RATIONAL NUMBER

PROPERTIES OF RATIONAL NUMBER

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(A) CLOSURE PROPERTY :

(i) Addition :

We take an example,

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

which is a rational number.

If a & b are two rational number then a+b is also a rational number. This property is known as closure property for addition of rational numbers.

(ii) Subtraction :

Subtraction is inverse of addition. So to subtract a rational number we add its additive inverse.

For example,

$$-\frac{2}{5}-\left(-\frac{4}{9}\right)=\frac{-2}{5}+\frac{4}{9}$$ {additive inverse of $\frac{-4}{9}$ is $\frac{4}{9}$}

Thus : If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers then :

$$\frac{a}{b}-\frac{c}{d}=\frac{a}{b}+\left(-\frac{c}{d}\right)$$

The difference of any two rational numbers a & b, i.e. a–b, is a rational numbers.

for e.g.

$$\frac{1}{2}-\frac{4}{9}=\frac{1}{2}+\left(-\frac{4}{9}\right)=\frac{9-8}{18}=\frac{1}{18}$$ a rational number.

This property is known as closure property for subtraction of rational numbers.

(iii) Multiplication :

If a and b are two rational numbers then a × b is also a rational number :

If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers, then:

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

for e.g. $\frac{2}{3}\times\frac{5}{7}=\frac{2\times5}{3\times7}=\frac{10}{21}$ which is a rational number.

Hence this is a closure property for multiplication of rational numbers.

(iv) Division:

If a & b are two rational numbers and b≠ 0 then a ÷ b is always a rational number.

for e.g. $\frac{2}{3}\div-\frac{4}{0}=\frac{2}{3}\times\frac{9}{-4}=-\frac{3}{3}$ is a rational number.

Hence this is a closure property for Division of rational numbers.

For any rational number a, a ÷ 0 is not defined.

So rational numbers are not closed under division.

However if we exclude zero then the collection of all other rational numbers is closed under division.

(B) COMMUTATIVE PROPERTY :

(i) Addition :

Addition is commutative for rational numbers.

If a and b are any two rational numbers then a + b = b + a.

This property is known as commutative property for addition of rational numbers.

If a and b are any two rational numbers then a+b is also a rational number.

For example,

$\frac{1}{2}+\frac{3}{4}=\frac{2+3}{4}=\frac{5}{4}$ which is a rational number.

$\frac{-2}{3}+\frac{-1}{5}=\frac{-10+(-3)}{15}=\frac{-13}{15}$ which is a rational number.

(ii) Subtraction is not commutative

It can be explanined as follows:

$a - b^{1} b - a$

e.g. $\frac{2}{3} - \frac{5}{4} \neq \frac{5}{4} - \frac{2}{3}$

both are not equal hence subtraction is not commutative for rational numbers.

(iii) Multiplication is commutative for rational number :

In general :

$a \times b = b \times a$ for any rational numbers.

$$\frac{3}{5} \times \frac{4}{9} = \frac{4}{9} \times \frac{3}{5} = \frac{12}{45}$$

Both are equal hence multiplication is commutative for rational numbers.

(iv) Division is not commutative for rational numbers :

$$\frac{-a}{b} \div \frac{c}{d} \neq \frac{c}{d} \div \left(\frac{-a}{b}\right)$$

The expression on both sides are not equal.

for .e.g. $\frac{-5}{4} \div \frac{3}{7} \neq \frac{3}{7} \div \frac{-5}{4} \quad \Rightarrow \quad \frac{-35}{12} \neq \frac{12}{-35}$

Hence division is not commutative for rational numbers.

(C) ASSOCIATIVE PROPERTY :

(i) Addition is associative:

e.g. a, b, c are three rational numbers then :

$a + (b + c) = (a + b) + c$

This property is known as associative property for addition of rational numbers.

(ii) Subtraction is not associative for rational number :

a – (b + c) ^{1} (a – b) + c

(iii) Multiplication is associative for rational number:

For any three rational numbers a, b, c

$a \times (b \times c) = (a \times b) \times c$

so multiplication is associative for rational numbers.

(iv) Division is not associative :

$$\frac{a}{b} \div \left(\frac{c}{d} \div \frac{e}{f}\right) \neq \left(\frac{a}{b} \div \frac{c}{d}\right) \div \frac{e}{f}$$

Properties of Rational Number

CLOSURE

Operation	Whole Numbers	Integers	Rational Numbers
Addition	Closed under addition	Closed under addition	Closed under addition
Subtraction	Not closed under subtraction	Closed under subtraction	Closed under subtraction
Multiplication	Closed under multiplication	Closed under multiplication	Closed under multiplication
Division	Not closed under division	Not closed under division	Not closed under division

COMMUTATIVITY

Operation	Whole Numbers	Integers	Rational Numbers
Addition	Commutative	Commutative	Commutative
Subtraction	Not Commutative	Not Commutative	Not Commutative
Multiplication	Commutative	Commutative	Commutative
Division	Not Commutative	Not Commutative	Not Commutative

ASSOCIATIVITY :

OPEATION	WHOLE NUMBERS	INTEGERS	RATIONAL NUMBERS
Addition	Associative	Associative	Associative
Subtraction	Not Associative	Not Associative	Not Associative
Multiplication	Associative	Associative	Associative
Division	Not Associative	Not Associative	Not Associative

THE ROLE OF ZERO (0)

Addition of 0 to a rational number

If C is a rational number then:

$C + 0 = 0 + C = C.$

Zero is called the identity for the addition of rational number.

If $\frac{p}{q}$ is a rational number then $0 \times \frac{p}{q} = 0 = \frac{p}{q} \times 0$

It follows that the product of a rational number and zero is always zero.