Exponential Notation: Using Exponents Or Exponentials

Positional Numbering System

Each position left or right of decimal represents a "power"

Exponent

$10^{6}\ 10^{5}\ 10^{4}\ 10^{3}\ 10^{2}\ 10^{1}\ 10^{0}\ \bullet\ 10^{-1}\ 10^{-2}\ 10^{-3}\ 10^{-4}$

Base (10)

We determine total" value" by adding positional values:

12345.67 is sum of:

1 x 10,000
2 x 1,000
3 x 100
4 x 10
5 x 1
6 x 0.1
7 x 0.01

Bases

Science mostly uses base 10

Computers use base 2 (binary)

$2^{6}\ 2^{5}\ 2^{4}\ 2^{3}\ 2^{2}\ 2^{1}\ 2^{0}\ \bullet\ 2^{-1}\ 2^{-2}\ 2^{-3}\ 2^{-4}$

Exponential Notation

Method of expressing numbers
Any number = coefficient x exponential

Example

Exponent

$3456 = 3.456 \times 10^{3}$

Base

Coefficient

$10^3 = 10 \times 10 \times 10 = 1000$

Number	=	coefficient	x	exponential
	n	= C	x	10^{exponent}
	425	= 4.25	x	10^2

Coefficient - the digits
Exponent – gives decimal point location

Implied Decimal Point

If no decimal point

ASSUME to be at the end of the written digits.

33,700 = 33,700.

Implied

Exponential Notation

Way to express very large and very small numbers

0.00000000000000000000000009107 g

9.197×10^{-25} (0.9197 yoctograms)

(mass of an electron, part of an atom)

602,300,000,000,000,000,000,000

6.023×10^{23} (0.6023 yottaatoms)

(# carbon atoms in 12.011 grams of carbon)

0.00000000000000000000000009107 g

602,300,000,000,000,000,000,000

Avoids calculator overflow

Saves time, paper, & copying errors

Exponential Notation

exponential = base exponent

(base 4) $4^2 = 4 \times 4 = 16$

(base 5) $5^{-3} = 1/5 \times 1/5 \times 1/5 = 1/125$

(Anything to the negative = a fraction)

(base 8) $8^0 = 1$

(Anything to the zero th =1)

(base 10) $10^4 = 10{,}000$

Examples

For Number: 5.91×10^5

Coefficient: 5.91

Exponential: 10^5

Base: 10

Exponent: 5

For Number: 210×10^{-8}

Coefficient: 210

Exponential: 10^{-8}

Base: 10

Exponent: -8

The Math for + Exponents

Exponent = a multiplying factor

4^2 = 4 x 4 = 16

2^4 = 2 x 2 x 2 x 2 = 16

5^3 = 5 x 5 x 5 = 125

10^6 = 10 x 10 x 10 x 10 x 10 x 10

10^6 = 1,000,000

The Math for – Exponents

Exponent = a dividing factor

4^{-2} = 1/4 x 1/4 = 1/16

2^{-4} = 1/2 x 1/2 x 1/ 2 x 1/2 = 1/16

5-3 = 1/5 x 1/5 x 1/5 = 1/125

10^{-6} = 1/10 x 1/10 x 1/10 x 1/10 x 1/10 x 1/ 10

10^{-6} = 0.000001

The Math for 0 Exponents

Any base^0 = 1

4^0 = 1

2^0 = 1

5^0 = 1

10^0 = 1

Expressing Numbers

Any number has a variety of exponentials:

Number	**=**	**Coefficient x**	**exponential**
n	**=**	**C x**	**$10^{exponent}$**
33,700.	=	337,000. x	10^{-1}
33,700.	=	33,700. x	10^0
33,700.	=	3,370. x	10^1

Exponential Notation (+) exponents

The coefficient is *multiplied* by $10^{exponent}$

33,700.	=	33.7	x	10^3
33,700.	=	3.37	x	10^4

The decimal Point is moved to the right

33.7 ➔ 33,700 decimal moved right 3

3.37 ➔ 33,700 decimal moved right 4

Exponential Notation (-) exponents

The coefficient is divided by 10^{exponent}

33,700. = 337,000 x 10^{-1}

33,700. = 3,370,000 x 10^{-2}

The decimal Point is moved to the left
337,000 ➔ 33,700 decimal moved left 1
3,370,000 ➔33,700 decimal moved left 2

Exponential Notation (0) exponents

The Coefficient is multiplied by 1

33,700. = 33,700 x 10^0

Since $10^0 = 1$
The decimal Point is not moved.

