PROPERTIES OF REAL NUMBERS

In math, properties are statements that are true for any numbers.
They justify steps when simplifying expressions and solving equations.

PROPERTY	MAIN IDEA	EXAMPLES
COMMUTATIVE *Property* (of Addition or Multiplication)	_____ of values does not matter!	
ASSOCIATIVE *Property* (of Addition or Multiplication)	_____ of values does not matter!	
IDENTITY *Property* (of Addition or Multiplication)	_____ _____ _____!	
INVERSE *Property* (of Addition or Multiplication)	Using _____ to "cancel" a value!	
PROPERTY OF ZERO	Multiplying by _____ always equals _____!	
DISTRIBUTIVE *Property*	_____ a value to an expression inside _____.	

New PROPERTIES

PROPERTY	MAIN IDEA	EXAMPLES
REFLEXIVE *Property*		
SYMMETRIC *Property*		
TRANSITIVE *Property*		

CLOSURE *Property*	A set is **closed** (under an operation) if the operation always produces an element of the same set. If an element outside the set is produced, then the operation is **not closed.**
	Directions: Answer True/False. If false, give a counterexample.
	1) Integers are closed under multiplication. _____
	2) Natural numbers are closed under subtraction. _____
	3) Even numbers are closed under addition. _____
	4) Irrational numbers are closed under division. _____
	5) Perfect squares are closed under subtraction. _____

Properties Warm-Up!!!

_____ **1.** 16 = 16

_____ **2.** $7 + (a + b) = (7 + a) + b$

_____ **3.** $(4y + 1) \cdot 0 = 0$

_____ **4.** If $5 \cdot 2 = 10$ and $10 = \sqrt{100}$, then $5 \cdot 2 = \sqrt{100}$

_____ **5.** $-2(x - y) = -2x + 2y$

_____ **6.** $3 \cdot \frac{1}{3} = 1$

_____ **7.** If $8x = 24$, then $24 = 8x$

_____ **8.** $(2 + 1) + 9 = (1 + 2) + 9$

_____ **9.** $6m \cdot 1 = 6m$

A. Commutative Property

B. Associative Property

C. Distributive Property

D. Identity Property

E. Inverse Property

F. Property of Zero

G. Reflexive Property

H. Symmetric Property

I. Transitive Property

10. True/False: Negative numbers closed under subtraction. Provide an example if false.

PROPERTIES OF REAL NUMBERS

In math, properties are statements that are true for any numbers.
They justify steps when simplifying expressions and solving equations.

PROPERTY	MAIN IDEA	EXAMPLES
COMMUTATIVE *Property* (of Addition or Multiplication)	order of values does not matter!	$a+b = b+a$ $2+3 = 3+2$ $x \cdot y = y \cdot x$ $5 \cdot 4 = 4 \cdot 5$
ASSOCIATIVE *Property* (of Addition or Multiplication)	grouping of values does not matter!	$(a+b)+c = a+(b+c)$ $(5+1)+3 = 5+(1+3)$ $(a \cdot b) \cdot c = a \cdot (b \cdot c)$ $(2 \cdot 4) \cdot 7 = 2 \cdot (4 \cdot 7)$
IDENTITY *Property* (of Addition or Multiplication)	Stays the same!	$a+0 = a$ $a \cdot 1 = a$
INVERSE *Property* (of Addition or Multiplication)	Using opposite to "cancel" a value!	$a + (-a) = 0$ $a \cdot \frac{1}{a} = 1$
PROPERTY OF ZERO	Multiplying by 0 always equals 0!	$17 \cdot 0 = 0$ $a \cdot 0 = 0$ $-\frac{1}{a} \cdot 0 = 0$
DISTRUBITVE *Property*	Multiply a value to an expression inside ( ).	$a(b+c) = ab + ac$ $2(x+7) = 2x + 14$ $-5(y-z) = -5y + 5z$

New PROPERTIES

PROPERTY	MAIN IDEA	EXAMPLES
REFLEXIVE *Property*	A value always equals itself! $a = a$	$16 = 16$ $5x = 5x$ $4y^2 = 4y^2$
SYMMETRIC *Property*	If $a = b$, then $b = a$.	If $x = 3$, then $3 = x$. If $5x = 30$, then $30 = 5x$.
TRANSITIVE *Property*	If $a = b$ and $b = c$, then $a = c$.	If $4 + 3 = 7$ and $7 = \sqrt{49}$, then $4 + 3 = \sqrt{49}$.

