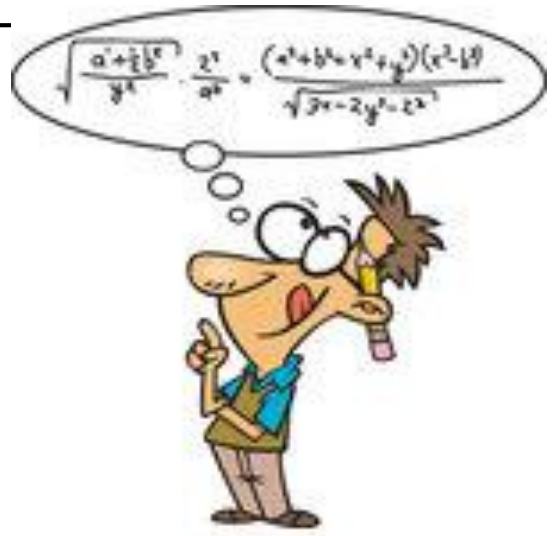
Expressions

Name _____ Period _____

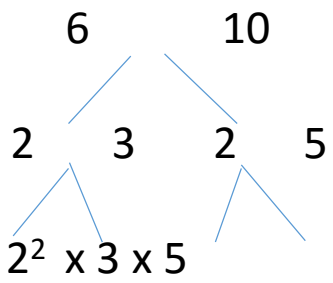


Exponents

A quick review of **exponents**:

So far this year, we have worked with exponents in prime factorization.

Prime factorization: 60



Write the prime factorization using exponents: 64

We have also worked on dividing and multiplying using a power of 10.

Example: 54.247 x 100 = 5,424.7

Example: 54.247 ÷ 100 = 0.54247

Exponents can be used to show powers (or multiples) of 10.

$10^1 = 10$ $10^2 = 100$ $10^3 = 1{,}000$ $10^4 = 10{,}000$ $10^5 = 100{,}000$ and so on.

Try these:

63.852×10^5 _____

$837.436 \div 10^2$ _____

9.2905×10^3 _____

$9253.98 \div 10^5$ _____

Now it's time to learn the proper vocabulary for exponents and to practice with larger numbers.

An **exponent** tells how many times a number is used as a factor.
The **base** is the number being multiplied repeatedly.

For example, in 2^5 5 is the exponent and 2 is the base.

2^5 =	2x2x2x2x2 =	32
power	expanded notation	standard form

Try these:

Write 5^3 in standard form _____

What is the base in this expression? 3^2 _____

What is the exponent in this expression? 3^4 _____

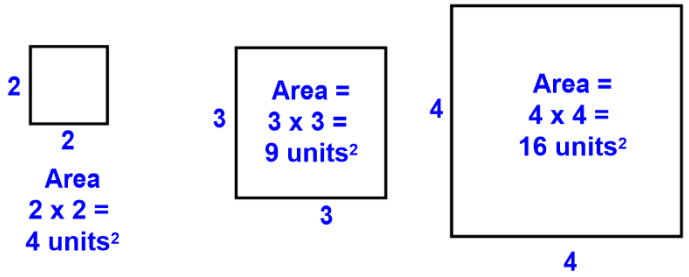
Write 7x7x7x7x7 as a power _____

There are two exponents that are used frequently in geometry: squares and cubes.

Squares

Squares - Raising a number to the power of 2 is called squaring it.

2^2 is two squared, and 4 is the square of 2
3^2 is three squared, and 9 is the square of 3
4^2 is four squared, and 16 is the square of 4

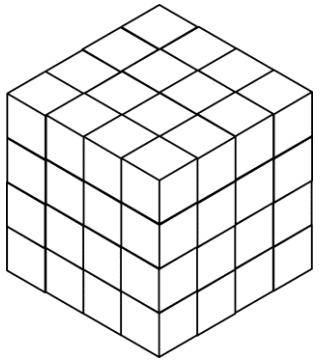


The formula for the area of a square is length x width or side^2 .

Cubes

Cubes - Raising a number to the power of 3 is called "cubing" it.

