# MATHEMATICS VERTICAL ARTICULATION TOOL (MVAT)

# 2016 *Mathematics Standards of Learning* - Patterns, Functions and Algebra

# Kindergarten-Algebra II Progression

KEY TO COLORED BOXES: **ES** = K-5 Prior Knowledge Concepts; **MS** = 6-8 Prior Knowledge Concepts; **HS** = 9-12 Prior Knowledge Concepts; N/A = No Concepts Listed

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| **Grade K** | **Grade 1** | **Grade 2** | **Grade 3** | **Grade 4** | **Grade 5** | **Grade 6** | **Grade 7** | **Grade 8** | **Related to Algebra 1** | **Related to Algebra 2** | **EQUALITY/SOLVING EQUATIONS** |
| N/A | [**1.15**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=35) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | demonstrate an understanding of equality through the use of the equal symbol |
| N/A | ES | [**2.17**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=39) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | demonstrate an understanding of equality through the use of the equal symbol = and the use of the not equal symbol ≠ |
| N/A | ES | ES | [**3.17**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=41) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | create equations to represent equivalent mathematical relationships  |
| N/A | ES | ES | ES | [**4.16**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=43) | N/A | N/A | N/A | N/A | N/A | N/A | recognize and demonstrate the meaning of equality in an equation |
| N/A | ES | ES | ES | ES | [**5.19b**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=45) | N/A | N/A | N/A | N/A | N/A | write an equation to represent a given mathematical relationship, using a variable |
| N/A | ES | ES | ES | ES | [**5.19d**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=45) | N/A | N/A | N/A | N/A | N/A | create a problem situation based on a given equation, using a single variable |
| N/A | ES | ES | ES | ES | ES | [**6.13**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=42) | N/A | N/A | N/A | N/A | solve one-step linear equations in one variable, including practical problems |
| N/A | ES | ES | ES | ES | ES | MS | [**7.12**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=41) | N/A | N/A | N/A | solve two-step linear equations in one variable, including practical problems |
| N/A | ES | ES | ES | ES | ES | MS | MS | [**8.17**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=44) | N/A | N/A | solve multistep linear equations in one variable with the variable on one and both sides of the equation, including practical problems |
| N/A | ES | ES | ES | ES | ES | MS | MS | MS | [**A.4a**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=10) | N/A | solve multistep linear equations in one variable algebraically |
| N/A | ES | ES | ES | ES | ES | MS | MS | MS | [**A.4b**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=10) | N/A | solve quadratic equations in one variable algebraically |
| N/A | ES | ES | ES | ES | ES | MS | MS | MS | [**A.4c**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=10) | N/A | solve literal equations for a specified variable |
| N/A | ES | ES | ES | ES | ES | MS | MS | MS | [**A.4d**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=10) | N/A | solve systems of two linear equations in two variables algebraically and graphically |
| N/A | ES | ES | ES | ES | ES | MS | MS | MS | [**A.4e**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=10) | N/A | solve practical problems involving equations and systems of equations |
| N/A | ES | ES | ES | ES | ES | MS | MS | MS | HS | [**AII.3a**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=9) | solve absolute value linear equations |

NOTE: Each Standard of Learning is hyperlinked to the corresponding 2016 *Mathematics Standards of Learning* Curriculum Framework grade level/course document on the VDOE website.

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| **Grade K** | **Grade 1** | **Grade 2** | **Grade 3** | **Grade 4** | **Grade 5** | **Grade 6** | **Grade 7** | **Grade 8** | **Related to Algebra 1** | **Related to Algebra 2** | **EQUALITY/SOLVING EQUATIONS** |
| N/A | ES | ES | ES | ES | ES | MS | MS | MS | HS | [**AII.3b**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=9) | solve algebraically and graphically, quadratic equations over the set of complex numbers |
| N/A | ES | ES | ES | ES | ES | MS | MS | MS | HS | [**AII.3c**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=9) | solve algebraically and graphically, equations containing rational algebraic expressions |
| N/A | ES | ES | ES | ES | ES | MS | MS | MS | HS | [**AII.3d**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=9) | solve algebraically and graphically, equations containing radical expressions |
| N/A | ES | ES | ES | ES | ES | MS | MS | MS | HS | [**AII.4**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=11) | solve systems of linear-quadratic and quadratic-quadratic equations, algebraically and graphically |