CLOSURE *Property*

A set is **closed** (under an operation) if the operation always produces an element of the same set. If an element outside the set is produced, then the operation is **not closed.**

Directions: Answer True/False. If false, give a counterexample.

1) Integers are closed under multiplication. True

2) Natural numbers are closed under subtraction. False
$5 - 9 = -4$

3) Even numbers are closed under addition. True

4) Irrational numbers are closed under division. False
$\frac{\pi}{\pi} = 1$

5) Perfect squares are closed under subtraction. False
$25 - 4 = 21$

Properties WarmUp!!!

G **1.** $16 = 16$

B **2.** $7 + (a + b) = (7 + a) + b$

F **3.** $(4y + 1) \cdot 0 = 0$

I **4.** If $5 \cdot 2 = 10$ and $10 = \sqrt{100}$, then $5 \cdot 2 = \sqrt{100}$

C **5.** $-2(x - y) = -2x + 2y$

E **6.** $3 \cdot \frac{1}{3} = 1$

H **7.** If $8x = 24$, then $24 = 8x$

A **8.** $(2 + 1) + 9 = (1 + 2) + 9$

D **9.** $6m \cdot 1 = 6m$

A. Commutative Property

B. Associative Property

C. Distributive Property

D. Identity Property

E. Inverse Property

F. Property of Zero

G. Reflexive Property

H. Symmetric Property

I. Transitive Property

10. True/False: Negative numbers closed under subtraction. Provide an example if false.

False; $-3 - (-7) = 4$ (not negative)

Name:	Date:
Topic:	Class:

Main Ideas/Questions	Notes/Examples
ALGEBRAIC EXPRESSION	
SUBSTITUTION *Property*	If _____, then _____
EVALUATING *Expressions*	**To evaluate an expression with variable replacements:** • _____ the variables with their given values. • Each time you substitute a variable with a number, put _____ around the number! • Follow the _____ _____ _____ to evaluate!
EXAMPLES	**Directions:** Evaluate each expression using the variable replacements. **1.** $ab^2 + c$ if $a = 2$, $b = 4$, $c = 7$ **2.** $3x^2 - 4x$ if $x = -2$
YOU TRY!	**Directions:** Evaluate each expression using the variable replacements. **3.** $a^2b - b^2$ if $a = 3$ and $b = -4$ **4.** $a^2b - b^2$ if $a = 4$ and $b = -7$ **5.** $-y^2 - 3xy$ if $x = -4$ and $y = 2$ **6.** $-y^2 - 3xy$ if $x = -\frac{5}{6}$ and $y = -12$

7. $\frac{a^2+b^2}{a-b}$ if a = 3 and b = 4

8. $\frac{a^2+b^2}{a-b}$ if a = -3 and b = -5

9. $x^2 - 2(x-y) - z^3$ if x = 2, y = -2, and z = -3

10. $x^2 - 2(x-y) - z^3$ if x = -3, y = 4 and z = -1

11. $-a^2 - 2bc - |c|$ if a = -2, b = 3, and c = -3

12. $-a^2 - 2bc - |c|$ if a = -3, b = -5, and c = 2

Summary: _____

_____

_____

_____

Name: _____ **Unit 1:** Algebra Basics

Date: _____ **Bell:** _____ **Homework 5:** Evaluating Expressions

Directions: Evaluate each expression for the given variable values.

