved in multiplication of fractions then we have to multiply fractions present within the brackets first.

Example 3 Solve $\frac{2}{3} \times \left(\frac{4}{5} \times \frac{1}{3}\right)$

Solution

$$\begin{aligned} \frac{2}{3} \times \left(\frac{4}{5} \times \frac{1}{3}\right) &= \frac{2}{3} \times \left(\frac{4 \times 1}{5 \times 3}\right) \\ &= \frac{2}{3} \times \frac{4}{15} \\ &= \frac{2 \times 4}{3 \times 15} = \frac{8}{45} \end{aligned}$$

Example 4 Solve $2\frac{2}{3} \times \left(1\frac{4}{7} \times 3\frac{1}{2}\right)$

Solution

$$\begin{aligned} 2\frac{2}{3} \times \left(1\frac{4}{7} \times 3\frac{1}{2}\right) &= \frac{8}{3} \times \left(\frac{11}{7} \times \frac{7}{2}\right) \\ &= \frac{8}{3} \times \frac{11}{2} \\ &= \frac{\cancel{8}^4 \times 11}{3 \times \cancel{2}_1} \\ &= \frac{44}{3} = 14\frac{2}{3} \end{aligned}$$

Solve:

Exercise 3.5

1. $\frac{1}{2} \times \left(\frac{2}{3} \times \frac{3}{4} \right)$
2. $\frac{1}{5} \times \left(\frac{3}{4} \times \frac{2}{7} \right)$
3. $\frac{1}{5} \times \left(\frac{5}{8} \times \frac{5}{7} \right)$
4. $\frac{3}{2} \times \left(\frac{8}{3} \times \frac{7}{4} \right)$
5. $\frac{7}{3} \times \left(\frac{1}{7} \times \frac{3}{2} \right)$
6. $\frac{1}{12} \times \left(\frac{4}{3} \times \frac{8}{5} \right)$
7. $\left(1\frac{2}{3} \times 3\frac{2}{3} \right) \times 2\frac{3}{4}$
8. $\left(2\frac{2}{9} \times 3\frac{4}{5} \right) \times 2\frac{3}{4}$
9. $\frac{6}{5} \times \left(1\frac{3}{4} \times \frac{2}{5} \right)$

3.2.3 Verification of Commutative Property of Multiplication of Fractions**Example 1** Show that $\frac{1}{7} \times \frac{4}{5} = \frac{4}{5} \times \frac{1}{7}$ **Solution:** $\frac{1}{7} \times \frac{4}{5} = \frac{4}{5} \times \frac{1}{7}$

$\begin{aligned} \text{L.H.S} &= \frac{1}{7} \times \frac{4}{5} \\ &= \frac{1 \times 4}{7 \times 5} \\ &= \frac{4}{35} \quad \text{.....(i)} \end{aligned}$		$\begin{aligned} \text{R.H.S} &= \frac{4}{5} \times \frac{1}{7} \\ &= \frac{4 \times 1}{5 \times 7} \\ &= \frac{4}{35} \quad \text{.....(ii)} \end{aligned}$
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From (i) and (ii)

L.H.S = R.H.S

Example 2 Verify that $1\frac{2}{3} \times 2\frac{4}{5} = 2\frac{4}{5} \times 1\frac{2}{3}$ **Solution:** $1\frac{2}{3} \times 2\frac{4}{5} = 2\frac{4}{5} \times 1\frac{2}{3}$

$\begin{aligned} \text{L.H.S} &= 1\frac{2}{3} \times 2\frac{4}{5} \\ &= \frac{5}{3} \times \frac{14}{5} \\ &= \frac{\cancel{5}^1 \times 14}{3 \times \cancel{5}_1} = \frac{14}{3} \\ &= 4\frac{2}{3} \quad \text{.....(i)} \end{aligned}$		$\begin{aligned} \text{R.H.S} &= 2\frac{4}{5} \times 1\frac{2}{3} \\ &= \frac{14}{5} \times \frac{5}{3} \\ &= \frac{14 \times \cancel{5}^1}{\cancel{5}_1 \times 3} = \frac{14}{3} \\ &= 4\frac{2}{3} \quad \text{.....(ii)} \end{aligned}$
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From (i) and (ii) it is clear that L.H.S = R.H.S