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| **K-8 Cross-Strand Connections – Equality/Solving Equations** |
| **Number and Number Sense Connections*** [**6.3c**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=14) **-** identify and describe absolute value of integers
* [**7.1d**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=8) **-** determine square roots of perfect squares
* [**7.1e**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=8) **-** identify and describe absolute value of rational numbers
* [**8.2**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=9) **-** describe the relationships between the subsets of the real number system
* [**8.3b**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=10) **-** determine both the positive and negative square roots of a given perfect square

**Computation and Estimation Connections*** [**K.6**](https://www.doe.virginia.gov/home/showpublisheddocument/3036#page=16) – single step story and picture problems – addition/subtraction
* [**1.6**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=16) **&** [**1.7**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=19) **–** single step story and picture problems – addition/subtraction
* [**2.5**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=16) **&** [**2.6**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=18) **–** practical problems with addition/subtraction with whole numbers
* [**3.3**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=14)**,** [**3.4**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=18)**,** [**3.5**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=23) **–** practical problems with whole numbers; practical problems add/sub fractions
* [**4.4**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=14)**,** [**4.5**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=22)**,** [**4.6**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=24) **–** computation with fractions and mixed numbers, whole numbers, decimals and practical problems
* [**5.4**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=13)**,** [**5.5**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=18)**,** [**5.6**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=20)**,** [**5.7**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=23) **–** solve practical problems using operations with whole numbers, fractions, mixed numbers, decimals; apply order of operations
* [**6.5**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=17) **&** [**6.6**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=19) **–** solve practical problems using operations with rational numbers; operations with integers; solve practical problems using operations with integers
* [**7.2**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=12) **–** solve practical problems using operations with rational numbers
* [**8.4**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=12) **–** solve practical problems involving consumer applications

**Measurement and Geometry Connections****Probability and Statistics Connections**  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Grade K** | **Grade 1** | **Grade 2** | **Grade 3** | **Grade 4** | **Grade 5** | **Grade 6** | **Grade 7** | **Grade 8** | **Related to Algebra 1** | **Related to Algebra 2** | **SOLVING INEQUALITIES** |
| N/A | N/A | N/A | N/A | N/A | N/A | [**6.14a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=45) | N/A | N/A | N/A | N/A | represent a practical situation with a linear inequality in one variable; and  |
| N/A | N/A | N/A | N/A | N/A | N/A | [**6.14b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=45) | N/A | N/A | N/A | N/A | solve one-step linear inequalities in one variable and graph the solution on a number line |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | [**7.13**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=43) | N/A | N/A | N/A | solve one- and two-step linear inequalities in one variable, including practical problems, and graph the solution on a number line |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | [**8.18**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=47) | N/A | N/A | solve multistep linear inequalities in one variable with the variable on one and both sides of the inequality symbol, including practical problems, and graph on a number line |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS | [**A.5a**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=13) | N/A | solve multi-step linear inequalities in one variable algebraically and represent the solution graphically |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS | [**A.5b**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=13) | N/A | represent the solution of linear inequalities in two variables algebraically and graphically |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS | [**A.5c**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=13) | N/A | solve practical problems involving inequalities; and  |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS | [**A.5d**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=13) | N/A | solve systems of inequalities algebraically and graphically |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS | HS | [**AII.3a**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=9) | solve absolute value linear inequalities |

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| **K-8 Cross-Strand Connections – Solving Inequalities** |
| **Number and Number Sense Connections*** [**K.2a**](https://www.doe.virginia.gov/home/showpublisheddocument/3036#page=10) **-** compare and describe one set as having more, fewer, or the same number of objects as the other set(s)
* [**1.2b**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=10) **-** compare two numbers between 0 and 110 represented pictorially or with concrete objects, using the words greater than, less than or equal to
* [**3.2c**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=10) **-** compare fractions having like and unlike denominators, using words and symbols (>, <, =, or ≠), with models

**Computation and Estimation Connections****Measurement and Geometry Connections*** [**6.8a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=23) **-** identify the components of the coordinate plane

