

Name: Key

Date: \_\_\_\_\_

Mrs. Rowlands

## Order of Operations and Evaluating Algebraic Expressions Algebra 1

**Exercise #1:**

(a) Evaluate  $3+4 \times 5$  by:   
 adding first:  $\frac{3+4 \times 5}{7 \times 5} = 35$    
 multiplying first:  $\frac{3+4 \times 5}{3+20} = 23$

(b) Are both answers above correct? NO

(c) Which answer is correct? 23 Why? you must FOLLOW order of operations & multiply first before you add.

As Exercise #1 above illustrates, the order in which we perform operations on numbers matters. In middle school, you learned the order to follow when evaluating numerical expressions. The order is summarized below:

*Order of Operations*

}	$\{ \}$ P	1 <sup>st</sup> - Perform operations within parentheses.
	$X^n$ E	2 <sup>nd</sup> - Evaluate expressions that contain exponents.
	$\cdot$ $:$ M/D	3 <sup>rd</sup> - Multiply and divide in the order that they appear from <u>left to right</u> .
	$+$ $-$ NS	4 <sup>th</sup> - Add and subtract in the order that they appear from <u>left to right</u> .

*What you see is what you do*

We **must** follow this order; otherwise, we couldn't possibly communicate mathematically. When we all look at a numerical expression, we all **must** interpret it the same way.

**Exercise #2:** Evaluate each of the following numerical expressions without the use of a calculator.

(a)  $(-3)(-5)+2$    
 $\frac{15+2}{17}$

(b)  $2(3)^2$    
 $\frac{2 \cdot 9}{18}$

(c)  $4-6 \cdot 2$    
 $\frac{4-12}{-8}$

(d)  $6 \cdot 5+6 \div (-2)$    
 $\frac{30+6 \div (-2)}{30+(-3)} = \frac{27}{27} = 1$

(e)  $(-1)(-3)^2+9$    
 $\frac{(-1) \cdot 9+9}{-9+9} = \frac{0}{0}$

(f)  $\frac{18-3 \cdot 4}{5-2}$    
 $\frac{18-12}{5-2} = \frac{6}{3} = 2$

(g)  $-2(3^2+4^2)$    
 $-2(9+16) = -2(25) = -50$

(h)  $5(\sqrt{100}-\sqrt{64})$    
 $5(10-8) = 5(2) = 10$

(i)  $6-2^2 \cdot 4+2\sqrt{25}$    
 $6-4 \cdot 4+2(5) = 6-16+10 = 0$

*Handwritten notes:*  
 -  $-3^2 \neq (-3)^2$   
 -  $-1 \cdot 3^2 \neq -3 \cdot 3$   
 -  $-1 \cdot 9 \neq 9$   
 -  $-9 \neq 9$   
 - *\* must have ( ) around a neg base when squaring in the calc*  
 - *(-3)^2 or it went right the neg sign*  
 - *DO NOT distribute here*  
 - *DO NOT distribute here*  
 - *you MUST use ( ) around the numerator + the denominator - or (Alpha) (y) to get a fraction*

**Exercise #3:** Fiona evaluated the expression  $\frac{12+6}{2+4}$  as follows using her graphing calculator. The display is shown at the right. Explain why Fiona obtained an incorrect answer.

$$\frac{12+6}{2+4}$$

$$\frac{12+3+4}{15+4} = 3$$

Fiona obtained the wrong answer because she did NOT put parenthesis around the  $12+6$  and  $2+4$  to separate the num. from the denom. So she did  $6 \div 2$  first instead of  $12+6$  then  $2+4$ .  
 It should be:  $\frac{12+6}{2+4} = \frac{18}{6} = 3$

CALC:  
 $\pi = \frac{2\pi}{1}$

**Exercise #4:** Evaluate each of the following numerical expressions using your calculator. Round all answers to the nearest hundredth, where appropriate.

(a)  $\pi(4.2)^2 + 2\pi(4.2)(3.1)$   
 $\rightarrow$  2 places after decimal  
137.22

(c)  $12(2.5) + 16(2.5)^2$   
130.00

(b)  $2\pi\sqrt{12/9.81}$   
6.95

(d)  $\frac{4(1-2.14^3)}{(1-2.14)}$   
30.88

CALC:  
 $\frac{1}{1}$  to get any exponent.

must add ( ) in calc around the numerator + the denominator work  
 Alpha  $y = \frac{1}{1}$  to get a fraction  
 no sign

Oftentimes we are asked to evaluate formulas or algebraic expressions for given replacements of their variables.

**Exercise #5:** If  $V = \pi r^2 h$ , then find the value of  $V$  if  $r = 2$  and  $h = 8$ . Round your answer to the nearest hundredth.

$V = \pi r^2 h$   
 $V = \pi \cdot (2)^2 \cdot (8)$   
 $V = \pi \cdot 4 \cdot 8$   
 $V = 32\pi$   
V = 100.53

**Exercise #6:** If  $V = \frac{4}{3}\pi r^3$ , then find the value of  $V$  if  $r = 12$ . Round your answer to the nearest hundredth.

CALC: Alpha  $y = \frac{1}{1}$  to put in fraction  
 $V = \frac{4}{3}\pi r^3$   
 $V = \frac{4}{3}\pi \cdot (12)^3$   
 $V = \frac{4}{3}\pi \cdot 1728$   
 $V = 2304\pi$   
V = 7,238.23

**Exercise #7:** If  $c = \sqrt{a^2 + b^2}$ , then find the value of  $c$ , to the nearest tenth, if  $a = 45$  and  $b = 17$ .

$c = \sqrt{45^2 + 17^2}$   
 $c = \sqrt{2025 + 289}$   
C = 48.1

**Exercise #8:** If  $x = -3$ , then find the value of each of the following algebraic expressions.

(a)  $2x + 1$   
 $2(-3) + 1$   
 $-6 + 1$   
-5

(c)  $-4x - 2$   
 $-4(-3) - 2$   
 $12 - 2$   
10

(e)  $-x^2 + 4$   
 $-(-3)^2 + 4$   
 $-(9) + 4$   
 $-9 + 4 = -5$

(b)  $x^2 - 2x + 3$   
 $(-3)^2 - 2(-3) + 3$   
 $9 - 2(-3) + 3$   
 $9 - (-6) + 3$  or  $9 + 6 + 3$   
18

(d)  $-3x^2 + 6x$   
 $-3(-3)^2 + 6(-3)$   
 $-3(9) + 6(-3)$   
 $-27 - 18$   
-45

(f)  $\frac{2 + \sqrt{x+19}}{6-2x}$   
 $\frac{2 + \sqrt{-3+19}}{6-2(-3)}$   
 $\frac{2 + \sqrt{16}}{6-2(-3)}$   
 $\frac{2 + 4}{6-2(-3)}$   
 $\frac{6}{6+6}$   
 $\frac{6}{12} = \frac{1}{2}$

Always use ( ) when substituting

put -3 [STO] [X] [ENTER] on home screen then type in the original expression and press [enter] to get answer

-3 must be inc in calc

on ~ Alpha  $y = \frac{1}{1}$  to get a fraction

Use ( ) on top + bottom when checking in the calculator!

To change a decimal to a fraction  
 1) MATH  
 Enter  
 Enter  
 OR  
 ALPHA  $y = \frac{1}{1}$   
 Enter