1. $n^2 - 3n + 8$ if $n = 4$

2. $\frac{x^2 - 4y}{2}$ if $x = 4$ and $y = -3$

3. $4|m - n|$ if $m = -7$ and $n = 2$

4. $19 - x^2$ if $x = -5$

5. $s^2t - 10$ if $s = -8$ and $t = \frac{3}{4}$

6. $4p^2 + 7q^3$ if $p = -3$ and $q = -2$

7. $\frac{(a+b)^5}{a-2b^2}$ if $a = 6$ and $b = -8$

8. $\frac{5c^2 - d^2 + 3}{2c - 4d}$ if $c = -1$ and $d = -4$

9. $-q^2 - r^2 + 3s$ if $q = 9$, $r = -6$, $s = -20$

10. $3|x + y|^2 - (xy)^2$ if $x = 3$ and $y = -5$

11. $2x^2 - 5xy - y^3$ if $x = -3$ and $y = -2$

12. $-a^2 + 7b^4 - 2c^3$ if $a = -4$, $b = -2$, $c = -3$

Name:	Date:
Topic:	Class:

Main Ideas/Questions	Notes/Examples
ALGEBRAIC EXPRESSION	A mathematical phrase made up of numbers and variables.
SUBSTITUTION *Property*	If $a = b$, then a may be replaced for b in any expression
EVALUATING *Expressions*	**To evaluate an expression variable replacements:** • Substitute the variables with their given values. • Each time you substitute a variable with a number, put parenthesis around the number! • Follow the order of operations to evaluate!
EXAMPLES	**Directions:** Evaluate each expression using the variable replacements.

1. $ab^2 + c$ if $a = 2$, $b = 4$, $c = 7$

$(2)(4)^2 + 7$

$2(16) + 7$

$32 + 7 = \boxed{39}$

2. $3x^2 - 4x$ if $x = -2$

$3(-2)^2 - 4(-2)$

$3(4) + 8$

$12 + 8 = \boxed{20}$

YOU TRY!	**Directions:** Evaluate each expression using the variable replacements.

3. $a^2b - b^2$ if $a = 3$ and $b = -4$

$(3)^2(-4) - (-4)^2$

$9(-4) - (16)$

$-36 - 16 = \boxed{-52}$

4. $a^2b - b^2$ if $a = 4$ and $b = -7$

$(4)^2(-7) - (-7)^2$

$16(-7) - 49$

$-112 - 49 = \boxed{-161}$

5. $-y^2 - 3xy$ if $x = -4$ and $y = 2$

$-(2)^2 - 3(-4)(2)$

$-4 + 12(2)$

$-4 + 24 = \boxed{20}$

6. $-y^2 - 3xy$ if $x = -\frac{5}{6}$ and $y = -12$

$-(-12)^2 - 3(-5/6)(-12)$

$-144 + (5/2)(-12)$

$-144 - 30 = \boxed{-174}$

7. $\frac{a^2+b^2}{a-b}$ if $a = 3$ and $b = 4$

$\frac{(3)^2+(4)^2}{3-4}$

$\frac{9+16}{-1} = \frac{25}{-1} = \boxed{-25}$

8. $\frac{a^2+b^2}{a-b}$ if $a = -3$ and $b = -5$

$\frac{(-3)^2+(-5)^2}{(-3)-(-5)}$

$\frac{9+25}{-3+5} = \frac{34}{2} = \boxed{17}$

9. $x^2 - 2(x-y) - z^3$ if $x = 2$, $y = -2$, and $z = -3$

$(2)^2-2(2-(-2)) - (-3)^3$

$4-2(4) - (-27)$

$4-8+27$

$-4+27 = \boxed{23}$

10. $x^2 - 2(x-y) - z^3$ if $x = -3$, $y = 4$ and $z = -1$

$(-3)^2-2(-3-4) - (-1)^3$

$9-2(-7) - (-1)$

$9+14+1$

$23+1 = \boxed{24}$

11. $-a^2 - 2bc - |c|$ if $a = -2$, $b = 3$, and $c = -3$

$-(-2)^2-2(3)(-3) - |-3|$

$-4-6(-3)-3$

$-4+18-3$

$14-3 = \boxed{11}$

12. $-a^2 - 2bc - |c|$ if $a = -3$, $b = -5$, and $c = 2$

$-(-3)^2-2(-5)(2) - |2|$

$-9+10(2)-2$

$-9+20-2$

$11-2 = \boxed{9}$

Summary: _____

Name: _____ **Unit 1:** Algebra Basics

Date: _____ **Bell:** _____ **Homework 5:** Evaluating Expressions

Directions: Evaluate each expression for the given variable values.