**Probability and Statistics Connections*** [**1.12b**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=29) **-** read and interpret data displayed in tables, picture graphs, and object graphs, using the vocabulary more, less, fewer, greater than, less than, and equal to
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| **Grade K** | **Grade 1** | **Grade 2** | **Grade 3** | **Grade 4** | **Grade 5** | **Grade 6** | **Grade 7** | **Grade 8** | **Related to Algebra 1** | **Related to Algebra 2** | **ALGEBRAIC EXPRESSIONS** |
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| N/A | N/A | N/A | N/A | N/A | [**5.19a**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=45) | N/A | N/A | N/A | N/A | N/A | investigate/describe the concept of variable |
| N/A | N/A | N/A | N/A | N/A | [**5.19c**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=45) | N/A | N/A | N/A | N/A | N/A | use a variable expression to represent a verbal quantitative expression involving one operation |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | [**7.11**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=39) |  |  |  | evaluate algebraic expressions for given replacement values of the variables |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | [**8.14a**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=30) | N/A | N/A | evaluate an algebraic expression for given replacement values of the variables |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | [**8.14b**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=30) | N/A | N/A | simplify expressions in one variable |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | MS | [**A.1a**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=7) | N/A | represent verbal quantitative situations algebraically |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | MS | [**A.1b**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=7) | N/A | evaluate algebraic expressions for given replacement values of the variables |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | MS | [**A.2a**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=8) | N/A | perform operations on polynomials, includingapplying laws of exponents to perform operations on expressions |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | MS | [**A.2b**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=8) | N/A | perform operations on polynomials, including adding, subtract, multiply, and divide polynomials |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | MS | [**A.2c**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=8) | N/A | perform operations on polynomials, including factoring first- and second-degree binomials and trinomials in one variable |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | MS | [**A.3a**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=9) | N/A | simplify square roots of non-negative rational numbers and monomial algebraic expressions;  |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | MS | HS | [**AII.1a**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=7) | add, subtract, multiply, divide and simplify rational algebraic expressions |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | MS | HS | [**AII.1b**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=7) | add, subtract, multiply, divide and simplify radical expressions containing rational numbers and variable, and expressions contain rational exponents |
| N/A | N/A | N/A | N/A | N/A | ES | N/A | MS | MS | HS | [**AII.1c**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=7) | factor polynomials completely in one or two variables |
| N/A | N/A | N/A | N/A | N/A | ES |  N//A | MS | MS | HS | [**AII.2**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=8) | perform operations on complex numbers, express the results in simplest form using patterns of *i* |

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| **K-8 Cross-Strand Connections – Algebraic Expressions** |
| **Number and Number Sense Connections*** [**7.1d**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=8) **-** determine square roots of perfect squares
* [**8.3a**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=10) **-** estimate and determine the two consecutive integers between which a square root lies
* [**8.3b**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=10) - determine both the positive and negative square roots of a given perfect square

**Computation and Estimation Connections*** [**3.4d**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=18) - solve single-step practical problems involving multiplication of whole numbers, where one factor is 99 or less and the second factor is 5 or less
* [**4.5a**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=22) **-** determine common multiples and factors, including least common multiple and greatest common factor
* [**1.6**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=16) - create and solve single-step story and picture problems using addition and subtraction within 20
* [**2.5a**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=16) **-** recognize and use the relationships between addition and subtraction to solve single-step practical problems, with whole numbers to 20
* [**2.6c**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=18) **-** create and solve single-step and two-step practical problems involving addition and subtraction
* [**3.5**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=23) - solve practical problems that involve addition and subtraction with proper fractions having like denominators of 12 or less
* [**4.4d**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=14) - create and solve single-step and multistep practical problems involving addition, subtraction, and multiplication, and single-step practical problems involving division with whole numbers
* [**4.5c**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=22) **-** solve single-step practical problems involving addition and subtraction with fractions and mixed numbers
* [**4.6b**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=24) **-** solve single-step and multistep practical problems involving addition and subtraction with decimals
* [**5.4**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=13) - create and solve single-step and multistep practical problems involving addition, subtraction, multiplication, and division of whole numbers
* [**5.5b**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=18)  - create and solve single-step and multistep practical problems involving addition, subtraction, and multiplication of decimals, and create and solve single-step practical problems involving division of decimals
* [**5.6a**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=20) - solve single-step and multistep practical problems involving addition and subtraction with fractions and mixed numbers
* [**5.6b**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=20) - solve single-step practical problems involving multiplication of a whole number, limited to 12 or less, and a proper fraction, with models
* [**5.7**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=23) - simplify whole number numerical expressions using the order of operations
* [**6.5a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=17) - multiply and divide fractions and mixed numbers
* [**6.5b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=17) - solve single-step and multistep practical problems involving addition, subtraction, multiplication, and division of fractions and mixed numbers
* [**6.5c**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=17) **-** solve multistep practical problems involving addition, subtraction, multiplication, and division of decimals
* [**6.6a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=19) - add, subtract, multiply, and divide integers
* [**6.6b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=19) - solve practical problems involving operations with integers
* [**6.6c**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=19) - simplify numerical expressions involving integers

