Study the following.

order (**or**-dur) - which comes first, second, third, etc. (The recipe said what order to stir-fry the vegetables.)

operation (op-uh-**ray**-shuhn) – in math, something you do to a number or numbers to get a different number. Examples: addition, subtraction, multiplication. (I used the operation of addition to solve the problem.)

order of operations- which operation you do first, second, third, etc.

expression (ek-**spresh**-uhn)
　　　1. a mathematical statement that does not contain an equal sign.
　　　(4 + 6 × 2 is an expression.)

　　　2. the group of numbers and symbols above a fraction line or below
　　　it. (In the fraction $\frac{2+3}{4-1}$ the 2 + 3 and the 4-1 are both expressions.)

exponent (**ek**-spoh-nuhnt) – the small number indicating how many times another number is multiplied by itself. 4^2 means 4 × 4.
In the expression 4^2 , the 2 is called the exponent.

Say each word out loud and write it in the blank.

order _____
operation _____
expression _____
exponent _____

Write each definition in your own words.

order

operation

order of operations

expression (definition 1)

expression (definition 2)

exponent

Write two sentences using each word.

order
1.

2.

operation
1.

2.

order of operations
1.

2.

expression (definition 1)
1.

2.

expression (definition 2)
1.

2.

exponent
1.

2.

Matching. (Words can connect to more than one definition.)

order   shows how many times a number is
                                              multiplied by itself

operation   a mathematical statement that does not
                                              contain an equal sign

order of operations   which comes first, second, etc.

                                              the group of numbers and symbols above a
expression   fraction line or below it

                                              an action performed on numbers
exponent
                                              which operation you do first, second, etc.

Fill in the blanks.

The little number that is written higher than other numbers is called a(n)
_____.

$\times$ and $\div$ are _____.

Whether you add, multiply, or do parentheses first is called the

_____.

$4 \times 7 \times 3$ is called a(n) _____.

In the fraction $\dfrac{8 \times 2}{6 - 3}$ the 8×2 is called a(n) _____.

Math operations have to be done in a certain _____.

Study the following.

( ) These symbols are called parentheses. They are used to enclose
numbers and/or symbols in math.
Parenthes<u>es</u> (puh-**ren**-thuh-seez) means two or more of these
symbols ( ).
Parenthe<u>sis</u> (puh-**ren**-thuh-siss) means one of these symbols (.

They shows multiplication if there is no other operation symbol
between a number and a parenthesis. Example: 3(4) means 3 times 4.
Or 3(1 + 5) means 3 times what is in the parentheses.

[ ] These symbols are called brackets (**brak**-it). These are used
sometimes when you have parentheses within parentheses.
Example: (3 + 2(4 + 1)) can also be written [3 + 2(4 + 1)] .

— This is a fraction line (**frak**-shuhn **line**). The line between two
numbers or expressions of a fraction shows division.
Examples: $\underline{10}$ shows 10 divided by 2.
     2

$$\frac{3 + 2}{4 + 1}$$ shows 3 + 2 divided by 4 + 1 .

Say each word out loud and write it in the blank.

parentheses _____
parenthesis _____
bracket _____
division line _____

Write each definition in your own words.

parentheses

parenthesis

bracket

division line

Fill in the blanks.

( ) are called _____.

[ ] are called _____.

( ) and [ ] _____ numbers together.

— (as in ¼) means _____ and is a(n) _____.

Write two sentences using each word.

parentheses
1.

2.

brackets
1.

2.

fraction line
1.

2.

Write three examples of each.

parentheses

brackets

fraction line

Study the following.

PEMDAS - Say this as a word to remember the order of operations.

P for Parentheses   Done first.
E for Exponents   Done second.
M for Multiplication   Multiplication and Division are done third from
D for Division   left to right.
A for Addition   Addition and Subtraction are done fourth.
S for Subtraction

Examples:

$$3(1 + 1)^2 + 6$$

$3(2)^2 + 6$	parentheses
$3\,(4) + 6$	exponents
$12 + 6$	multiplication
18	addition

$$25 - (4 - 1)^2 + 10 \div 5 \times 3$$

$25 - (3)^2 + 10 \div 5 \times 3$	parentheses
$25 - 9 + 10 \div 5 \times 3$	exponents
$25 - 9 + 2 \times 3$	division
$25 - 9 + 6$	multiplication
$16 + 6$	subtraction
22	addition

Write "PEMDAS" 5 times and say it out loud.

1.
2.
3.
4.
5.

More details on the order of operations.

