Dutchtown
Elementary School
"We are a family of learners"

5th Grade CCGPS Math ***Unit 1: Order of Operations and Whole Numbers*** Study Guide

Dear Student:

Please review the Math standards below to prepare for the end-of-unit assessment during the week of **October 27, 2014.** This will require that students take their interactive math notebook home each night to review notes, handouts, and examples from class. Please visit the **websites for extra practice** listed throughout this study guide. These websites are aligned to all 5th grade common core standards and include interactive exercises, math games, pdf printables, and video review lessons. Set aside enough study time each day prior to the assessment to ensure that you will do your best. Thanks! ☺

Unit 1 STANDARDS FOR MATHEMATICAL CONTENT

- **MCC5.OA.1** Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.
- **MCC5.OA.2** Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.
- **MCC5.NBT.1.** Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.
- **MCC5.NBT.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.
- **MCC5.NBT.5** Fluently multiply multi-digit whole numbers using the standard algorithm.
- **MCC5.NBT.6** Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

Order of Operations

Problem: Evaluate the following arithmetic expression:
3 + 4 x 2

Solution:

Student 1	**Student 2**
3 + 4 x 2	3 + 4 x 2
= 7 x 2	= 3 + 8
= 14	= 11

It seems that each student interpreted the problem differently, resulting in two different answers. Student 1 performed the operation of addition first, then multiplication; whereas student 2 performed multiplication first, then addition. When performing arithmetic operations there can be only one correct answer. We need a set of rules in order to avoid this kind of confusion. Mathematicians have devised a standard order of operations for calculations involving more than one arithmetic operation.

Rule 1: First perform any calculations inside parentheses.

Rule 2: Next perform all multiplications and divisions, working from left to right.

Rule 3: Lastly, perform all additions and subtractions, working from left to right.

The above problem was solved correctly by Student 2 since she followed Rules 2 and 3. Let's look at some examples of solving arithmetic expressions using these rules.

Example 1: Evaluate each expression using the rules for order of operations.

Solution:

Order of Operations		
Expression	**Evaluation**	**Operation**
6 + 7 x 8	= 6 + **7 x 8**	Multiplication
	= 6 + 56	Addition
	= 62	
16 ÷ 8 - 2	= **16 ÷ 8** - 2	Division
	= 2 - 2	Subtraction
	= 0	
(25 - 11) x 3	= **(25 - 11)** x 3	Parentheses
	= 14 x 3	Multiplication
	= 42	

In Example 1, each problem involved only 2 operations. Let's look at some examples that involve more than two operations.

Example 2: Evaluate 3 + 6 x (5 + 4) ÷ 3 - 7 using the order of operations.

Solution:

Step 1:	3 + 6 x **(5 + 4)** ÷ 3 - 7	=	3 + 6 x 9 ÷ 3 - 7	Parentheses
Step 2:	3 + **6 x 9** ÷ 3 - 7	=	3 + 54 ÷ 3 - 7	Multiplication
Step 3:	3 + **54 ÷ 3** - 7	=	3 + 18 - 7	Division

Step 4: **3 + 18** - 7 = 21 - 7 Addition

Step 5: 21 - 7 = 14 Subtraction

Example 3: Evaluate 9 - 5 ÷ (8 - 3) x 2 + 6 using the order of operations.

Solution:

Step 1:	9 - 5 ÷ **(8 - 3)** x 2 + 6	=	9 - 5 ÷ 5 x 2 + 6	Parentheses
Step 2:	9 - **5 ÷ 5** x 2 + 6	=	9 - 1 x 2 + 6	Division
Step 3:	9 - **1 x 2** + 6	=	9 - 2 + 6	Multiplication
Step 4:	**9 - 2** + 6	=	7 + 6	Subtraction
Step 5:	7 + 6	=	13	Addition

In Examples 2 and 3, you will notice that multiplication and division were evaluated from left to right according to Rule 2. Similarly, addition and subtraction were evaluated from left to right, according to Rule 3.

Practice Problems:

Solve.

1. **9 + 6 x (8 - 5)**
2. **(14 - 5) ÷ (9 - 6)**
3. **5 x 8 + 6 ÷ 6 - 12 x 2**

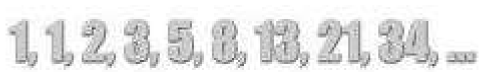
When two or more operations occur inside a set of parentheses, these operations should be evaluated according to Rules 2 and 3. This is done in Example 4 below.

