Commutative Properties of Real Numbers

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Commutative Property of Addition $a+b=b+a$ (The order in which two numbers are added does not affect the sum.)

Commutative Property of Multiplication $ab=ba$ (The order in which two numbers are multiplied does not affect the product.) $\frac{6}{2} \neq \frac{2}{6}$

Note: The operations of subtraction and division are not commutative. $5-3 \neq 3-5$

Use the commutative property of addition or multiplication to rewrite each expression.

1. $-m(x)$
   $-m(x)$
   $= -xm$
2. $a-17$
   $= -17+a$
3. $b(-52)$
   $= -52b$
4. $5a+12z$
   $= 12z+5a$

Associative Properties of Real Numbers

Commutative Properties of Real Numbers

Associative Property of Addition $(a+b)+c=a+(b+c)$ (The manner in which three numbers are grouped under addition does not affect the sum.)

Associative Property of Multiplication $(ab)c=a(bc)$ (The manner in which three numbers are grouped under multiplication does not affect the sum.)

Use the associative property of addition or multiplication to rewrite each expression. Then simplify the expression.

5. $-4(13a)$
   $= (-4\cdot 13)a$
   $= -52a$
   Distributive Prop.: $-4(13+a) = \boxed{-52-4a}$
6. $(4b+13)+(-8)$
   $= 4b+13-8$
   $= \boxed{4b+5}$
7. $-27(-2x)$
   $= ((-27)(-2))x$
   $= \boxed{54x}$

Identity and Inverse Properties of Real Numbers

Identity and Inverse Properties of Real Numbers If a is a real number and b is a nonzero real number, then

Identity Property of Addition $a+0=0+a=a$ additive identity
Identity Property of Multiplication $a\cdot 1=1\cdot a=a$
Inverse Property of Addition $a+(-a)=-a+a=0$ $\Rightarrow$ $-a$ is the additive inverse of a

Inverse Property of ultiplication $b\cdot\frac{1}{b}=\frac{1}{b}\cdot b=1$ $\Rightarrow$ $\frac{1}{b}$ is the multiplicative inverse of b

0 is said to be the *additive identity* and 1 is said to be the *multiplicative identity*.

multiplicative identity

Distributive Property of Multiplication over Addition

Distributive Property of Multiplication over Addition

If a, b, and c are real numbers, then

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

Use the distributive property to rewrite each expression.

8. $5(a-3)$ $= \boxed{5a-15}$

9. $6(-9x+8y-12z)$

$= 6(-9x)+6(8y)+6(-12z)$

$= \boxed{-54x+48y-72z}$

$\begin{array}{r} 12 \\ 6 \\ \hline 72 \end{array}$

10. $-(-6x+3y)$

$= -1(-6x+3y)$

$= -1(-6x)-1(3y)$

$= \boxed{6x-3y}$

why is $\frac{3x}{2}=\frac{3}{2}x$?

$\frac{3}{2}x = \frac{3}{2}\cdot\frac{x}{1}$

$= \frac{3x}{2}$

11. $-\frac{3}{4}(2x-16)$

$= -\frac{3}{4}\frac{(2x)}{1} - \frac{3}{4}\frac{(-16)}{1}$

$= -\frac{\cancel{6}^{3}x}{\cancel{4}_{2}} + \frac{\cancel{48}^{12}}{\cancel{4}_{1}} = -\frac{3x}{2}+\frac{12}{1}$

$= \boxed{-\frac{3x}{2}+12}$

$= \boxed{-\frac{3}{2}x+12}$

$\boxed{-1.5x+12}$

Algebraic Expressions

Term A *term* is a constant or the product or quotient of constants and variables.

Example: $5x^3$ is a *variable* term. 5 is the numerical *coefficient* of the term $5x^3$.
12 is a *constant* term.

Algebraic Expression An *algebraic expression* is the sum of one or more terms.

