Math 9 – Unit 1: Real Numbers Name: Mrs. Jacob

Lesson #4i: Order of Operations Date: Feb 5, 2025

Learning Goal: We are learning to work with the Order of Operations

Evaluate the following expression on your own, without anybody's help:

$$2(4-6)^2 - 9 \div (5-2) + 1$$

$= 2(-2)^2 - 9 \div 3 + 1$

$= 2(4) - 9 \div 3 + 1$

$= 8 - 3 + 1$

$= 6$

Without order, there is chaos. Math cannot have chaos, so logically there must be an order. The order of operations (sometimes knows as BEDMAS) gives the structure or algorithm to solve mathematical questions.

The order is:
1. B → BRACKETS
2. E → EXPONENTS
3. D → DIVISION
   M → MULTIPLICATION
4. A → ADDITION
   S → SUBTRACTION

The same order MUST be applied when we work with fractions. Let's do some examples:

a) $2 + \boxed{\frac{4}{5} \times \frac{1}{4}}$

$= \frac{2}{1} + \frac{1}{5}$

$= \frac{10}{5} + \frac{1}{5}$

$= \frac{11}{5}$

b) $\frac{3}{2} - \boxed{\frac{7}{5} \div \frac{1}{3}} + \frac{3}{2}$

$= \frac{3}{2} - \boxed{\frac{7}{5} \times \frac{3}{1}} + \frac{3}{2}$

$= \frac{3^{\times 5}}{2_{\times 5}} - \frac{21^{\times 2}}{5_{\times 2}} + \frac{3^{\times 5}}{2_{\times 5}}$ LCD(2, 5, 2) = 10

$= \frac{15}{10} - \frac{42}{10} + \frac{15}{10}$

$= \frac{-12}{10} = \frac{-6}{5}$

c) $\frac{5}{6}+\left(\frac{9}{5}\div\frac{6}{5}\right)^2-\frac{1}{2}$

$=\frac{5}{6}+\left(\frac{\cancel{9}^{3}}{\cancel{5}_{1}}\times\frac{\cancel{5}^{1}}{\cancel{6}_{2}}\right)^2-\frac{1}{2}$

$=\frac{5}{6}+\left(\frac{3}{2}\right)^2-\frac{1}{2}$

$=\frac{5^{\times2}}{6_{\times2}}+\frac{9^{\times3}}{4_{\times3}}-\frac{1^{\times6}}{2_{\times6}}$

$=\frac{10}{12}+\frac{27}{12}-\frac{6}{12}$

$=\frac{31}{12}$

2	6, 4, 2
2	3, 2, 1
3	3, 1, 1
	1, 1, 1

LCD(6, 4, 2) = 12

d) $\frac{2}{5}\times\frac{3}{5}+\left(\frac{4}{3}+\frac{2}{1}\right)\times\frac{1}{2}$

$=\frac{2}{5}\times\frac{3}{5}+\left(\frac{4}{3}+\frac{6}{3}\right)\times\frac{1}{2}$

$=\boxed{\frac{2}{5}\times\frac{3}{5}}+\boxed{\frac{10}{3}\times\frac{1}{2}}$

$=\frac{6^{\times6}}{25_{\times6}}+\frac{10^{\times25}}{6_{\times25}}$

LCD(25, 6) = 150

$=\frac{36}{150}+\frac{250}{150}=\frac{\cancel{286}^{\div2}}{\cancel{150}}=\frac{143}{75}$

In Math, you are usually given an algebraic expression which you need to use to solve given certain values. When you substitute numbers into letters, always do so with parenthesis ().

Example: Solve the following two expressions given $x=(4)$ and $y=(-2)$.

a) $6y-x^2-y$

$=6(-2)-(4)^2-(-2)$

$=-12-16+2$

$=-26$

b) $(x-y)(x+y)$

$=(4-(-2))(4+(-2))$

$=(4+2)(4-2)$

$=(6)(2)$

$=12$

Lesson #4ii: Powers and Scientific Notations Date: ______________________

Learning Goal: We are learning to work with powers and expressing numbers in scientific notation

Powers, as the name suggests, are a powerful way to express repeated multiplication of the same number. Specifically, powers of 10 express very large and very small numbers in a manner which is convenient to read, write and compare.