2^3 is read as "two cubed," and 8 is the cube of 2
3^3 is read as "three cubed," and 27 is the cube of 3
4^3 is read as "four cubed," and 64 is the cube of 4



In this picture, the volume of the cube is 4^3 units^3 since each side is four small cubes long.
The formula for the volume of a cube can be written as length x width x height or side^3 .
The volume is 64 units^3 .

Try these:

$4^{2} =$ _____ $5^{3} =$ ____

Find the square of 6: _____ Find the cube of 4: _____

Find the area of a square with sides of 5: _____ (Area of a Square = side^{2})

Find the volume of a cube with sides of 2: _____ (Volume of a Cube = side^{3})

On Tuesday, you invited 2 friends to your party. On Wednesday, each of those friends invited 2 friends. This pattern continued on Thursday and Friday. How many people were invited by Friday? Write your answer as a power.

Bob is putting a new carpet in his living room. The room is 14 ft x 14 ft . How much carpeting does Bob need to buy?

Order of Operations

The order of operations is a set of rules made by mathematicians.
The rules tell what to do first, second, third and so on in a number sentence.
Without these rules, the world would descend into chaos:

2 x 3 + 4 could equal 10 if we multiply first then add second.
2 x 3 + 4 could equal 14 if we all first then multiply second.
Pure Chaos!!

To prevent pure chaos, the following rules have been agreed upon:

Step 1: Complete any work within **p**arentheses or brackets.

Step 2: Use **e**xponents to raise any bases by a power.

Step 3: **M**ultiply or **D**ivide working from left to right.

Step 4: **A**dd or **S**ubtract working from left to right.

You may have heard of these steps before.

PEMDAS

P- parentheses
E-exponents
M-multiply
D-divide
A-add
S-subtract

Sometimes people use a mnemonic device to remember the order:

Please
Excuse
My **D**ear
Aunt **S**ally

We'll start simply, and work our way up to more complicated. Please make sure you solve these problems the way I show you. This will be very important as the expressions become more complicated. This is the format your 7^{th} grade teachers will expect you to use as well.

$2 + 5 \times 6$ $4 + 2 - 5$ $36 \div 6 + 6$ $24 \div 4 + 8 + 2$

$36 \div (6 + 6)$ $48 \div (4 + 8) + 2^2$ $48 \div 4 + 8 + 2^2$ $3^2 - 8 \times 3$

It’s very important to notice the difference between these two expressions:

P E M/D A/S

$12 \times (3 + 2^2) \div 2 - 10$

P E M/D A/S

$12 \times (3 + 2)^2 \div 2 - 10$

More to try:

$(5^2 + 7) \div 4$

$6 \times 4 - 4 + 2$

$18 - 3 \times 5 + 2$

$49 - 4 \times (49 \div 7)$

$(64 \div 8) \times 3 + 6$

$72 \div (4 + 4) \times 5$

$25 + 14 \times (52 - 6)$

$39 \div (2 + 1) - 2 \times (4 + 1)$

After you have completed the quiz question, try out these fun games!

http://mrnussbaum.com/orderops/

http://www.math-play.com/Order-of-Operations-Millionaire/division-millionaire.html

Expressions Vocabulary

- **Expression –** a variable or combination of variables, numbers and symbols that represent a mathematical relationship.

- **Algebra** is the type of math that uses letters and symbols to represent numbers.

- A **variable** is any letter or symbol that represents a number. In **5m + 7 (m is a variable)**

- A **constant** is a fixed value, a number on its own, whose value does not change.
  A constant may either be negative or positive.
  In **2x + 8 (8 is a constant.)** In **8b – 12 (-12 is a constant)**

- A **coefficient** is the number multiplied by the variable. In **2x -10 (2 is the coefficient.**)
  In **h + 9 (1 is the coefficient)**

- An **algebraic expression** is a group of numbers, symbols, and variables that express an operation or a series of operations. It has at least one variable and one operation.

- A **term** is a number, variable, product or quotient in an expression.

  There are two terms in 5x +14 (5x is a term and 14 is a term.)