Exercise 3.6

Verify that:

$$1. \quad \frac{5}{7} \times \frac{6}{11} = \frac{6}{11} \times \frac{5}{7}$$

$$3. \quad \frac{2}{3} \times \frac{2}{7} = \frac{2}{7} \times \frac{2}{3}$$

$$5. \quad 1\frac{1}{11} \times 2\frac{3}{4} = 2\frac{3}{4} \times 1\frac{1}{11}$$

$$7. \quad 2\frac{1}{3} \times 3\frac{4}{5} = 3\frac{4}{5} \times 2\frac{1}{3}$$

$$9. \quad 4\frac{1}{4} \times 1\frac{4}{5} = 1\frac{4}{5} \times 4\frac{1}{4}$$

$$2. \quad \frac{1}{12} \times \frac{5}{8} = \frac{5}{8} \times \frac{1}{12}$$

$$4. \quad 1\frac{2}{5} \times \frac{7}{9} = \frac{7}{9} \times 1\frac{2}{5}$$

$$6. \quad 3\frac{2}{3} \times \frac{1}{9} = \frac{1}{9} \times 3\frac{2}{3}$$

$$8. \quad 4\frac{1}{5} \times 2\frac{4}{5} = 2\frac{4}{5} \times 4\frac{1}{5}$$

$$10. \quad 1\frac{1}{2} \times 1\frac{1}{3} = 1\frac{1}{3} \times 1\frac{1}{2}$$

3.2.4 Verification of Associative Property of Multiplication of fractions

Example 1 Show that: $\frac{2}{3} \times \left(\frac{1}{3} \times \frac{5}{7}\right) = \left(\frac{2}{3} \times \frac{1}{3}\right) \times \frac{5}{7}$

Solution: $\frac{2}{3} \times \left(\frac{1}{3} \times \frac{5}{7}\right) = \left(\frac{2}{3} \times \frac{1}{3}\right) \times \frac{5}{7}$

$$\begin{aligned} \text{L.H.S} &= \frac{2}{3} \times \left(\frac{1}{3} \times \frac{5}{7}\right) \\ &= \frac{2}{3} \times \left(\frac{1 \times 5}{3 \times 7}\right) \\ &= \frac{2}{3} \times \frac{5}{21} \\ &= \frac{2 \times 5}{3 \times 21} \\ &= \frac{10}{63} \quad \text{.....(i)} \end{aligned}$$

$$\begin{aligned} \text{L.H.S} &= \left(\frac{2}{3} \times \frac{1}{3}\right) \times \frac{5}{7} \\ &= \left(\frac{2 \times 1}{3 \times 3}\right) \times \frac{5}{7} \\ &= \frac{2}{9} \times \frac{5}{7} \\ &= \frac{2 \times 5}{9 \times 7} \\ &= \frac{10}{63} \quad \text{.....(ii)} \end{aligned}$$

From (i) and (ii)
L.H.S = R.H.S

Example2: Verify that: $1\frac{2}{3} \times \left(2\frac{1}{3} \times \frac{4}{5}\right) = \left(1\frac{2}{3} \times 2\frac{1}{3}\right) \times \frac{4}{5}$

Solution: $1\frac{2}{3} \times \left(2\frac{1}{3} \times \frac{4}{5}\right) = \left(1\frac{2}{3} \times 2\frac{1}{3}\right) \times \frac{4}{5}$

$$\begin{aligned} \text{L.H.S} &= 1\frac{2}{3} \times \left(2\frac{1}{3} \times \frac{4}{5}\right) \\ &= \frac{5}{3} \times \left(\frac{7}{3} \times \frac{4}{5}\right) \\ &= \frac{5}{3} \times \frac{28}{15} \\ &= \frac{\cancel{5}^1 \times 28}{3 \times \cancel{15}_3} = \frac{28}{9} \\ &= 3\frac{1}{9} \quad \dots\dots\text{(i)} \end{aligned}$$

$$\begin{aligned} \text{R.H.S} &= \left(1\frac{2}{3} \times 2\frac{1}{3}\right) \times \frac{4}{5} \\ &= \left(\frac{5}{3} \times \frac{7}{3}\right) \times \frac{4}{5} \\ &= \frac{\cancel{5}^7 \times 4}{9 \times \cancel{5}_1} \\ &= \frac{28}{9} \\ &= 3\frac{1}{9} \quad \dots\dots\text{(ii)} \end{aligned}$$

From (i) and (ii) it is clear that L.H.S = R.H.S

Thus the product of any three fractions remains the same when multiplied in any order.