**Measurement and Geometry Connections****Probability and Statistics Connections** |

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| **Grade K** | **Grade 1** | **Grade 2** | **Grade 3** | **Grade 4** | **Grade 5** | **Grade 6** | **Grade 7** | **Grade 8** | **Related to Algebra 1** | **Related to Algebra 2** | **PROPORTIONAL AND ADDITIVE RELATIONSHIPS;** **SLOPE; LINEAR FUNCTIONS** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| N/A | N/A | N/A | N/A | N/A | N/A | [**6.12a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) | N/A | N/A | N/A | N/A | represent a proportional relationship between two quantities, including those arising from practical situations; |
| N/A | N/A | N/A | N/A | N/A | N/A | [**6.12b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) | N/A | N/A | N/A | N/A | determine the unit rate of a proportional relationship and use it to find a missing value in a ratio table; |
| N/A | N/A | N/A | N/A | N/A | N/A | [**6.12c**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) | N/A | N/A | N/A | N/A | determine whether a proportional relationship exists between two quantities; |
| N/A | N/A | N/A | N/A | N/A | N/A | [**6.12d**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) | N/A | N/A | N/A | N/A | make connections between and among representations of a proportional relationship between two quantities using verbal descriptions, ratio tables, and graphs. |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | [**7.10a**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=31) | N/A | N/A | N/A | determine the slope, *m*, as rate of change in a proportional relationship between two quantities and write an equation in the form *y*=*mx* to represent the relationship |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | [**7.10b**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=31) | N/A | N/A | N/A | graph a line representing a proportional relationship between two quantities given the slope and an ordered pair, or given the equation in *y*=*mx* form where *m* represents the slope as rate of change; |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | [**7.10c**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=31) | N/A | N/A | N/A | determine the *y*-intercept, *b*, in an additive relationship between two quantities and write an equation in the form *y* = *x* + *b* to represent the relationship; |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | [**7.10d**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=31) | N/A | N/A | N/A | graph a line representing an additive relationship between to quantities given the *y*-intercept and an ordered pair, or given the equation in the form *y* = *x* + *b*, where *b* represents the *y*-intercepts;  |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | [**7.10e**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=31) | N/A | N/A | N/A | make connections between and among representations of proportional or additive relationships between two quantities using verbal descriptions, tables, equations, and graphs |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | [**8.16a**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=36) | N/A | N/A | recognize and describe the graph of a linear function with a slope that is positive, negative, or zero |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | [**8.16b**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=36) | N/A | N/A | identify the slope and y-intercept of a linear function given a table of values, a graph, or an equation in y = mx + b form; |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | [**8.16c**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=36) | N/A | N/A | determine the independent and dependent variable, given a practical situation modeled by a linear function; |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | [**8.16d**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=36) | N/A | N/A | graph a linear function given the equation in y = mx + b form; and |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | [**8.16e**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=36) | N/A | N/A | make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs. |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS | [**A.6a**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=15) | N/A | determine the slope of a line when given an equation of the line, the graph of the line, or two points on the line;  |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS | [**A.6b**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=15) | N/A | write the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line; and  |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS | [**A.6c**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=15) | N/A | graph linear equations in two variables |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS | [**A.8**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=18) | N/A | given a data set or practical situation, students will analyze a relation to determine whether a directvariation exists, and represent a direct variation algebraically and graphically |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS | HS | [**AII.5**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=12) | investigate and apply the properties of arithmetic and geometric sequences and series to solve practical problems, including writing the first *n* terms, determining the *n*th term and evaluating summation formulas. |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS |  | [**AII.6b**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=13) | **For absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic functions, the student will**use knowledge of transformations to convert between equations and the corresponding graphs of functions.  |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS |  |  |  |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS |  |  |  |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS |  |  |  |
| N/A | N/A | N/A | N/A | N/A | N/A | MS | MS | MS |  |  |  |

