

Rational Numbers

Rational Numbers are those Real numbers that can be written in $\frac{p}{q}$ form, where p and q are

integers and $q \neq 0$

y: law followed, n: law not followed

Number system	Closure law				Commutative				Associative			
	A	S	M	D	A	S	M	D	A	S	M	D
Natural (N)	y	n	y	n	y	n	y	n	y	n	y	n
Whole (w)	y	n	y	n	y	n	y	n	y	n	y	n
Integer (Z)	y	y	y	n	y	n	y	n	y	n	y	n
Rational (Q)	y	y	y	n	y	n	y	n	y	n	y	n

For any 2 rational numbers a and b :

Closure law: $a + b$ (sum), $a - b$ (difference) and $a \times b$ (product) is rational

$\frac{a}{0}$ is not defined, however excluding zero, collection of other rational numbers is closed under division

commutative law : $a + b = b + a$ and $a \times b = b \times a$

associative law : $a + (b + c) = (a + b) + c$ and $a \times (b \times c) = (a \times b) \times c$

0 is the additive identity for rational numbers

1 is multiplicative identity for rational numbers

If $\frac{a}{b}$ denotes a rational number :

additive inverse of $\frac{a}{b}$ is $-\frac{a}{b}$ and vice versa

$$\frac{a}{b} + (-\frac{a}{b}) = 0 = (-\frac{a}{b}) + \frac{a}{b}$$

reciprocal or multiplicative inverse of $\frac{a}{b}$ is $\frac{b}{a}$

$$\frac{a}{b} \times \frac{b}{a} = 1 = \frac{b}{a} \times \frac{a}{b}$$

All rational numbers except zero have a reciprocal

Distributive property of multiplication over addition and subtraction :

For any three rational numbers a, b and c

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

$$a(b - c) = ab - ac$$

All rational numbers can be represented on the number line

Between any two rational numbers there are infinite rational numbers

If a and b are two rational numbers,

$c = \frac{a + b}{2}$ is also rational, where $a < c < b$; c is the mean of a and b