1.   Multiplication and division are solved from left to right.

$$10 \div 2 \times 3$$
$$5 \quad \times 3$$
$$15$$

2.   Addition and subtraction can be done in any order.

$$4 + 5 + 3 + 1$$
$$9 \quad + \quad 4$$
$$13$$

3.   Addition and subtraction can also be done by adding all positives then adding all negatives and solving.

$$4 - 1 + 8 - 2 + 10$$
$$4 + 8 + 10 \; - 1 \; - 2$$
$$+22 \qquad -3$$
$$+22 - 3$$
$$19$$

4.   For parentheses and brackets do inner first and work your way to outer.

$$[4 + (6 - 1)] + 8$$
$$[4 + \quad 5 \quad] + 8$$
$$9 \qquad + 8$$
$$17$$

5.   Parentheses show multiplication if a number is next to the parenthesis.

$$2(1 + 4)$$
$$2(5)$$
$$10$$

6.   Or parentheses shows addition/subtraction if a + or – sign is shown
      directly outside the parentheses.

$$2 + (1 + 4)$$
$$2 + (\ \ 5\ \ )$$
$$7$$

7.   Work downward with each step and write the complete problem each
      time. Write <u>neatly</u> and <u>carefully</u>.

$$4[1 + (2 + 4)] + 7 - 9 \div 3$$
$$4[1 + (\ \ 6\ \ )] + 7 - 9 \div 3$$
$$4[\ \ 7\ \ ] \qquad + 7 - 9 \div 3$$
$$28 \qquad\quad + 7 - 3$$
$$35 \qquad\quad - 3$$
$$32$$

8.   Solve top and bottom separately, then divide.

$$\frac{10 + 8}{(1 + 2)^2}$$

$$\frac{18}{(3)^2}$$

$$\frac{18}{9} \quad \text{which is 2.}$$

9. $\underline{2\times3\times4\times20}$ You can multiply or divide these in any order.
      $2\times6\times10$

      $\underline{2\times3\times4\times20}$ Two divided by 2 is 1, and 20 divided by 10 is 2.
      $2\times6\times10$

      $\underline{1\times3\times4\times2}$ Now multiply the top to get 24.
      $\qquad 6$

      $\underline{24}$ which is 4.
      $\ 6$

Show 2 examples of each of the previous items 1-9.

1.

2.

3.

4.

5.

6.

7.

8.

9.

Fill in the blanks.

What is the word you can use to remember the order of operations?

_____

What is the order of operations? First _____
                        Second _____
                        Third _____ and _____
                        Fourth_____ and _____

$3(1 + 2)$ the parentheses show _____.

$4 + (5 + 1)$ the parentheses show _____.

For parentheses and brackets, you solve _____ work first, and then solve _____ work.

Work   _____ with each step. (choose sideways or downwards)

_____ and _____ can be done in any order.

_____ and _____ are done left to right.

$\dfrac{2 + 5}{3 + 4}$ Solve _____ and _____ separately first.

$\dfrac{10 \times 4 \times 9 \times 12}{5 \times 2 \times 3 \times 3}$ You can multiply and divide in _____ order.

Study the following.

<u>More information related to example 9.</u>

Fractions review.

A fraction with the same number divided by the same number equals 1.

Examples: $\dfrac{2}{2} = 1$ $\dfrac{-5}{-5} = 1$ $\dfrac{350}{350} = 1$

To simplify a fraction, divide the top and bottom by the same number.

Example: $\dfrac{4}{6}$ $\dfrac{4 \div 2 =}{6 \div 2 =}$ $\dfrac{2}{3}$ divide top and bottom by 2

Fractions multiplied together can be written as one big fraction and solved like the order of operations example 9 above. You can multiply or divide in any order, or simplify a number on top with a number on the bottom.

Example 1: $\dfrac{2}{3} \times \dfrac{1}{4}$

$\dfrac{2 \times 1}{3 \times 4}$ write as one big fraction

$\dfrac{2 \times 1}{3 \times 4}$ simplify the 2 on top with the 4 on the bottom first.
                    $2 \div 2 = 1$
                    $4 \div 2 = 2$

$\dfrac{1 \times 1}{3 \times 2}$
                    multiply $1 \times 1 = 1$.
                    multiply $3 \times 2 = 6$.

$\dfrac{1}{6}$ answer.

Example 2: $\dfrac{10}{15} \times \dfrac{3}{7} \times \dfrac{7}{2}$

$\dfrac{10 \times 3 \times 7}{15 \times 7 \times 2}$ Write as one big fraction.

$\dfrac{10 \times 1 \times 7}{5 \times 7 \times 2}$ simplify 3 over 15

$\dfrac{10 \times 1 \times 1}{5 \times 1 \times 1}$ simplify 7 over 7

$\dfrac{10}{5}$ multiply top numbers
     multiply bottom numbers

2   divide

Solve. Simplify if possible.