NOTE: Each Standard of Learning is hyperlinked to the corresponding 2016 *Mathematics Standards of Learning* Curriculum Framework grade level/course document on the VDOE website.

|  |
| --- |
| **K-8 Cross-Strand Connections – Proportional and Additive Relationships; Slope; Linear Functions** |
| **Number and Number Sense Connections*** [**K.4a**](https://www.doe.virginia.gov/home/showpublisheddocument/3036#page=12) **-** recognize and describe with fluency part-whole relationships for numbers up to 5
* [**K.4b**](https://www.doe.virginia.gov/home/showpublisheddocument/3036#page=12) **-** investigate and describe part-whole relationships for numbers up to 10
* [**1.7a**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=19) - recognize and describe with fluency part-whole relationships for numbers up to 10
* [**2.2a**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=10) - count forward by twos, fives, and tens to 120, starting at various multiples of 2, 5, or 10
* [**2.5**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=16) **-** recognize and use the relationships between addition and subtraction to solve single-step practical problems, with whole numbers to 20
* [**4.2b**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=9) - represent equivalent fractions
* [**4.5a**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=22) - determine common multiples
* [**6.1**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=8) **-** represent relationships between quantities using ratios, and will use appropriate notations, such as ab , a to b, and a:b

**Computation and Estimation Connections****Measurement and Geometry Connections*** [**6.8a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=23) **-** identify the components of the coordinate plane

**Probability and Statistics Connections**  |

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KEY TO COLORED BOXES: **ES** = K-5 Prior Knowledge Concepts; **MS** = 6-8 Prior Knowledge Concepts; **HS** = 9-12 Prior Knowledge Concepts; N/A = No Concepts Listed

| **Grade K** | **Grade 1** | **Grade 2** | **Grade 3** | **Grade 4** | **Grade 5** | **Grade 6** | **Grade 7** | **Grade 8** | **Related to Algebra 1** | **Related to Algebra 2** | **PATTERNS, RELATIONS AND FUNCTIONS** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [**K.12**](https://www.doe.virginia.gov/home/showpublisheddocument/3036#page=28) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | sort and classify objects according to attributes. |
| [**K.13**](https://www.doe.virginia.gov/home/showpublisheddocument/3036#page=29)/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | identify, describe, extend, create and transfer repeating patterns. |
| ES | /[**1.13**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=32)A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | sort and classify objects according to one or more attributes |
| ES | [**1.14**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=33) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | identify, recognize, describe, extend, and transfer growing and repeating patterns. |
| ES | ES | [**2.16**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=37) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | identify, describe, create, extend, and transfer patterns found in objects, pictures, and numbers |
| ES | ES | ES | [**3.16**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=39) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | identify, describe, create, extend, and transfer patterns found in objects, pictures, numbers, and tables. |
| ES | ES | ES | ES | [**4.15**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=42) | N/A | N/A | N/A | N/A | N/A | N/A | identify, describe, create, and extend patterns found in objects, pictures, numbers, and tables. |
| ES | ES | ES | ES | ES | [**5.18**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=43) | N/A | N/A | N/A | N/A | N/A | describe and express the relationship of number patterns found in objects, pictures, numbers, and tables |
| ES | ES | ES | ES | ES | ES | N/A | N/A | [**8.15a**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=33) | N/A | N/A | determine whether a given relation is a function |
| ES | ES | ES | ES | ES | ES | N/A | N/A | [**8.15b**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=33) | N/A | N/A | determine domain and range of a function |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | [**A.7a**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=16) | N/A | **Investigate and analyze function families and their characteristics both algebraically and graphically, including** determining whether a relation is a function |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | [**A.7b**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=16) | N/A | domain and range |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | [**A.7c**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=16) | N/A | zeros |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | [**A.7d**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=16) | N/A | intercepts |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | [**A.7e**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=16) | N/A | values of a function for elements in its domain  |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | [**A.7f**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=16) | N/A | connections between any two representations of functions, including concrete/verbal/numeric/graphic/algebraic |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.6a**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=13) | **For absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic functions** recognize the general shape of function families |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.6b**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=13) | use knowledge of transformations to convert between graphic and symbolic forms of functions |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7a**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | **The student will investigate and analyze linear, quadratic, absolute value, square root, cube root, rational, polynomial, exponential and logarithmic function families algebraically and graphically. Key concepts include:** domain and range, and continuity |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7b**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | intervals in which a function is increasing or decreasing |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7c**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | maxima and minima |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7d**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | investigate and analyze linear, quadratic, absolute value, square root, cube root, rational, polynomial, exponential and logarithmic function families algebraically and graphically. Key concepts include: zeros  |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7e**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | intercepts |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7f**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | values of a function for elements in its domain  |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7g**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | connections between any two representations of function including concrete, verbal, numeric, graphic, and algebraic;  |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7h**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | end behavior;  |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7i**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | vertical and horizontal asymptotes;  |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7j**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | inverse of a function; and  |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.7k**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=14) | composition of functions algebraically |
| ES | ES | ES | ES | ES | ES | N/A | N/A | MS | HS | [**AII.8**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=19) | Investigate and describe the relationships among solutions of an equation, zeros of a function, *x*-intercepts of a graph, and factors of a polynomial expression. |

