Name _____ Date _____

Properties of Zero/Identity Elements

Zero is a very special number in our numeration system. Zero never has a positive or negative sign associated with it. So when zero is added to any number, the answer is always the number to which zero is added. This is known as the *identity element for addition.*

5 + 0 = 5	12 + 0 = 12	180 + 0 = 180
0 + 5 = 5	0 + 12 = 12	0 + 180 = 180

In algebra you will see the identity element for addition stated as $a + 0 = a$ and $0 + a = a$.

Zero has another property called the *multiplication property for zero.* This property states that if zero is multiplied by any number, the result is always zero.

5 X 0 = 0	0 X 114 = 0	28 X 0 = 0
0 X 9 = 0	12 X 0 = 0	0 X 13 = 0

In algebra this property is often stated as $a \times 0 = 0$ and $0 \times a = 0$.

The *identity element for multiplication* says that when any number is multiplied by 1, the answer will always be the number being multiplied by one. In algebra books you will often see the identity element for multiplication stated as $a \times 1 = a$ and $1 \times a = a$.

Answer the following:

1. When zero is added to any number, the answer is always the (a) _____ to which zero has been added.
(b) 6 + 0 = _____ (c) 0 + 6 = _____ (d) 24 + 0 = _____ (e) 0 + 24 = _____

2. When zero is multiplied by any number, the answer is always (a) _____ .
(b) 6 X 0 = _____ (c) 0 X 6 = _____ (d) 24 X 0 = _____ (e) 0 X 24 = _____

3. The identity element for multiplication says that when any number is multiplied by 1, the answer will always be the number being multiplied by (a) _____ .
(b) 6 X 1 = _____ (c) 1 X 6 = _____ (d) 24 X 1 = _____ (e) 1 X 24 = _____

Place the letter that matches the definition of the property demonstrated in each problem in the space before it. The first one is done for you.

A. Identity element for addition B. Identity element for multiplication
C. Multiplication property of zero

1. A 8 + 0 = 8	6. _____ 0 + 48 = 48	11. _____ 96 X 1 = 96
2. _____ 9 X 1 = 9	7. _____ 1 X 17 = 17	12. _____ 1 X 124 = 124
3. _____ 4 X 0 = 0	8. _____ 17 X 1 = 17	13. _____ 47 X 0 = 0
4. _____ 0 X 27 = 0	9. _____ 0 X 38 = 0	14. _____ 117 + 0 = 117
5. _____ 19 + 0 = 19	10. _____ 22 X 0 = 0	15. _____ 0 X 0 = 0

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Properties of Subtraction and Division

So far all of your work with number properties has involved addition and multiplication. Will these same number properties work with subtraction and division?

The commutative properties for multiplication and addition let you multiply or add whole numbers in any order and get the correct product or sum.

The commutative property for whole number multiplication says $a \times b = b \times a$. If $a = 4$ and $b = 2$, then $4 \times 2 = 2 \times 4$ or $8 = 8$.

The commutative property for whole number addition says $a + b = b + a$. If $a = 4$ and $b = 2$, then $4 + 2 = 2 + 4$ or $6 = 6$.

Will the commutative property work for subtraction? Does $a - b = b - a$? If $a = 4$ and $b = 2$, does $4 - 2 = 2 - 4$? No, because $4 - 2 = 2$, while $2 - 4 = -2$. So $a - b$ does *not* equal $b - a$. You will note that -2 is not a whole number; it is a negative number and part of the integer number system.

What about the commutative property and division? Does $a \div b = b \div a$? If $a = 4$ and $b = 2$, does $4 \div 2 = 2 \div 4$? No, because $4 \div 2 = 2$, while $2 \div 4 = 1/2$. So $a \div b$ does not equal $b \div a$.

The commutative property does not work for subtraction and division problems.

Will the associative property work for subtraction? Will $(a - b) - c = a - (b - c)$? Let's check by letting $a = 8$, $b = 4$, and $c = 2$.

$(8 - 4) - 2 = 2$, but $8 - (4 - 2) = 6$, so $(a - b) - c$ does not equal $a - (b - c)$.

The associative property does not work for subtraction.

Does the associative property work for division? Does $(a \div b) \div c = a \div (b \div c)$? Let's check by letting $a = 8$, $b = 4$, and $c = 2$.

$(8 \div 4) \div 2 = 1$, but $8 \div (4 \div 2) = 4$, so $(a \div b) \div c$ does not equal $a \div (b \div c)$.

The associative property does not work for division.

For the next exercise you will use two symbols. The symbols are (=) for equals and ($\neq$) for does not equal. Insert the correct symbol (= or $\neq$) in the blank in each of the following problems.

Example: $a \times b$ = $b \times a$
(a X b equals b X a, so the symbol = goes in the blank)

Remember to check each problem to determine if = or $\neq$ is correct. Substitute $a = 8$, $b = 4$, and $c = 2$, and work each problem.

1. $a + b$ _____ $b + a$
2. $a \times (b \times c)$ _____ $(a \times b) \times c$
3. $a + (b + c)$ _____ $(a + b) + c$
4. $a - b$ _____ $b - a$
5. $a \div b$ _____ $b \div a$
6. $a - (b - c)$ _____ $(a - b) - c$
7. $a \div (b \div c)$ _____ $(a \div b) \div c$

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