Example 4: Evaluate 150 ÷ (6 + 3 x 8) - 5 using the order of operations.

Solution:

Step 1:	150 ÷ (6 + **3 x 8**) - 5	=	150 ÷ (6 + 24) - 5	Multiplication inside Parentheses
Step 2:	150 ÷ **(6 + 24)** - 5	=	150 ÷ 30 - 5	Addition inside Parentheses
Step 3:	**150 ÷ 30** - 5	=	5 - 5	Division
Step 4:	5 - 5	=	0	Subtraction

Exponents



In the table below, the number 2 is written as a factor repeatedly. The product of factors is also displayed in this table. Suppose that your teacher asked you to *Write 2 as a factor one million times* for homework. How long do you think that would take? Answer

Factors	Product of Factors	Description
2 x 2 =	4	2 is a factor 2 times
2 x 2 x 2 =	8	2 is a factor 3 times
2 x 2 x 2 x 2 =	16	2 is a factor 4 times
2 x 2 x 2 x 2 x 2 =	32	2 is a factor 5 times

2 x 2 x 2 x 2 x 2 x 2 =	64	2 is a factor 6 times
2 x 2 x 2 x 2 x 2 x 2 x 2 =	128	2 is a factor 7 times
2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 =	256	2 is a factor 8 times

Writing 2 as a factor one million times would be a very time-consuming and tedious task. A better way to approach this is to use **exponents**. Exponential notation is an easier way to write a number as a product of many factors.

$\text{Base}^{\text{Exponent}}$ The *exponent* tells us how many times the *base* is used as a factor.

For example, to write 2 as a factor one million times, the base is 2, and the exponent is 1,000,000. We write this number in exponential form as follows:

$2^{1,000,000}$ read as *two raised to the millionth power*

Example 1: Write 2 x 2 x 2 x 2 x 2 using exponents, then read your answer aloud.

Solution: 2 x 2 x 2 x 2 x 2 = 2^5 *2 raised to the fifth power*

Let us take another look at the table from above to see how exponents work.

Exponential Form	**Factor Form**	**Standard Form**
2^2 =	2 x 2 =	4
2^3 =	2 x 2 x 2 =	8
2^4 =	2 x 2 x 2 x 2 =	16
2^5 =	2 x 2 x 2 x 2 x 2 =	32
2^6 =	2 x 2 x 2 x 2 x 2 x 2 =	64
2^7 =	2 x 2 x 2 x 2 x 2 x 2 x 2 =	128
2^8 =	2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 =	256

So far we have only examined numbers with a base of 2. Let's look at some examples of writing exponents where the base is a number other than 2.

Example 2: Write 3 x 3 x 3 x 3 using exponents, then read your answer aloud.

Solution: 3 x 3 x 3 x 3 = 3^4 *3 to the fourth power or 3 raised to the fourth power*

Example 3: Write 6 x 6 x 6 x 6 x 6 using exponents, then read your answer aloud.

Solution: 6 x 6 x 6 x 6 x 6 = 6^5 *6 to the fifth power or 6 raised to the fifth power*

Example 4: Write 8 x 8 x 8 x 8 x 8 x 8 x 8 using exponents, then read your answer aloud.

Solution: 8 x 8 x 8 x 8 x 8 x 8 x 8 = 8^7 *Eight to the seventh power or 8 raised to the seventh power*

Example 5: Write 10^3, 3^6, and 1^8 in factor form and in standard form.

Solution:

Exponential Form	**Factor Form**	**Standard Form**
10^3	10 x 10 x 10	1,000
3^6	3 x 3 x 3 x 3 x 3 x 3	729
1^8	1 x 1 x 1 x 1 x 1 x 1 x 1 x 1	1

The following rules apply to numbers with exponents of 0, 1, 2 and 3:

Rule	**Example**
Any number (except 0) raised to the zero power is equal to 1.	$149^0 = 1$
Any number raised to the first power is always equal to itself.	$8^1 = 8$
If a number is raised to the second power, we say it is *squared*.	3^2 is read as *three squared*
If a number is raised to the third power, we say it is *cubed*.	4^3 is read as *four cubed*

Whole numbers multiplied by powers of 10

When multiplying a whole number by a power of ten, just count how many zero you have and attached that to the whole number

Examples:

1) 56 × 10

There is only one zero, so 56 × 10 = 560

2) 45 × 10,000

There are 4 zeros, so 45 × 10000 = 450000

3) 18 × 10,000,000

There are 7 zeros, so 18 × 10,000,000 = 180,000,000

Multiplying By Powers of Ten Video Link:
http://www.youtube.com/watch?v=TwZMeKipGXY

Practice exercises:

1.

a. 7 × 1,000 =
b. 7 × 10,000 =
c. 7 × 100,000 =

2.

a. 2 × 10,000 =
b. 2 × 100,000 =
c. 2 × 1,000,000 =

Solve.