NOTE: Each Standard of Learning is hyperlinked to the corresponding 2016 *Mathematics Standards of Learning* Curriculum Framework grade level/course document on the VDOE website.

|  |
| --- |
| **Cross-Strand Connections – Relations and Functions** |
| **Number and Number Sense Connections*** [**6.1**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=8) – represents relationships between quantities using ratios

**Computation and Estimation Connections*** [**6.4**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=15) **-** recognize and represent patterns with whole number exponents and perfect squares

**Measurement and Geometry Connections****Probability and Statistics Connections**  |

NOTE: Each Standard of Learning is hyperlinked to the corresponding 2016 *Mathematics Standards of Learning* Curriculum Framework grade level/course document on the VDOE website. This is only a representative list of the connections that could be made and not a comprehensive list of all cross-strand connections.

**Middle School Mathematics *2016 Mathematics Standards of Learning***

**Application of Properties of Real Numbers1 - Patterns, Functions, and Algebra Strand**

****= property can be applied in this standard; N/A = not applicable

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Standard of Learning Description** | Solve One-Step Linear Equations[**6.13**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=42) | Solve One-Step Linear Inequalities (addition/subtraction only)[**6.14b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=45) | Evaluate Algebraic Expressions [**7.11**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=39) | Solve Two-Step Linear Equations[**7.12**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=41) | Solve One- and Two-Step Linear Inequalities[**7.13**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=43) | Evaluate/Simplify Algebraic Expressions [**8.14**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=30)**a,b** | Solve Multistep Linear Equations[**8.17**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=44) | Solve Multistep Linear Inequalities[**8.18**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=47) |
| **Commutative Property of Addition***a* + *b* = *b* +a |  |  |  |  |  |  |  |  |
| **Commutative Property of Multiplication***ab* = *b*a |  |  |  |  |  |  |  |  |
| **Associative Property of Addition**(*a* + *b*) + *c* = *a* +(*b* + *c*) | N/A | N/A |  | N/A | N/A |  |  |  |
| **Associative Property of Multiplication**(*ab*)*c* = *a*(*bc*) | N/A | N/A |  | N/A | N/A |  |  |  |
| **Distributive Property** **(over addition/subtraction)***a*(*b* + *c*) = *ab* + *ac*  and *a*(*b* − *c*) = *ab* − *ac*   | N/A | N/A |  | N/A | N/A |  |  |  |
| **Identity Property of Addition***a* + 0 = *a* = 0 + *a*  |  |  |  |  |  |  |  |  |
| **Identity Property of Multiplication***a*· 1 = *a* = 1·*a* |  |  |  |  |  |  |  |  |
| **Inverse Property of Addition***a* + (-*a*) = 0 = (-*a*) + *a* |  |  |  |  |  |  |  |  |
| **Inverse Property of Multiplication** |  |  |  |  |  |  |  |  |
| **Multiplicative Property of Zero†***a* · 0 = 0 ∙ *a* |  | N/A |  |  |  |  |  |  |
| **Substitution Property†** If *a* = *b*, then *b* can be substituted for *a* in any expression, equation or inequality |  |  |  |  |  |  |  |  |

**1** The properties of real numbers listed apply given *a*, *b*, and *c* are real numbers. In some standards, limitations may exist on the values of *a*, *b*, or *c* (e.g., integers only or rational numbers only), or impose other parameters (e.g., one-step equations) that may prevent situations in which a property could be applied. **†**Multiplicative Property of Zero and theSubstitution Property may also be considered properties of equality/inequality.