$8g + 3$ is an algebraic expression

g is the variable

3 is the constant

8 is the coefficient

$25f - 8$

___ is the variable

___ is the constant

___ is the coefficient

$43 + 17k$

___ is the variable

___ is the constant

___ is the coefficient

$12 - 4x$

___ is the variable

___ is the constant

___ is the coefficient

Circle the constant and underline the coefficient for each expression below

a. $5x - 3$

b. $2x + 7$

c. $2 - 4x$

d. $x + 3$

Addition Key Words		Subtraction Key Words	
sum	*more than	minus	decreased by
total	add	difference	less
altogether	in all	*less than	take away
plus	added to	*fewer than	subtract
increased by		How many more	

Multiplication Key Words		Division Key Words	
product	times	divided by	divisible by
multiplied by	groups of	quotient of	half
of	factor	Each	per
twice	double	fractions	

Be Very Careful

If you see the words <u>than</u> or <u>from</u> with a key word, it means you have to reverse the order of the two items on either side of the word.

So many ways to show the same thing! These are all acceptable ways to show multiplication. Now that x might be used as a variable, you should mostly use parentheses or the dot or touching.

The many looks of multiply:

$3(5)$

$3 \cdot 5$

$3x$

In algebra, division is often shown in fraction form.

$12 \div 3$ is $\frac{12}{3}$

1. *Three less than eight:

2. Eight less three

3. *3 more than x

4. 2 times m

5. 8 divided by s

6. The product of 6 and 8, minus k

7. 35 times the quantity of x minus 7

Watch for word clues or punctuation that tell you that part of the expression needs to be kept separate from another part. We use parentheses to separate parts.
Word clues: the quantity of
the sum of
the product of
the difference of
the quotient of
Punctuation clue: ,

The order of operations still counts!!

Adult ticket prices are $3 more than child ticket prices. Determine the adult ticket price, given the child ticket price.

Child Ticket Price	Adult Ticket Price
$5	
$7	
$10	
$12	

Write an expression that represents the adult price, if the child price is "x"

Mary has $\frac{1}{2}$ the amount of money that Jim has. Determine the amount of money that Mary has, given Jim's amount of money.

Jim's Amount of Money	Mary's Amount of Money
$50	
$100	
$175	
$220	

Write an expression that represents the amount of money Mary has, given the amount of Jim's money, if Jim's money is "m".

Evaluating Expressions

To evaluate an expression, just put a number in for the variable. Then follow the order of operations to get an answer.

Putting a number in for the variable is called substituting.

We'll start simply and work our way up to a challenge level.

Use substitution to evaluate each expression.

$t-8$ if $t=18$ $6w + 9$ if $w=3$ $2x + 4$ if $x=12$

$3m + 4 - 2m$ if $m=5$

$p + (8p-4)$ if $p=9$

$9x$ if $x=3$

$\frac{x}{5}$ if $x=60$

$n-4^2$ if $n=40$

$5y-5^2$ if $y=10$

Let's try some stories now. Read the story. Write the expression using the variable m. Then evaluate each expression if m=10.

Sammy has two more baseballs than his brother Ethan.

_____

_____

Ella wrote 8 fewer stories than Anna.

_____

_____

Nick has twice as many pencils as Justin.

_____

_____

Kaleea has half the number of papers that Ciara has.

_____

_____

$(2n + 1)^2$ for n = 3

$2(n + 1)^2$ for n = 4

$2n + 2^2$ for n = 3

4x + 3x for x = 5

3(x – 3) for x = 7

8(x + 5)(x – 2) for x = 4

$3x^2$ for x = 2

$5x + 45$ for $x = \frac{1}{4}$

$x + (2x - 8)$ for x = 10

$5(3x) + 8y$ for x = 2.5 and y = 10

$6x + 8y$ for $x = 9$ and $y = \frac{1}{4}$

Commutative Property

"Change Order"

You can add or multiply numbers in any order and the sum or product will be the same.

Commutative Property of Addition

10+5+3 = 5+3+10

Commutative Property of Multiplication

7x5 = 5x7

Associative Properties

You can group numbers differently. It will not affect the sum or product.