1.

a. $18 \times 10^1 =$

b. $18 \times 10^2 =$

c. $18 \times 10^3 =$

2.

a. $82 \times 10^2 =$

b. $82 \times 10^3 =$

c. $82 \times 10^4 =$

Writing Numerical Expressions

3. Three times the difference between eighteen and thirteen	3 x (18 - 13)
4. Five less than the product of eight and three	(8 x 3) - 5
5. Twelve minus the product of nine and seven	(9 X 7)-12
6. The difference between sixteen, and the product of seven and two	16 – (7 x 2)
7. Ten more than the quotient of thirty-six divided by nine	(36 ÷ 9) + 10
8. Twice as much as the sum of eighteen and eleven	2 x (18 + 11)
9. Twenty-four less than the product of six and seven	(6 x 7)- 24
10. Thirty-seven more than the quotient of twenty-four divided by eight	_____________?

Dividing by powers of ten

Video Review Links: http://www.youtube.com/watch?v=OlbwHyzcQC0

http://www.mentormob.com/learn/i/understanding-multidigit-whole-number-place-value-concepts/divide-by-powers-of-10

Multiplying Whole Numbers Using the Standard Algorithm

Learn Zillion Video Review Link: http://learnzillion.com/lessonsets/257-multiply-multidigit-whole-numbers-using-the-standard-algorithm

When numbers are multiplied, each number is called a factor. The result of multiplying numbers is called a product

$$\begin{array}{rl} 5 & \text{—— factor} \\ \times 2 & \text{—— factor} \\ \hline 10 & \text{—— product} \end{array}$$

The easiest multiplication we can perform is the one with one digit because all we need is a good remembrance of a multiplication table.

Look at the following multiplication problems. You can get your answer right off a multiplication table. Note that 0 × 6 = 0. In fact, any number times 0 = 0.

$$\begin{array}{r} 6 \\ \times 5 \\ \hline 30 \end{array} \qquad \begin{array}{r} 3 \\ \times 8 \\ \hline 24 \end{array} \qquad \begin{array}{r} 0 \\ \times 6 \\ \hline 0 \end{array} \qquad \begin{array}{r} 8 \\ \times 8 \\ \hline 64 \end{array}$$

Multiplying a two-digit number by a one-digit may be a little bit more fun.

The following is a multiplication of two-digit by a one digit (46 × 7)

Study this example carefully!

$$\begin{array}{rcr} 46 & = & \text{4 tens and 6 ones} \\ \times\ 7 & = & \times \qquad\qquad \text{7 ones} \\ \hline & & \text{28 tens and 42 ones} \\ & & \text{32 tens and 2 ones} = 322 \end{array}$$

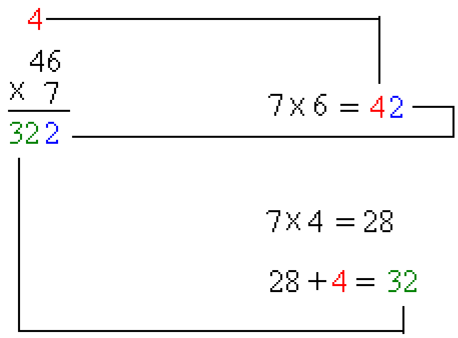
Notice that when the product of the ones is greater than 9, you must rename the tens and ones.

In our example above, 42 ones were renamed 4 tens and 2 ones. Then, the 4 tens are added to the 28 tens in the tens column to get 32 tens.