1. $n^2 - 3n + 8$ if $n = 4$

$(4)^2 - 3(4) + 8$

$16 - 12 + 8$

$4 + 8 = \boxed{12}$

2. $\frac{x^2 - 4y}{2}$ if $x = 4$ and $y = -3$

$\frac{(4)^2 - 4(-3)}{2} = \frac{16 + 12}{2} = \frac{28}{2}$

$= \boxed{14}$

3. $4|m - n|$ if $m = -7$ and $n = 2$

$4|(-7) - 2|$

$4|-9|$

$4(9) = \boxed{36}$

4. $19 - x^2$ if $x = -5$

$19 - (-5)^2$

$19 - 25 = \boxed{-6}$

5. $s^2t - 10$ if $s = -8$ and $t = \frac{3}{4}$

$(-8)^2(3/4) - 10$

$64(3/4) - 10$

$48 - 10 = \boxed{38}$

6. $4p^2 + 7q^3$ if $p = -3$ and $q = -2$

$4(-3)^2 + 7(-2)^3$

$4(9) + 7(-8)$

$36 - 56 = \boxed{-20}$

7. $\frac{(a+b)^5}{a - 2b^2}$ if $a = 6$ and $b = -8$

$\frac{(6 + (-8))^5}{6 - 2(-8)^2} = \frac{(-2)^5}{6 - 2(64)} = \frac{-32}{6 - 128}$

$= \frac{-32}{-122} = \boxed{\frac{16}{61}}$

8. $\frac{5c^2 - d^2 + 3}{2c - 4d}$ if $c = -1$ and $d = -4$

$\frac{5(-1)^2 - (-4)^2 + 3}{2(-1) - 4(-4)} = \frac{5 - 16 + 3}{-2 + 16}$

$= \frac{-8}{14} = \boxed{-\frac{4}{7}}$

9. $-q^2 - r^2 + 3s$ if $q = 9$, $r = -6$, $s = -20$

$-(9)^2 - (-6)^2 + 3(-20)$

$-81 - 36 - 60$

$-117 - 60 = \boxed{-177}$

10. $3|x + y|^2 - (xy)^2$ if $x = 3$ and $y = -5$

$3|3 + (-5)|^2 - (3 \cdot -5)^2$

$3|-2|^2 - (-15)^2$

$3(4) - 225$

$12 - 225 = \boxed{-213}$

11. $2x^2 - 5xy - y^3$ if $x = -3$ and $y = -2$

$2(-3)^2 - 5(-3)(-2) - (-2)^3$

$2(9) + 15(-2) - (-8)$

$18 - 30 + 8$

$-12 + 8 = \boxed{-4}$

12. $-a^2 + 7b^4 - 2c^3$ if $a = -4$, $b = -2$, $c = -3$

$-(-4)^2 + 7(-2)^4 - 2(-3)^3$

$-16 + 7(16) - 2(-27)$

$-16 + 112 + 54$

$96 + 54 = \boxed{150}$

WARM-UP!!!

Translate the following expressions, equations, & inequalities:

1. "The product of a number and 7" _____

2. "Nine subtracted from twice a number" _____

3. "One less than the quotient of a number and -5. _____

4. "Three times the sum of a number and 10 is 24" _____

5. "The difference of twice a number and 3 is -21." _____

6. "One-third of a number increased by 8 is 37." _____

7. "x is at most 6" _____

8. "You must be at least 18 years old to vote" _____

WARM-UP!!!