**Middle School Mathematics *2016 Mathematics Standards of Learning***

**Application of Properties of Equality/Inequality2 - Patterns, Functions, and Algebra Strand**

****= property can be applied in this standard; N/A = not applicable

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Standard of Learning Description** | Solve One-Step Linear Equations[**6.13**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=42) | Solve One-Step Linear Inequalities (addition/subtraction only)[**6.14b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=45) | Solve Two-Step Linear Equations[**7.12**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=41) | Solve One- and Two-Step Linear Inequalities[**7.13**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=43) | Solve Multistep Linear Equations[**8.17**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=44) | Solve Multistep Linear Inequalities[**8.18**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=47) |
| **Addition Property of Equality**If *a* = *b*, then *a* + *c* = *b* + *c* |  | N/A |  | N/A |  | N/A |
| **Subtraction Property of Equality**If *a* = *b*, then *a* - *c* = *b* – *c* |  | N/A |  | N/A |  | N/A |
| **Multiplication Property of Equality**If *a* = *b*, then a*c* = *bc* |  | N/A |  | N/A |  | N/A |
| **Division Property of Equality**If *a* = *b* and *c* ≠ 0, then $\frac{a}{c}$ = $\frac{b}{c}$ |  | N/A |  | N/A |  | N/A |
| **Addition Property of Inequality**If *a* < *b*, then *a* + *c* < *b* + *c;* If *a* > *b*, then *a* + *c* > *b* + *c* | N/A |  | N/A |  | N/A |  |
| **Subtraction Property of Inequality**If *a* < *b*, then *a* - *c* < *b* – *c;* If *a* > *b*, then *a* - *c* > *b* − *c* | N/A |  | N/A |  | N/A |  |
| **Multiplication Property of Inequality** If *a* < *b* and *c* > 0, then a*c* < *bc*; If *a* > *b* and *c* > 0, then a*c* > *bc;*If *a* < *b* and *c* < 0, then a*c* > *bc;* If *a* > *b* and *c* < 0, then a*c* < *bc* | N/A | N/A | N/A |  | N/A |  |
| **Division Property of Inequality**If *a* < *b* and *c* > 0, then $\frac{a}{c}$ < $\frac{b}{c}$; If *a* < *b* and *c* < 0, then $\frac{a}{c}$ > $\frac{b}{c}$If *a* > *b* and *c* > 0, then $\frac{a}{c}$ > $\frac{b}{c}$; If *a* > *b* and *c* < 0, then $\frac{a}{c}$ < $\frac{b}{c}$ | N/A | N/A | N/A |  | N/A |  |
| **Substitution Property** If *a* = *b*, then *b* can be substituted for *a* in any expression, equation or inequality |  |  |  |  |  |  |

**2** The properties of equality and inequality listed apply given *a*, *b*, and *c* are real numbers. In some standards, limitations may exist on the values of *a*, *b*, or *c* (e.g., integers only or rational numbers only), or impose other parameters (e.g., 1-step equations) that may prevent situations in which a property could be applied.