Exercise 3.7

Verify that:

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

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

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

4. $1\frac{2}{5} \times \left(2\frac{2}{3} \times \frac{7}{9}\right) = \left(1\frac{2}{5} \times 2\frac{2}{3}\right) \times \frac{7}{9}$

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

6. $\frac{4}{3} \times \left(\frac{3}{7} \times \frac{4}{9}\right) = \left(\frac{4}{3} \times \frac{3}{7}\right) \times \frac{4}{9}$

3.3 Division

3.3.1 Division of a fraction by another fraction (proper, improper and mixed)

In the process of division of a fraction by another fraction, we take the reciprocal of the second fraction and then multiply the fractions.

Example 1 Solve: $\frac{2}{3} \div \frac{1}{2}$

Solution $\frac{2}{3} \div \frac{1}{2}$
 $= \frac{2}{3} \times \frac{2}{1}$ [Reciprocal of $\frac{1}{2}$ is $\frac{2}{1}$]
 $= \frac{2 \times 2}{3}$
 $= \frac{4}{3} = 1\frac{1}{3}$

Example 2 Solve: $\frac{4}{5} \div \frac{7}{5}$

Solution: $\frac{4}{5} \div \frac{7}{5}$
 $= \frac{4}{5} \times \frac{5}{7}$
 $= \frac{4 \times \cancel{5}}{\cancel{5} \times 7}$
 $= \frac{4}{7}$

Example 3 Solve: $4\frac{1}{5} \div \frac{7}{2}$

Solution: $4\frac{1}{5} \div \frac{7}{2} = \frac{21}{5} \times \frac{2}{7}$
 $= \frac{21}{5} \times \frac{2}{7}$
 $= \frac{\cancel{3}^1 \cancel{7}^1 \times 2}{5 \times \cancel{7}_1}$
 $= \frac{3 \times 2}{5}$
 $= \frac{6}{5} = 1\frac{1}{5}$

Exercise 3.8

Solve the following:

1. $\frac{3}{10} \div \frac{3}{5}$

2. $\frac{2}{3} \div \frac{1}{3}$

3. $\frac{7}{9} \div \frac{5}{6}$

4. $\frac{4}{7} \div 2\frac{1}{10}$

5. $\frac{2}{3} \div 1\frac{1}{3}$

6. $\frac{7}{4} \div 1\frac{1}{2}$

7. $2\frac{3}{4} \div 4\frac{1}{5}$

8. $1\frac{1}{2} \div 1\frac{1}{3}$

9. $3\frac{1}{5} \div 2\frac{2}{3}$

3.3.2 Simplification of expressions involving fractions using BODMAS rule

Example Solve $1\frac{1}{3} + \{(5\frac{1}{3} \div 2) - \frac{1}{4}\}$

<p>Solution $1\frac{1}{3} + \{(5\frac{1}{3} \div 2) - \frac{1}{4}\}$</p> $= \frac{4}{3} + \{(\frac{16}{3} \div 2) - \frac{1}{4}\}$ $= \frac{4}{3} + \{(\frac{8}{3} \times \frac{1}{2}) - \frac{1}{4}\}$ $= \frac{4}{3} + \{\frac{8}{3} - \frac{1}{4}\}$ $= \frac{4}{3} + \{\frac{32-3}{12}\}$	$\Rightarrow \frac{4}{3} + \frac{29}{12}$ $= \frac{16+29}{12}$ $= \frac{45}{12} = \frac{15}{4}$ $= 3\frac{3}{4}$
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Exercise 3.9

Solve the following:

