

Properties of the number systems

N

- Natural Numbers
 - Closure for addition and multiplication, if a and b are natural numbers then $a + b =$ a natural number and $a \cdot b =$ a natural number
 - Associative property of multiplication and addition – grouping of the numbers doesn't matter. $(a+b) + c = a + (b+c)$
 - Commutative property of multiplication and addition – order of the numbers doesn't matter $a \cdot b = b \cdot a$ and $a+b = b+a$
 - Identity property – additive identity is 0, multiplicative identity is 1
 $a+0=a$ and $a \cdot 1=a$ and they are contained in the set of natural numbers
 - Distributive property – multiplication distributes through addition/subtraction

W

- Whole numbers
 - Closure property – any two whole numbers added or multiplied together will produce another whole number
 - Commutative property for addition and multiplication – order of the numbers doesn't matter $a \cdot b = b \cdot a$ and $a+b = b+a$
 - Associative property – grouping doesn't matter
 - Identity property – additive identity is 0, multiplicative identity is 1, and both are contained in the set of whole numbers

Z

○ Integers

- Closure property – any two integers added, subtracted or multiplied together will produce another integer
- Commutative property – only for addition and multiplication the order of the integers doesn't matter
- Associative property – grouping doesn't matter for multiplication and addition
- Identity property – additive identity is 0, multiplicative identity is 1, and they are contained in the set of integers
- Inverses – additive inverses are contained in the set of integers: if a is in Z , then so is $-a$
- Distributive property – $a(b+c) = ab + ac$

Q

○ Rational numbers

- Commutative property – the order of the rational numbers doesn't matter with addition and multiplication
- Associative – grouping doesn't matter with addition and multiplication
- Closure – addition, subtraction and multiplication of two rational numbers will produce a rational number
- Identity property – additive identity is 0, multiplicative identity is 1, and both are contained in the set of rational numbers
- Inverses – additive and multiplicative inverses are contained in the set of rational numbers: if a is in Q , then so is $-a$ and so is $1/a$ (for all nonzero a)
- Distributive property - $a(b + c) = ab + ac$

R

- Real Numbers
 - Closure – closed under addition, subtraction and multiplication
 - Commutative property – the order of the real numbers doesn't matter in addition and multiplication
 - Associative property – the grouping of the real numbers in addition and multiplication doesn't matter
 - Distributive property – $a(b+c) = ab + ac$
 - Identity property – additive identity is 0, multiplicative identity is 1, and both are contained in the set of real numbers
 - Inverses – additive and multiplicative inverses are contained in the set of real numbers: if a is in R , then so is $-a$ and $1/a$ (for all nonzero a)

I

- Irrational numbers
 - Closure – irrational numbers are **not** closed under any arithmetic operation
 - Associative property – the grouping of irrational numbers in addition and multiplication doesn't matter
 - Identity property – there is no additive or multiplicative identity in the set of irrational numbers
 - Inverses – additive and multiplicative inverses are contained in the set of irrational numbers