1. $\dfrac{16}{16} =$

2. $\dfrac{59}{59} =$

3. $\dfrac{9}{45} =$

4. $\dfrac{12}{18} =$

5. $\dfrac{4}{15} \times \dfrac{5}{12} =$

6. $\dfrac{2}{7} \times \dfrac{3}{15} \times \dfrac{21}{2} =$

7. $\dfrac{1}{2} \times \dfrac{6}{3} \times \dfrac{10}{50} =$

Solve.

1. $3 + 5 \times 2 + 22 \times (3 + 2)$

2. $2 + 2(2 + 1)2 - 4 \div 2$

3. $\dfrac{(3 + 3)2 - 30}{(2 - 1) + 2}$

4. $10 \div 2 \times 3 \div 5 \times 4$

5. $\dfrac{4}{9} \times \dfrac{9}{7} \times \dfrac{35}{11}$

Solve.

6. $10 - 3 + 6 - 1$

7. $2 + [3 + (4 - 2)]$

8. $\dfrac{10 \times 5 \times 9 \times 16}{10 \times 2 \times 4 \times 3}$

9. $\dfrac{10 + 3[4 + (3 - 2)]}{5^2}$

Study the following.

Order of operations problems with negative integers.

1.   Multiplication and division are solved from left to right.

Example: $10 \div (-2) \times 3$
           $-5 \quad \times 3$
              -15

2.   Addition and subtraction can be done in any order.

     $4 + (-5) + 3 + 1$
       $-1 \quad + \quad 4$
          3

3.   Addition and subtraction can also be done by adding all positives then adding all negatives and solving.

     $4 + (-1) + 8 + (-2) + 10$
     $4 + 8 + 10 + (-1) + (-2)$
     $+22 \quad + \quad -3$
        $+22 - 3$
          19

4.   For parentheses and brackets do inner first and work your way to outer.

     $[-4 + (6 - 1)] + -8$
     $[-4 + \quad 5 \quad] + -8$
        $1 \quad\quad + -8$
        -7

5.   Parentheses show multiplication if a number is next to the parenthesis.

         $-2(1 + 4)$
          $-2(5)$
           -10

6. Or parentheses shows addition/subtraction if a + or – sign is shown directly outside the parentheses.

$$-2 + (1 + 4)$$
$$-2 + (\ 5\ )$$
$$3$$

7. Work downward with each step and write the complete problem each time. Write <u>neatly</u> and <u>carefully</u>.

$$-4[1 + (2 + 4)] + 7 - 9 \div (-3)$$
$$-4[1 + (\ 6\ )] + 7 - 9 \div (-3)$$
$$-4\ [\quad 7\quad]\quad +7 - 9 \div (-3)$$
$$-28 \qquad\quad + 7 + 3$$
$$-28 \quad + 10$$
$$-18$$

8. Solve top and bottom separately, then divide.

$$\frac{-10 + -8}{(1 + 2)^2}$$

$$\frac{-18}{(3)^2}$$

$$\frac{-18}{9} \quad \text{which is -2.}$$

9. $\underline{2\times(-3)\times4\times20}$ You can multiply or divide these in any order.
    $2\times6\times(-10)$

    $\underline{2\times(-3)\times4\times20}$ Two divided by 2 is 1, and 20 divided by -10 is -2.
    $2\times6\times(-10)$

    $\underline{1\times(-3)\times4\times(-2)}$ Now multiply the top to get 24.
    $\quad\ 6$

    $\underline{24}$ which is 4
    $\ 6$

Show 2 examples of each of the previous items 1-9. Use negative integers in your examples.

1.

2.

3.

4.

5.

6.

7.

8.

9.

Solve.

1. $3 + 5 \times (-2) + 21 \times (3 + -2)$

2. $-2 - 2(2 + 1)^2 - 4 \div (-2)$

3. $\dfrac{(-3 + 3)^2 - 15}{(2 - 1) - -2}$

4. $-10 \div (-2) \times 3 \div 5 \times 2$

5. $\dfrac{-4}{3} \times \dfrac{-11}{2} \times \dfrac{12}{-44}$

Solve.

6. -8 – 3 + -6 – -1

7. -2 + [3 + (-4 – 2)]

8. $\dfrac{10 \times (\text{-}5) \times 9 \times (\text{-}16)}{\text{-}10 \times 2 \times (\text{-}4) \times 3}$

9. $\dfrac{10 + 3[4 - (3 - (+2)]}{5^2 - \text{-}5}$