Translate the following expressions, equations, & inequalities:

1. "The product of a number and 7" — $7n$
2. "Nine subtracted from twice a number" — $2n - 9$
3. "One less than the quotient of a number and -5." — $\frac{n}{-5} - 1$
4. "Three times the sum of a number and 10 is 24" — $3(n + 10) = 24$
5. "The difference of twice a number and 3 is -21." — $2n - 3 = -21$
6. "One-third of a number increased by 8 is 37." — $\frac{1}{3}n + 8 = 37$
7. "x is at most 6" — $x \leq 6$
8. "You must be at least 18 years old to vote" — $x \geq 18$

Name:	Date:
Topic:	Class:

Main Ideas/Questions	Notes/Examples		
Distributive Property **Recall:** $a(b+c)=$ or $a(b-c)=$	**1.** $7(x+4)$	**2.** $2(b-3)$	**3.** $-4(y+3)$
	4. $-5(m-2)$	**5.** $-(y-9)$	**6.** $8(4-b)$
	7. $-4(-w-10)$	**8.** $5(2m-3)$	**9.** $-3(2x-4)$
	10. $3(m+n)$	**11.** $x(y+4)$	**12.** $d(c-4)$
	13. $6a(b+2c)$	**14.** $2(x-y+8)$	**15.** $x(2y-5z+1)$
	16. $\frac{1}{4}(8x-4)$	**17.** $\frac{1}{6}\left(\frac{3}{5}x+18\right)$	**18.** $-\frac{1}{8}\left(\frac{4}{5}x-24\right)$
Distribute AND Combine!	To **simplify an expression** means to ensure there are **no parentheses** and **no like terms**. In order to do this, distribute first (if needed),then combine like terms.		
Examples	**19.** $8(2x-3)-6x$	**20.** $9(2k-4)-2(7k-12)$	
	21. $10-(y-6)-y$	**22.** $6+8(4w-7)-(2w+1)$	
	23. $\frac{9}{4}\left(\frac{10}{3}x-4\right)-\frac{1}{4}(2x-8)$	**24.** $\frac{7}{8}\left(\frac{4}{5}x+16\right)+\frac{3}{5}\left(\frac{1}{2}x-10\right)$	

Name: _____ **Unit 1:** Algebra Basics

Date: _____ **Bell:** _____ **Homework 8:** Simplifying Expressions

Directions: Simplify each expression by distributing.	
1. $8(x + 5)$ = _____	**2.** $3(2y - 7)$ = _____
3. $-2(3m + 9)$ = _____	**4.** $-6(z - 1)$ = _____
5. $-(5x + 1)$ = _____	**6.** $-(x + 4)$ = _____
7. $b(a - 6)$ = _____	**8.** $7a(3b - 2c + 4)$ = _____
9. $\frac{1}{2}(8x+2)$ = _____	**10.** $\frac{2}{3}\left(\frac{1}{4}x-6\right)$ = _____

Directions: Simplify each expression by distributing and combining like terms.	
11. $-7(w - 4) + 3w - 27$	**12.** $6(x + 1) - 5(x + 2)$
13. $-5(k + 6) + 7(k - 4)$	**14.** $8(x + 5) - 4(x + 4)$
15. $-9(m + 2) + 4(6 - 7m)$	**16.** $-3(-9v - 4) - 2(v - 2)$
17. $-4(8 - c) - (3c + 7)$	**18.** $6(p + 6) - (p - 6)$
19. $21 - 8(w + 3) + 3 + 7w$	**20.** $\frac{1}{2}\left(\frac{3}{5}x-8\right)+\frac{7}{4}\left(\frac{2}{5}x+4\right)$

Name:	Date:
Topic:	Class:

Main Ideas/Questions	Notes/Examples		
Distributive Property Recall: $a(b+c)=$ $ab+ac$ or $a(b-c)=$ $ab-ac$	**1.** $7(x+4)$ $7x+28$	**2.** $2(b-3)$ $2b-6$	**3.** $-4(y+3)$ $-4y-12$
	4. $-5(m-2)$ $-5m+10$	**5.** $-(y-9)$ $-y+9$	**6.** $8(4-b)$ $32-8b$
	7. $-4(-w-10)$ $4w+40$	**8.** $5(2m-3)$ $10m-15$	**9.** $-3(2x-4)$ $-6x+12$
	10. $3(m+n)$ $3m+3n$	**11.** $x(y+4)$ $xy+4x$	**12.** $d(c-4)$ $dc-4d$
	13. $6a(b+2c)$ $6ab+12ac$	**14.** $2(x-y+8)$ $2x-2y+16$	**15.** $x(2y-5z+1)$ $2xy-5xz+x$
	16. $\frac{1}{4}(8x-4)$ $2x-1$	**17.** $\frac{1}{6}\left(\frac{3}{5}x+18\right)$ $\frac{1}{10}x+3$	**18.** $-\frac{1}{8}\left(\frac{4}{5}x-24\right)$ $-\frac{1}{10}x+3$
Distribute AND Combine!	To **simplify an expression** means to ensure there are **no parentheses** and **no like terms**. In order to do this, distribute first (if needed), then combine like terms.		
Examples	**19.** $8(2x-3)-6x$ $16x-24-6x$ $=\boxed{10x-24}$	**20.** $9(2k-4)-2(7k-12)$ $18k-36-14k+24$ $=\boxed{4k-12}$	
	21. $10-(y-6)-y$ $10-y+6-y$ $=\boxed{-2y+16}$	**22.** $6+8(4w-7)-(2w+1)$ $6+32w-56-2w-1$ $=\boxed{30w-51}$	
	23. $\frac{9}{4}\left(\frac{10}{3}x-4\right)-\frac{1}{4}(2x-8)$ $\frac{15}{2}x-9-\frac{1}{2}x+2$ $=\boxed{7x-7}$	**24.** $\frac{7}{8}\left(\frac{4}{5}x+16\right)+\frac{3}{5}\left(\frac{1}{2}x-10\right)$ $\frac{7}{10}x+14+\frac{3}{10}x-6$ $=\boxed{x+8}$	

Name: _____ **Unit 1:** Algebra Basics

Date: _____ **Bell:** _____ **Homework 8:** Simplifying Expressions

Directions: Simplify each expression by distributing.	
1. $8(x + 5) =$ $8x + 40$	**2.** $3(2y - 7) =$ $6y - 21$
3. $-2(3m + 9) =$ $-6m - 18$	**4.** $-6(z - 1) =$ $-6z + 6$
5. $-(5x + 1) =$ $-5x - 1$	**6.** $-(x + 4) =$ $-x - 4$
7. $b(a - 6) =$ $ab - 6b$	**8.** $7a(3b - 2c + 4) =$ $21ab - 14ac + 28a$
9. $\frac{1}{2}(8x + 2) =$ $4x + 1$	**10.** $\frac{2}{3}\left(\frac{1}{4}x - 6\right) =$ $\frac{1}{6}x - 4$

Directions: Simplify each expression by distributing and combining like terms	
11. $-7(w - 4) + 3w - 27$ $-7w + 28 + 3w - 27$ $= \boxed{-4x + 1}$	**12.** $6(x + 1) - 5(x + 2)$ $6x + 6 - 5x - 10$ $= \boxed{x - 4}$
13. $-5(k + 6) + 7(k - 4)$ $-5k - 30 + 7k - 28$ $= \boxed{2k - 58}$	**14.** $8(x + 5) - 4(x + 4)$ $8x + 40 - 4x - 16$ $= \boxed{4x + 24}$
15. $-9(m + 2) + 4(6 - 7m)$ $-9m - 18 + 24 - 28m$ $= \boxed{-37m + 6}$	**16.** $-3(-9v - 4) - 2(v - 2)$ $27v + 12 - 2v + 4$ $= \boxed{25v + 16}$
17. $-4(8 - c) - (3c + 7)$ $-32 + 4c - 3c - 7$ $= \boxed{c - 39}$	**18.** $6(p + 6) - (p - 6)$ $6p + 36 - p + 6$ $= \boxed{5p + 42}$
19. $21 - 8(w + 3) + 3 + 7w$ $21 - 8w - 24 + 3 + 7w$ $= \boxed{-w}$	**20.** $\frac{1}{2}\left(\frac{3}{5}x - 8\right) + \frac{7}{4}\left(\frac{2}{5}x + 4\right)$ $\frac{3}{10}x - 4 + \frac{7}{10}x + 7 = \boxed{x + 3}$