Associative Property of Addition

2+(8+3) = (2+8)+3

Associative Property of Multiplication

(4x5) x 8 =4 x (5x8)

Identity Properties

Identity Property of Addition - You can add zero to a number and not change the value of the number.

0+10+5+3 = 5+3+10

Identity Property of Multiplication- You can multiply a number by 1 and not change the value of the number.

7x5 = 5x7x1

Distributive Property

85 = 80+5

10 x 24 = (10x20) + (10x4)

8(6+7) = 48 + 56

9(m + 7) = 9m + 63

Use the property named to rewrite each expression.

Commutative Property	10 + 3	_____
Associative Property	22 + (10 + 2)	_____
Distributive Property	6(4 + 2)	_____
Identity Property of addition	32 + 16	_____
Identity Property of multiplication	6 x 3	_____

Combining Like Terms

Earlier in this unit we talked about "terms". A term is a part of an expression.
For example, in the expression 5x + 6y – 3, there are three terms: 5x 6y -3

Now we will work on combining, or putting together any terms that are "like" using addition and subtraction. Like terms can be two numbers, two of the same variables, two of the same variable raised to the same power, two coefficients with the variable and so on.

Let's look at some examples.

Like terms	Not like terms
2 5	2 b
b b	b w
c^2 c^2	c^2 c^3
4m 2m	4w 2b
$5a^2$ $6a^2$	$5a^2$ $5a^4$

Combine like terms. Use any properties that will help!

$7x + 8x$

$6x + 8y + 2x$

$15x^2 + 5x^2$

$5x + 2(x + 8)$

$10y + 4y$

$9(x + 5) + 7(x - 3)$

$8 + 2(x - 4)$

$7y + 8x + 3y + 2x$

$x + 2x$

$x^2 + 5x^2$

$2x + 4x + 3$

$6y - 3y$

$9y + 4y - 2y + y$

$x + 5x + x + 12$

$8x - 3x + 2x + 15$

Let's kick it up a notch! Here are a few more rules that you will need to know for 7^{th} grade.

- Make sure you are only combining terms when the variable has the same exponent.
- You should always put the variables of your answer in alphabetical order, then in order by exponent.

$2a + 3a^2 - 4a$

$14m + 3m^2 - 2m^2 + 3m - 5$

$4c + 3a - 2b + 7a^2$

$m(3m + 5) - 2m^2 - 7$

$3h + 5h + 14g - 5g$

$2x^2 + 5x^3 - 6x^2 + x^4$

Equivalent Expressions

Two expressions are equivalent if they match after we work with them using properties and combining like terms.

$6(p + q)$ and $6p + q$

$7y - 15 + 2y$ and $9y - 15$

$1 + (8r + 9)$ and $(2 + 8) + 8r$

$0 \times 11 + 5n$ and $5n$

$16m - 4 + m$ and $12m$

$11d \times 2$ and $22d$

$10(e + 0.5g)$ and $10e + 5g$

$8m + (9m - 1)$ and $8m - 8$

$7(1 + 2h)$ and $10 + h + h - 3$

Using Expressions to Describe Patterns

Pounds of Apples (input)	**1**	**2**	**3**	**5**	**10**
Cost (output)	$2	$4	$6		

Study the table to understand the pattern.
How much does each pound of apples cost? _____
What is the pattern? _____
Write it as an expression using a variable in place of the input_____
Fill in the table for 5 pounds and 10 pounds.
What would the cost be for 15 pounds? _____

Total Students (Input)	12	18	27	33	39	60	90
Number of Study Groups (Output)	4	6	9				

What is the pattern? _____
Write it as an expression using a variable in place of the input _____
Fill in the table for 33, 39, 60 and 90.

Tanya has a job delivering newspapers. Every week, each of her customers pay her $1.50. She also receives $5.00 each week for completing her route.

Number of Customers (Input)	1	2	5	8	10	20	30
Earnings(Output) $5 + $1.50 per customer	$6.50	$8.00					

What is the pattern? _____
Write it as an expression using a variable in place of the input _____
Fill in the table for 5, 8, 10, 20 and 30.