Like Terms Terms are *like terms* if they have the same variables and the corresponding variables are raised to the same powers.

Which of the pairs are *like* terms?

Terms: expressions being added

Factors: expressions being multiplied

12. $4b$, $\frac{2}{3}b$

Like terms

13. $8xy^2$, $2x^2y$

Not like terms

14. $3y$, 3

Not like terms

Two terms can be added or subtracted only if they are *like* terms.

Example: $5y+6y=(5+6)y=11y$
using the distributive property

$7z-10z=-3z$
in one step

We can only combine like terms. We combine terms by adding the coefficients.

Ex:

$5 - 3 = \boxed{2}$

$3 - 5 = \boxed{-2}$

$-3 - 5 = \boxed{-8}$

$3 + 5 = \boxed{8}$

$-3 + 5 = \boxed{2}$

Same as

$5 - 3 = \boxed{2}$

$5(-3) = \boxed{-15}$

$3(-5) = \boxed{-15}$

$-3(-5) = \boxed{15}$

$3(5) = \boxed{15}$

Ex: $-0.6x+1.3x$

$= \boxed{0.7x}$

Simplify by combining like terms.

15. $6x+14x$

$= \boxed{20x}$

16. $-0.3a+2b-1.5a$

$-0.3a-1.5a+2b$

$\boxed{-1.8a+2b}$

17. $12-6x^2-8+x^2$

$= -6x^2+x^2+12-8$

$= -6x^2+1x^2+12-8$

$= \boxed{-5x^2+4}$

18. $\frac{1}{3}x-2y+\frac{2}{3}x+\frac{1}{4}y$

$\frac{1}{3}x+\frac{2}{3}x-2y+\frac{1}{4}y$

$\frac{3}{3}x-\frac{2}{1}y\left(\frac{4}{4}\right)+\frac{1}{4}y$

$= 1x-\frac{8}{4}y+\frac{1}{4}y = \boxed{x-\frac{7}{4}y}$

Same as $x-1.75y$ (because $\frac{7}{4}=1\frac{3}{4}$

Clear parentheses and combine like terms.

19. $3(x+8)-43$

$= 3x+24-43$

$= \boxed{3x-19}$

$\begin{array}{r} 43 \\ -24 \\ \hline 19 \end{array}$

20. $-23+12(-3x+5)$

$-23-36x+60$

$\boxed{-36x+37}$

21. $-16-9(21-2n)$

$-16-9(21-2n)$

$-16-189+18n$

$= \boxed{-205+18n}$

22. $3(-5y+2)+7(y-4)$

$-15y+6+7y-28$

23. $\frac{1}{8}(16x+24)-\frac{3}{4}(2x+12)$

$\frac{1}{8}\left(\frac{16x}{1}\right)+\frac{1}{8}\left(\frac{24}{1}\right)-\frac{3}{4}\left(\frac{2x}{1}\right)-\frac{3}{4}\left(\frac{12}{1}\right)$

$= \frac{16}{8}x+\frac{24}{8}-\frac{6}{4}x-\frac{36}{4}$

$= 2x+3-\frac{3}{2}x-9$

$= \frac{2x}{1}\left(\frac{2}{2}\right)-\frac{3}{2}x+3-9$

$= \frac{4}{2}x-\frac{3}{2}x-6 = \boxed{\frac{1}{2}x-6}$

24. $5x-3[x+2(3x-6)]$

$5x-3[x+6x-12]$

$= 5x-3(7x-12)$

$= 5x-21x+36$

$= \boxed{-16x+36}$

Caution: Never write these:

$\frac{3}{4x}$ or $3/4x$ — Does this mean $\frac{3}{4}x = \frac{3x}{4}$ or $\frac{3}{4x}$

$\frac{3}{4}x = \frac{3}{4} \cdot \frac{x}{1} = \frac{3x}{4}$. The x in $\frac{3}{4}x$ is really in the numerator.

It's best to avoid diagonal fraction bars.