In science and engineering, quite often you want to represent very large or very small numbers. For example, the Mass of earth is 5,970,000,000,000, 000, 000, 000, 000 kg and the Size of a bacteria is 0.0000005 m. Is there a more convenient way to represent this without having to write a lot of zeros?
Yes! This can be achieved by using Scientific Notation. However, scientific notation utilizes powers, so we first need to discuss exponents.

A power is REPEATED MULTIPLICATION!!!

A power has two parts. The BASE is the number used in the multiplication. An EXPONENT indicates how many times the repeated multiplication occurs.

$$4^3$$

$3 \rightarrow$ EXPONENT

$4 \rightarrow$ BASE

A power can be written in two forms. Exponential form is the same as the above example, then there is the expanded (or standard) form which shows the repeated multiplication.

* LAW: $a^0 = 1$

$4^3 = (4)(4)(4) = 64$

Example 1: Write the following in expanded form, then evaluate:

a) $5^4 = (5)(5)(5)(5)$ $= 625$

b) $(-3)^2 = (-3)(-3)$ $= 9$

c) $-3^2 = -(3)(3)$ $= -9$

d) $\left(\frac{2}{3}\right)^3 = \left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right) = \frac{8}{27}$

Now for some interesting ones:

e) 4^1 $= 4$

f) 4^0 $= 1$

h) $\frac{4^{-1}}{1} = \frac{1}{4}$

i) $\frac{4^{-2}}{1} = \frac{1}{4^2} = \frac{1}{16}$

* NEGATIVE EXPONENT FLIPS THE BASE!!

Powers of 10. Powers of 10 are quick to calculate and they are, well, powerful!

To evaluate a power of 10, the exponent indicates how many zeros will be behind the 1 or in front of the 1 if negative.

$10^5 = 100000$

POSITIVE EXPONENT — VERY BIG #

$10^{-5} = \frac{1}{10^5} = \frac{1}{100000} = 0.00001$

NEGATIVE EXPONENT — VERY SMALL #

When writing really large (or really small) numbers, we can use scientific notation to eliminate the need to write all the zeros and focus on the significant digits.

* SCIENTIFIC NOTATION
(1) one digit # with two decimal digits
(2) exponent of 10

Example: Write the full number from the scientific notation:

a) 3.45×10^8

345000000

b) 6.2×10^{-5}

0.000062

Example: Convert the numbers to scientific notation. Keep 3 digits.

a) 0.000000432

4.32×10^{-7}

b) 82348709008713

8.23×10^{13}

Applications:

1. Jimmy went to Tim Horton's during their "Roll up the Rim" season and won a bike. However, in order to get the bike, he had to answer the following skill testing question: $4+4\div2\times(3+1)$. Jimmy answered 16. Did he get the bike?

$4+4\div2\times4$

$4+8$

12

No! He did not get the bike ☹

2. The table shows the average distance of some planets in our solar system to the sun.
(a) Complete the table by expressing the distance from each planet to the Sun in scientific notation.

Planet	Distance from Sun (km)	Distance from the Sun (Scientific Notation)
Earth	149,600,000	1.496×10^8
Jupiter	778,300,000	7.783×10^8
Mars	227,900,000	2.279×10^8
Mercury	57,900,000	5.79×10^8

3. This table shows the mass of one atom for some chemical elements. Write out the mass in kg.

Element	Mass of Atom (Scientific Form)	Mass of Atom (in kg)
Titanium	7.95×10^{-26}	$0.\underbrace{0\ldots0}_{25\text{ zeros}}795$
Lead	3.44×10^{-25}	$0.\underbrace{0\ldots0}_{24\text{ zeros}}344$
Silver	1.79×10^{-25}	$0.\underbrace{0\ldots0}_{24\text{ zeros}}179$

Success Criteria:
- I can BEDMAS
- I can solve multi-step questions using the proper order of operations
- I can safely substitute numbers into parentheses/brackets
- I recognize the two parts of a power
- I can express powers in the expanded form and vice-versa
- I can express very big and very small numbers using scientific notation