- | | |
|---|--|
| <p>1. $2\frac{1}{3} \times (\frac{2}{3} + \frac{3}{5}) \div \frac{2}{5}$</p> <p>3. $1\frac{2}{3} \times (\frac{4}{9} + \frac{2}{3}) \div (2\frac{2}{5} \times \frac{1}{2})$</p> <p>5. $[\{(\frac{9}{10} \div 3) + \frac{7}{10}\} - \frac{1}{5}]$</p> <p>7. $2\frac{2}{3} \times \{1\frac{1}{4} + (3\frac{1}{3} - 2\frac{1}{2})\}$</p> | <p>2. $(\frac{1}{2} + \frac{1}{5}) \div (\frac{3}{3} \times \frac{1}{2})$</p> <p>4. $4\frac{1}{3} + \{(3\frac{3}{5} + 1\frac{3}{4}) \times 4\}$</p> <p>6. $\frac{1}{4} + \{\frac{1}{3} \div \frac{1}{2} \times (\frac{1}{5} - \frac{1}{10})\}$</p> <p>8. $[2\frac{4}{9} - \{\frac{4}{9} - (\frac{5}{9} - \frac{1}{3})\} \times 9]$</p> |
|---|--|

Review Exercise 3

1. Four options are given for each question. Encircle the correct answer

- | | | | |
|---|--------------------------------------|---------------------------------------|---------------------------------------|
| <p>(i) $\frac{1}{3} + \frac{1}{3}$</p> <p>(a) $\frac{1}{3}$</p> | <p>(b) $\frac{2}{3}$</p> | <p>(c) $\frac{3}{3}$</p> | <p>(d) $\frac{4}{3}$</p> |
| <p>(ii) $\frac{7}{9} - \frac{4}{9}$</p> <p>(a) $\frac{11}{9}$</p> | <p>(b) $\frac{28}{9}$</p> | <p>(c) $\frac{3}{9}$</p> | <p>(d) $\frac{1}{9}$</p> |
| <p>(iii) $\frac{2}{3} \times \frac{5}{7}$</p> <p>(a) $\frac{7}{10}$</p> | <p>(b) $\frac{3}{4}$</p> | <p>(c) $\frac{10}{21}$</p> | <p>(d) $\frac{14}{15}$</p> |

(iv) $\frac{5}{9} \div \frac{1}{9}$

(a) 9

(b) 5

(c) $\frac{1}{9}$

(d) $\frac{1}{5}$

2. Solve:

i. $\frac{7}{8} + \frac{5}{8}$

ii. $\frac{1}{3} + 2\frac{1}{3}$

iii. $1\frac{7}{9} + 1\frac{1}{9}$

iv. $\frac{7}{9} - \frac{5}{9}$

v. $1\frac{1}{3} - \frac{2}{3}$

vi. $3\frac{1}{12} - 1\frac{1}{12}$

vii. $\frac{1}{4} + \frac{3}{4} + \frac{5}{4}$

viii. $\frac{5}{7} + \frac{1}{7} + \frac{3}{7}$

ix. $\frac{2}{3} + \frac{1}{3} + 1\frac{1}{3}$

x. $\frac{1}{3} \times 2\frac{1}{3}$

xi. $2\frac{3}{4} \times \frac{1}{4}$

xii. $\frac{2}{7} + (\frac{3}{7} + \frac{4}{7})$

xiii. $\frac{2}{3} \times (\frac{2}{3} \times \frac{1}{3})$

xiv. $3\frac{1}{2} \div \frac{1}{4}$

xv. $4\frac{1}{5} \div 1\frac{1}{5}$

xvi. $\frac{7}{20} - \frac{7}{30}$

Summary

- To add or subtract two or more fractions with different denominators we have to make denominators of fractions equal by converting fractions to equivalent fractions.
- Multiplication of fraction by a number means number of times addition of that fraction.
- To multiply a fraction by a whole number, simply multiply the numerator by the whole number.
- To multiply two or more fractions, multiply their numerators to get numerator and multiply their denominators to get denominator of the required product.
- $\frac{1}{2} + \frac{1}{3} = \frac{1}{3} + \frac{1}{2}$ is called commutative property of addition of fractions.
- $\frac{1}{4} \times \frac{1}{3} = \frac{1}{3} \times \frac{1}{4}$ is called commutative property of multiplication of fractions.
- $(\frac{1}{7} + \frac{2}{7}) + \frac{3}{7} = \frac{1}{7} + (\frac{2}{7} + \frac{3}{7})$ is called associative property of addition of fractions.
- $(\frac{1}{5} \times \frac{2}{5}) \times \frac{4}{5} = \frac{1}{5} \times (\frac{2}{5} \times \frac{4}{5})$ is called associative property of multiplication of fractions.