Standard exponential notation
"Scientific Notation"

coefficient
greater than or equal to one and less than ten

$1 \leq C < 10$

3 = yes
0.01 = no
134. = no

Which is in scientific notation?

33,700 = 337,000 x 10^{-1}
33,700 = 33,700 x 10^0
33,700 = 3,370 x 10^1
33,700 = 337 x 10^2
33,700 = 33.7 x 10^3
33,700 = 3.37 x 10^4
33,700 = 0.337 x 10^5

Express 15,208 in scientific notation

1. Determine the Coefficient
write down digits starting with the first nonzero digit
15208
2. Place decimal point between the 1st & 2nd digit
1.5208
3. Determine correct exponent (both number & sign)
1.5208 x $10^{\pm ?}$ = 15,208

Count number of places the decimal needs to be moved

coefficient ➔ number

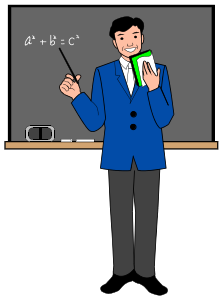
Move to right 4 places … so, exponent is 4

Expressing in scientific notation

$1.528 \times 10^{-4} = 0.0001528$

$1.528 \times 10^{4} = 15280$

$1.528 \times 10^{0} = 1.528$



From the Coefficient
Move to left = less (-)
Move to right = more (+)
No Move = 0

Fill In The Blanks

Number	Coefficient	Exponential	Base	Exponent
5.91×10^{5}				
210×10^{-8}				
0.061×10^{-3}				
4.88×10^{-6}				
3.83×10^{9}				
6.023×10^{23}				
4.18×10^{0}				

Number	Coefficient	Exponential	Base	Exponent
5.91×10^{5}	5.91	10^{5}	10	5
210×10^{-8}	210	10^{-8}	10	-8
0.061×10^{-3}	0.061	10^{-3}	10	-3
4.88×10^{-6}	4.88	10^{-6}	10	-6
3.83×10^{9}	3.83	10^{9}	10	9
6.023×10^{23}	6.023	10^{23}	10	23
4.18×10^{0}	4.18	10^{0}	10	0

Scientific Notation?

Which of the above are not in scientific notation?

210×10^{-8} 0.061×10^{-3}

Re-write them in scientific notation.

2.10×10^{-6} 6.1×10^{-5}

Write the following in scientific notation:

570,000 = 4,820 =

0.00699 = 0.000000311 =

958×10^{4} = 0.0744×10^{-3} =

570,000 = **5.7×10^{5}** 4,820 = 4.82×10^{3}

0.00699 = **6.99×10^{-3}** 0.000000311 = **3.11×10^{-7}**

958×10^{4} = **9.58×10^{6}** 0.0744×10^{-3} = **7.44×10^{-5}**

Write the following in ordinary decimal notation:

6.18×10^{4} 225×10^{-1}

3.86×10^{-5} 158×10^{2}

3.99×10^{-2} 1.64×10^{0}

6.18×10^{4} = **61,800** 225×10^{-1} = **22.5**

3.86×10^{-5} = **0.0000386** 158×10^{2} = **15,800**

3.99×10^{-2} = **0.0399** 1.64×10^{0} = **1.64**

Practice, Practice, Practice

Vince Lombardi (Coach of Green Bay Packers) repeatedly said,
"You win on fundamentals"

Practice, Practice, Practice

Unit Practice Problems
Unit Practice Quizzes

Assignment

Take Unit 2 Practice Test
Blackboard only records highest score
Take until multiple 100's have been scored (questions are variable)
(Gives sense of test exam format and content)

The Practice Quiz is very similar to the Unit Exam
Success on Unit exam is directly related to practice exam experiences

Continue memorizing:
Conversion factors
Polyatomic Ions
Elemental Symbols

Unit 4 & 5 have an enormous amount of memorization … continue memorizing!

Bring Calculator to Class for future sessions