Lesson 1.10 – Order of Magnitude

Recall that we can use the commutative property of multiplication to evaluate an expression that involves multiplying two numbers in scientific notation. Simplify the expressions below. Express your answer using proper scientific notation.

$(8.32\times10^{7})\times(5.01\times10^{11})=$	$(4.08\times10^{5})\div(1.02\times10^{9})=$

Before we can begin to add or subtract numbers in scientific notation, we must explore the magnitude of a number in scientific notation.

Order of Magnitude

$$4.3\times10^{8}$$

A number expressed in scientific notation.
Its order of magnitude is 8.

Before we begin to add/subtract numbers in scientific notation, we need to focus on the base of 10. As you know a number expressed in scientific notation is expressed in the form of $a\times10^{b}$, where a is any real number and $1\le a<10$, and b is an integer. If you focus on the lead term, a, the value for it has its limits. The lead term can be equal to 1 or must be between 1 and 10. The base of 10 is the part of the expression that truly controls its size. As the value of the exponent, b, increases the size of the number grows increasingly larger. As the value of the exponent, b, decreases the size of the number becomes increasingly smaller. By looking at the exponent we can get a feel for the **magnitude** (how large or how small) of a number that is expressed in scientific notation. The **order of magnitude** of a number is the number of powers of 10 contained in the number [1].

We will complete the activity on the next page to become more acquainted with the order of magnitude.

Activity [2] – Fill in the missing values for the "Power of Ten" and "Order of Magnitude" columns.

In words	Decimal	Power of ten	Order of magnitude
septillionth	0.000,000,000,000,000,000,000,001		−24
sextillionth	0.000,000,000,000,000,000,001	10^{-21}	
quintillionth	0.000,000,000,000,000,001		
quadrillionth	0.000,000,000,000,001		−15
trillionth	0.000,000,000,001	10^{-12}	−12
billionth	0.000,000,001	10^{-9}	
millionth	0.000,001		
thousandth	0.001		−3
hundredth	0.01	10^{-2}	
tenth	0.1		−1
one	1	10^{0}	0
ten	10	10^{1}	1
hundred	100		2
thousand	1,000		3
million	1,000,000		6
billion	1,000,000,000	10^{9}	9
trillion	1,000,000,000,000	10^{12}	
quadrillion	1,000,000,000,000,000		
quintillion	1,000,000,000,000,000,000		
sextillion	1,000,000,000,000,000,000,000	10^{21}	
septillion	1,000,000,000,000,000,000,000,000		24

Class Notes – State the magnitude of expressions below. Then determine the smallest power of 10 that will exceed it.

LP#1 8.31×10^{13}	5.332×10^{21}
LP#2 4.03×10^{-19}	1.56×10^{-6}
LP#3 345,700,675,019	8,452,935,012,498,001
LP#4 0.0000231	0.00000000753

Class Notes – For the pairs of numbers below, use a base of 10 to approximate how many times larger the larger number is than the smaller number.

LP#5 8.31×10^{13} 5.3×10^{19}	4.75×10^{27} 4.06×10^{17}
LP#6 345,700,675,019 8,452,935,012,498,001	52,763,985,123 1,788
LP#7 0.00003346 0.00100234	0.000000869 0.000000000988

Review – State the magnitude of expressions below. Then determine the smallest power of 10 that will exceed it.

R#1 6.19×10^{19}	5.26×10^{-24}
R#2 3.03×10^{32}	2,560,700,615,015
R#3 4.96×10^{-11}	0.00000153

Footnotes

[1] The definition for order of magnitude was taken from Wikipedia.org
[2] The table for the activity was a table taken from Wikipedia.org and has been modified