**High School Mathematics *2016 Mathematics Standards of Learning***

**Application of Properties of Real Numbers1 - Related to Patterns, Functions, and Algebra Strand**

****= property can be applied in this standard; N/A = not applicable

|  |  |  |
| --- | --- | --- |
| **Standard of Learning Description** | Solve Multistep Linear Equations; Literal Equations; Systems of Linear Equations[**A.4**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=10) | Solve Multistep Linear Inequalities; Systems of Linear Inequalities[**A.5**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=13) |
| **Commutative Property of Addition***a* + *b* = *b* +a |  |  |
| **Commutative Property of Multiplication***ab* = *b*a |  |  |
| **Associative Property of Addition**(*a* + *b*) + *c* = *a* +(*b* + *c*) |  |  |
| **Associative Property of Multiplication**(*ab*)*c* = *a*(*bc*) |  |  |
| **Distributive Property** **(over addition/subtraction)***a*(*b* + *c*) = *ab* + *ac*  and *a*(*b* − *c*) = *ab* − *ac*   |  |  |
| **Identity Property of Addition***a* + 0 = *a* = 0 + *a*  |  |  |
| **Identity Property of Multiplication***a*· 1 = *a* = 1·*a* |  |  |
| **Inverse Property of Addition***a* + (-*a*) = 0 = (-*a*) + *a* |  |  |
| **Inverse Property of Multiplication** |  |  |
| **Multiplicative Property of Zero†***a* · 0 = 0 ∙ *a* |  |  |
| **Substitution Property†** If *a* = *b*, then *b* can be substituted for *a* in any expression, equation or inequality |  |  |

**1** The properties of real numbers listed apply given *a*, *b*, and *c* are real numbers. In some standards, limitations may exist on the values of *a*, *b*, or *c* (e.g., integers only or rational numbers only), or impose other parameters (e.g., one-step equations) that may prevent situations in which a property could be applied. **†**Multiplicative Property of Zero and theSubstitution Property may also be considered properties of equality/inequality.

**High School Mathematics *2016 Mathematics Standards of Learning***

**Application of Properties of Equality/Inequality2 - Related to Patterns, Functions, and Algebra Strand**

****= property can be applied in this standard; N/A = not applicable

|  |  |  |
| --- | --- | --- |
| **Standard of Learning Description** | Solve Multistep Linear Equations; Literal Equations; Systems of Linear Equations[**A.4**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=10) | Solve Multistep Linear Inequalities; Systems of Linear Inequalities[**A.5**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=13) |
| **Addition Property of Equality**If *a* = *b*, then *a* + *c* = *b* + *c* |  | N/A |
| **Subtraction Property of Equality**If *a* = *b*, then *a* - *c* = *b* – *c* |  | N/A |
| **Multiplication Property of Equality**If *a* = *b*, then a*c* = *bc* |  | N/A |
| **Division Property of Equality**If *a* = *b* and *c* ≠ 0, then $\frac{a}{c}$ = $\frac{b}{c}$ |  | N/A |
| **Addition Property of Inequality**If *a* < *b*, then *a* + *c* < *b* + *c;* If *a* > *b*, then *a* + *c* > *b* + *c* | N/A |  |
| **Subtraction Property of Inequality**If *a* < *b*, then *a* - *c* < *b* – *c;* If *a* > *b*, then *a* - *c* > *b* − *c* | N/A |  |
| **Multiplication Property of Inequality** If *a* < *b* and *c* > 0, then a*c* < *bc*; If *a* > *b* and *c* > 0, then a*c* > *bc;*If *a* < *b* and *c* < 0, then a*c* > *bc;* If *a* > *b* and *c* < 0, then a*c* < *bc* | N/A |  |
| **Division Property of Inequality**If *a* < *b* and *c* > 0, then $\frac{a}{c}$ < $\frac{b}{c}$; If *a* < *b* and *c* < 0, then $\frac{a}{c}$ > $\frac{b}{c}$If *a* > *b* and *c* > 0, then $\frac{a}{c}$ > $\frac{b}{c}$; If *a* > *b* and *c* < 0, then $\frac{a}{c}$ < $\frac{b}{c}$ | N/A |  |
| **Substitution Property** If *a* = *b*, then *b* can be substituted for *a* in any expression, equation or inequality. |  |  |
| **Zero Product Property**If *ab* = 0, then *a* = 0 or *b* = 0. |  | N/A |
| **Reflexive Property***a* = *a* |  | N/A |
| **Symmetric Property**If *a* = *b*, then *b* = *a.* |  | N/A |
| **Transitive Property**If *a* = *b* and *b* = *c*, then *a* = *c.* |  |  |

**2** The properties of equality and inequality listed apply given *a*, *b*, and *c* are real numbers. In some standards, limitations may exist on the values of *a*, *b*, or *c* (e.g., integers only or rational numbers only), or impose other parameters (e.g., 1-step equations) that may prevent situations in which a property could be applied.

Does this property apply to simplifying expressions?