

Lesson #1: Understanding and Using the properties of Real Numbers to Simplify Expressions.

(Reference: Lesson #1 + #2 in book)

* Now we can talk about some more properties of real numbers that can help us simplify expressions or write equivalent Expressions.

- These Properties are as follows:

- Identity Property of Addition
for every Real Number a,

$$a+0 = a \text{ (meaning that the additive Identity in addition is } 0\text{.)}$$

Example: $5+0=5$

- Identity Property of Multiplication
for every Real number a,

$$a \cdot 1 = a \text{ (means that } 1 \text{ is the multiplicative Identity.)}$$

Example: $5 \cdot 1 = 5$

- Commutative Property of Addition/Multiplication

(Commutative means able to go back and forth.)

(The commutative properties say that if two members are added or multiplied together in any order, they will give the same result.)

(for every a and b) Commutative Property of Addition

$$a+b = b+a$$

Commutative Property of Multiplication

$$ab = ba$$

Examples: $-8+5 = 5+(-8)$ $(8)(5) = (5)(8)$

- Associative Properties of Addition/Multiplication

for every a, b, c

(The associative properties say that when we add or multiply three numbers, we can re-group them in any manner and get the same answer.)

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Associative Property of Addition

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

Associative Property of Multiplication

$$(ab)c = a(bc)$$

or

$$abc = cba \text{ or } cab \text{ or } bac, \dots$$

Examples:

$$8 + (-1 + 4) = (8 + -1) + 4$$

$$[2 \cdot (-7)] \cdot 6 = 2 \cdot [(-7) \cdot 6]$$

Inverse Properties of Addition/Multiplication

(The inverse properties of addition and multiplication lead to the additive and multiplicative Identities.)

(The opposite of a , $-a$, is the Additive Inverse of a .)

(The reciprocal of a , $\frac{1}{a}$, is the Multiplicative Inverse of the non-zero number a .)

Inverse Properties of Addition -

for each real number a , there is a single real number $-a$ such that

$$a + (-a) = 0 \text{ and } (-a) + a = 0$$

Inverse Properties of Multiplication

for each non zero real number a , there is a single real number $\frac{1}{a}$ such that

$$a \cdot \frac{1}{a} = 1 \text{ and } \frac{1}{a} \cdot a = 1$$

Distributive Property - "Distribute" - or "to give out from one to several."

for all real numbers a, b, c .

$$a(b+c) = ab+ac \text{ or } (b+c)a = ba+ca$$

or

$$a(b-c) = ab-ac \text{ or } (b-c)a = ba-ca$$

or

or

(The distributive property will be the most frequently used property when dealing with simplifying expressions.)

For Example:

$$-4(x+7) = -4x + 7(-4) = \boxed{-4x - 28}$$

$$(5-x)6 = (5)(6) - 6x = \boxed{30 - 6x}$$

or
 $\boxed{-6x + 30}$

* These are the main properties of real numbers that can and will be used at times to simplify expressions. (3)

* Try the following examples and tell me which property is in action.

(a) $2 \cdot (4 \cdot 6) = (2 \cdot 4) \cdot 6$ Assoc.

(b) $(2 \cdot 4) \cdot 6 = (4 \cdot 2) \cdot 6$ Comm.

(c) $(2+4)+6 = 4+(2+6)$ Assoc + Comm.

(d) $x+9 = 9+x$ Comm

(e) $-5(x+3)$ Dis.

(f) $(7-x)4$ Dis.

(g) $1 \cdot 8 = 8$ M. Identity

(h) $(3 \cdot 4) \cdot 7 = 3 \cdot (4 \cdot 7)$ Ass.

(i) $(5)(6) = (6)(5)$ Comm.

* Now with these equations in mind please Simplify the following expressions.

(1) $mn(mx + ny + 2p) \Rightarrow m^2nx + mn^2y + 2mnp$

(2) $-5(x+3) \Rightarrow -5x - 15$

(3) $(7-x)4 \Rightarrow 28 - 4x$

(4) $-xy(y^2 - x^2z) \Rightarrow -xy^3 + x^3yz$

(5) $(mx + 2ny + z)mn \Rightarrow m^2nx + 2mn^2y + MNz$

(6) $(y^3 - z \cdot x^3)(-yz) \Rightarrow -y^4z + x^3yz^2$

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Simplify the following Expressions using
the properties of Real Numbers

$$⑦ -\frac{4}{3}(12y + 15z)$$

$$⑧ -(-13x - 15y)$$

$$⑨ -(-4z + 5w - 9y)$$

$$⑩ -5(2x - 5y + 6z)$$

$$⑪ 4xy^3(x^4y - 5x) \Rightarrow 4x^5y^4 - 20x^2y^3$$

$$⑫ -2x^2m^2(m^2 - 4m) \Rightarrow -2x^2m^4 + 8x^2m^3$$

$$⑬ -10(m + 4) \Rightarrow -10m - 40$$

$$⑭ 12 + 4x + 8 \Rightarrow 4x + 20$$

$$⑮ (15) \cdot y \cdot \frac{1}{15} \Rightarrow y$$

$$⑯ \text{True or False: } d \cdot 0 = d \quad \begin{matrix} \text{False} \\ \text{Correct it?} \end{matrix}$$

$$⑰ \text{True or False: } (er)b = (re)b \quad \begin{matrix} \text{True} \\ \text{Comm.} \end{matrix}$$

$$⑱ \text{True or False: } x(y+z) = (x+y)z \quad \begin{matrix} \text{Assoc.} \\ \text{False} \\ \text{Correct it?} \end{matrix}$$

* now that we know the properties of real numbers that can help us simplify Expression, lets look into another way of simplifying expressions, through the evaluation of Square roots.

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Lesson #1: Simplifying Expression: Using Properties and Rules and Combining Like Terms

* What are like terms?

- When two or more terms that have the same variable or variables raised to the same power are considered like terms. (These like terms are able to be combined to simplify the expression.)

For example: Simplify the following expressions

$$\textcircled{1} \quad 5x + 7x \Rightarrow \textcircled{12x}$$

$$\textcircled{2} \quad x^5 + y^3 + x^5 + y^3 \Rightarrow \textcircled{2x^5 + 2y^3}$$

$$\textcircled{3} \quad -4y - (-3y) + 5y \Rightarrow -4y + 3y + 5y = \textcircled{4y}$$

$$\textcircled{4} \quad 6xy - 3a + \underline{4yx} \Rightarrow 6xy - 3a + \underline{4xy} \quad \begin{matrix} \text{Switch order to} \\ \text{combine} \end{matrix}$$

$$\Rightarrow \textcircled{10xy - 3a}$$

$$\textcircled{5} \quad 2x^2y^3 + xy - 8y^3x^2 - 5yx \Rightarrow 2x^2y^3 + xy - 8x^2y^3 - 5xy =$$