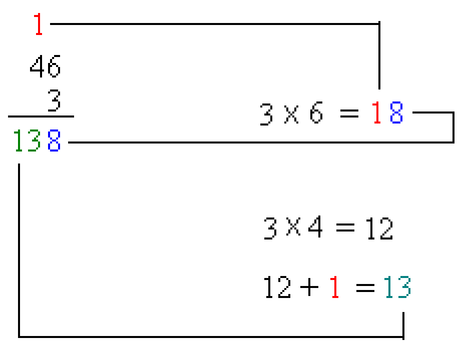
It can be time-consuming to write the tens and the ones when doing multiplication. You can also do the following:

$$\begin{array}{r} 46 \\ \times 7 \\ \hline 42 \\ +\ 280 \\ \hline 322 \end{array} \qquad\qquad \begin{array}{rcr} 7 \times 6 & = & 42 \\ 7 \times 40 & = & 280 \\ \hline & & 322 \end{array} \quad \text{We add these two products}$$

There is even a shorter way to multiply with renaming. Generally, that is how we perform multiplication.

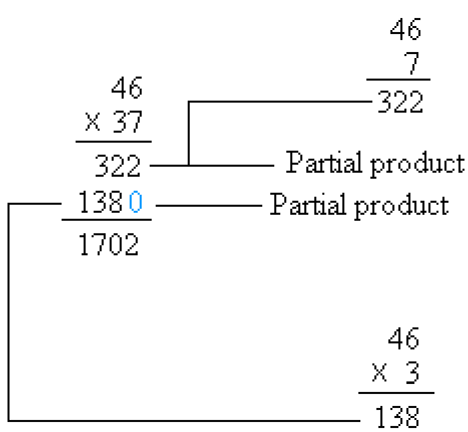


Study also the next example:



Sometimes, you multiply by a factor that contains two or more digits.

For example, multiply 46 by 37. Look at the way it is done below and notice that you already performed the multiplication for 46 × 7 and 46 × 3



Why did we put a 0 beneath the 2? Because there is no value for the ones place(value smaller than 9. Multiplying 3 by 6 gave us 18 and 18 is bigger than 9.

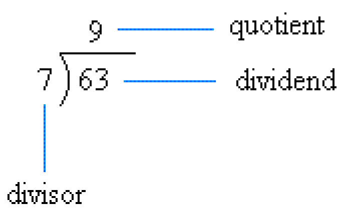
Division & Interpreting Remainders

This concept-based lesson is intended to help assess how well students are able to use a variety of strategies to multiply. In particular, this unit aims to identify and help students who have difficulties with:

- The traditional division algorithm.
- Representing division in multiple ways
- Interpreting Remainders

Dividing whole numbers is the opposite of multiplying whole numbers It is the process by which we try to find out how many times a number (divisor) is contained in another number (dividend).

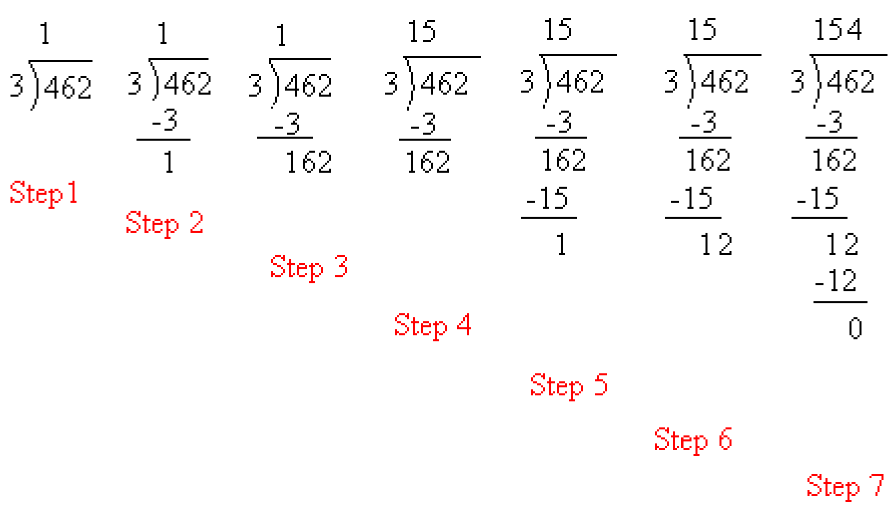
The answer in the division problem is called a quotient. In the division problem below(63 ÷ 7) , 7 is contained into 63, 9 times. (9 × 7 = 63)



Other examples:

$\begin{array}{r}5\\6\overline{)30}\end{array}$ $\qquad\begin{array}{r}4\\5\overline{)20}\end{array}$ $\qquad\begin{array}{r}6\\7\overline{)42}\end{array}$

When the dividend is bigger than 100, the answer may not be obvious. In this case you need to do long division. Study the following example (462 ÷ 3) carefully.



