

**CHAPTER 01****Rational Numbers****Associative property:**

Let us check,

$$\left(\frac{-2}{3}\right) + \left[\frac{3}{5} + \left(\frac{-5}{6}\right)\right] = \left(\frac{-2}{3}\right) + \left(\frac{-7}{30}\right) = \frac{-27}{30} \text{ and}$$

$$\left[\frac{-2}{3} + \frac{3}{5}\right] + \left(\frac{-5}{6}\right) = \frac{-1}{15} + \left(\frac{-5}{6}\right) = \frac{-27}{30}$$

In both cases, we got same answer even though grouping them is not same.

∴ We can say that, while adding any three rational numbers. We can group them in any order.

∴ From the above example, we can conclude that

$a + (b + c) = (a + b) + c$ , which is true for associative property under addition.

**Subtraction:**

**Subtraction is not associative for integers, then what about rational numbers?**

Let us check,

$$\left(\frac{-2}{3}\right) - \left[\frac{3}{5} - \left(\frac{5}{6}\right)\right] = \left(\frac{-2}{3}\right) + \frac{7}{30} = \frac{1}{30} \text{ and}$$

$$\left(\frac{-2}{3} - \frac{3}{5}\right) - \frac{5}{6} = \frac{-19}{15} - \frac{5}{6} = \frac{-63}{30}$$

In both cases, we got different answer. Therefore, we can say that while subtracting any three rational numbers, we cannot group them in any order.

We can conclude that, subtraction is not associative for rational numbers.

For any three rational numbers a, b and c we can say that,

$$\boxed{a - (b - c) \neq (a - b) - c}$$

Associative property exists under multiplication of integers.

Is this application for rational numbers also?

**Multiplication:**

**Example:**

$$\frac{1}{2} \times \left[ \left( \frac{-5}{3} \right) \times \frac{4}{6} \right] = \frac{1}{2} \times \left( \frac{-20}{18} \right) = \frac{-20}{36} \text{ and}$$

$$\left[ \frac{1}{2} \times \frac{-5}{3} \right] \times \frac{4}{6} = \frac{-5}{6} \times \frac{4}{6} = \frac{-20}{36}$$

In both cases, we got same answer even though grouping them differently.

Therefore, we can say that while multiplying any three rational numbers we can group them in any order.

∴ From the above example, we can conclude that

$$\boxed{a \times (b \times c) = (a \times b) \times c}, \text{ for any three rational numbers.}$$

### Division:

Recall that, division is not associative for integers. Then what about rational numbers?

Let us see,

$$\frac{1}{2} \div \left[ \frac{-1}{3} \div \frac{2}{5} \right] = \frac{1}{2} \div \left[ \frac{-1}{3} \times \frac{5}{2} \right] = \frac{1}{2} \div \left[ \frac{-5}{6} \right] = \frac{1}{2} \times \left( \frac{6}{-5} \right) = \frac{6}{-10}$$

(And)

$$\left[ \frac{1}{2} \div \left( \frac{-1}{3} \right) \right] \div \frac{2}{5} = \left[ \frac{1}{2} \times \left( \frac{3}{-1} \right) \right] \div \frac{2}{5} = \left( \frac{3}{-2} \right) \div \frac{2}{5} = \left( \frac{3}{-2} \right) \times \frac{5}{2} = \frac{15}{-4}$$

In both cases, we got different answers. So, while dividing any three rational numbers. We cannot group them in any order.

So we can conclude that,

$$\boxed{a \div (b \div c) \neq (a \div b) \div c}$$

Therefore, associative property does not exist under division of rational numbers.

**Can we say that, distributive property exists under addition of rational numbers?**

To understand this, consider three rational numbers  $\frac{-3}{4}$ ,  $\frac{2}{3}$  and

$$\frac{-5}{6}.$$

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

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

In both situations, we got same answer.

We can say that, distributive property exists under addition of natural numbers.

In general, for any three rational numbers a, b and c we can conclude that,  $a \times (b \times c) = (a \times b) + (a \times c)$ .

Similarly, we can say that  $a \times (b - c) = (a \times b) - (a \times c)$ .

i.e., Distributive property exists under subtraction also.