It is not easy to see immediately how many times 3 is contained into 462. It may not be easy also to see how many times 3 is contained into 46. However, it is fairly easy to see that 3 is contained into 4 once.

Therefore, we do this in step 1 and put the 1 above the 4.

In step 2, we multiply 1 by 3 and subtract the answer(3) from 4.

In step 3, we bring down the 62. Now, we need to find out how many times 3 is contained in 162. Still, it may not be obvious, so we will try to find out instead how many times 3 is contained into 16.

This is done in step 4 and we see that 3 is contained into 16, 5 times. We put the 5 above the 4.

In step 5 , we multiply 5 by 3 and subtract the answer (15) from 16.

In step 6 , we bring down the 2.

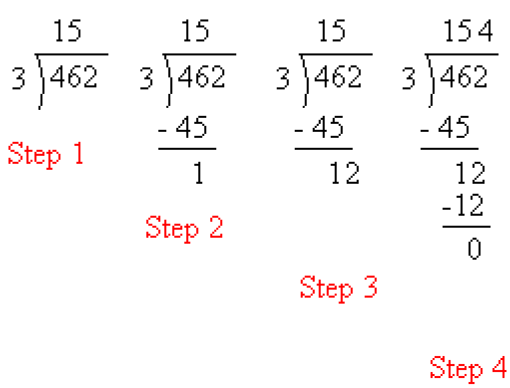
In step 7 , we try to find out how many times 3 is contained into 12.

3 × 4 = 12, so 3 is contained into 12, 4 times.

Finally, we put the 4 above the 6.

The answer is 154. or 3 is contained into 462, 154 times

The same division can be done faster if you can find out how many times 3 is contained into 45. 45 contains 3, 15 times. Then, you can finish the problem in 4 steps.



Interpreting Remainders **(when do we keep or trash the remainders?)**

Sally scooped out forty-three pieces of hard candy to buy at the store. She wants to divide the candy evenly among eighteen people. How many pieces of candy will each person get?
43 ÷ 18 = 2 remainder 7 but each person only gets 7 to keep the each person's share fair, each only gets 2 pieces

You are organizing a trolley ride for ninety-five total students, teachers & parents. If each trolley can seat fifteen people, how many trolleys do you need?
95 ÷ 15 = 6 remainder 5 but you need 7 trolleys however you need another whole trolley to make sure everyone has a ride

Mr. Jones bought ninety-five new pencils to give his class of nineteen students. How many pencils will each student get?
95 ÷ 19 = 5 no remainder

The soccer team bought their coach a $55.00 sweatshirt. The fifteen players split the bill evenly. How much did each pay?
55 ÷ 15 = 3 remainder 10 or 3.67
However since this is money the remainder can be written as a decimal so each player pays $3.67

Compact discs are on sale for $13.00 including tax. How many can you buy with $84.00?
84 ÷ 13 = 6 remainder 6
So you could only by 6 CDs and you have 6 dollars left over

There are eighty-four girls in a basketball league and six girls on each team. How many teams are there?
84 ÷ 6 = 14 no remainder

The twelve cheerleaders each want a piece of pink ribbon to wear for the breast cancer march. There is eighty-seven inches of ribbon. How much ribbon should each girl get?
87 ÷ 12 = 7 remainder 3 or 7 3/12 which reduces to 7 ¼
However since the ribbon is cut in inches each girl would get 7 ¼ inches of ribbon.

***Websites and Resource for **Math Tutorials and Extra Practice** (aligned to the 5th Grade Common Core State Standards):

http://www.helpingwithmath.com/by_grade/gr5_cc_skills.htm

http://www.k-5mathteachingresources.com/5th-grade-number-activities.html

http://www.khanacademy.org/

http://nsdl.org/commcore/math?id=5

https://sites.google.com/a/norman.k12.ok.us/mr-wolfe-s-math-interactive-whiteboard/5th-grade http://pinterest.com/teaching4real/5th-grade-common-core/

http://www.mathscore.com/math/standards/Common%20Core/5th%20Grade/

http://www.ixl.com/math/standards/common-core/grade-5

http://intermediateelem.wikispaces.com/Fifth+Grade+Math+Resource+Backup

http://mail.clevelandcountyschools.org/~ccselem/?OpenItemURL=S07BB59E1