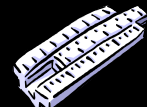



Exponential Notation: Using Exponents Or Exponentials

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Positional Numbering System

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



Exponent

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


Base (10)

We determine total "value" by adding positional values:

12045.67 is sum of:	
1 x	10,000
2 x	1,000
0 x	100
4 x	10
5 x	1
6 x	0.1
7 x	0.01

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Bases

Science mostly uses base 10

Computers use base 2 (binary)

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

10111 Binary:

1	x	16	=	16
0	x	8	=	0
1	x	4	=	4
1	x	2	=	2
1	x	1	=	1
<hr/>				
23 (Base 10)				

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The Math for + Exponents

Exponent = a multiplying factor

$$4^2 = 4 \times 4 = 16$$

$$2^4 = 2 \times 2 \times 2 \times 2 = 16$$

$$5^3 = 5 \times 5 \times 5 = 125$$

$$10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10$$

$$10^6 = 1,000,000$$



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The Math for - Exponents

Exponent = a dividing factor

$$4^{-2} = 1/4 \times 1/4 = 1/16$$

$$2^{-4} = 1/2 \times 1/2 \times 1/2 \times 1/2 = 1/16$$

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

$$10^{-6} = 1/10 \times 1/10 \times 1/10 \times 1/10 \times 1/10 \times 1/10$$

$$10^{-6} = 0.000001$$



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The Math for 0 Exponents

Exponent of zero

Any base⁰ = 1

$$4^0 = 1$$

$$2^0 = 1$$

$$5^0 = 1$$

$$10^0 = 1$$

Multiplying by 10⁰ is multiplication by number 1

$$45.67 \times 10^0 \rightarrow 45.67 \times 1 = 45.67$$

Often missed test question



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Expressing Numbers

Any number has a variety of exponentials:

Number = Coefficient x exponential

$$\begin{array}{l} C \quad \times \quad 10^{\text{exponent}} = n \\ 337,000 \quad \times \quad 10^{-1} = 33,700 \\ 33,700 \quad \times \quad 10^0 = 33,700 \quad (10^0 = 1) \\ 3,370 \quad \times \quad 10^1 = 33,700 \end{array}$$



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Exponential Notation (+) exponents



The coefficient is multiplied by 10^{exponent}

$$33.7 \times 10^3 = 33,700$$

$$3.37 \times 10^4 = 33,700$$

If coefficient gets smaller, exponent gets larger

If coefficient gets larger, exponent gets smaller

When changing expressions

Exponent and coefficient are inverse of each other

This keeps value for each expression the same

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Exponential Notation (-) exponents



The coefficient is divided by 10^{exponent}

$$337,000 \times 10^{-1} = 33,700$$

$$3,370,000 \times 10^{-2} = 33,700$$

If coefficient gets smaller, exponent gets larger

If coefficient gets larger, exponent gets smaller

When changing expressions

Exponent and coefficient are inverse of each other

This keeps value for each expression the same

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Exponential Notation (0) exponents

The Coefficient is multiplied 10^0

$33,700 \times 10^0 = 33,700 \quad 10^0 = 1$

Multiplying by 10^0 does not change the value



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Standard Exponential Notation "Scientific Notation"

**coefficient
greater than or equal to one
and less than ten**

$1 \leq C < 10$

Examples:
 $3 = \text{yes}$
 $0.01 = \text{no}$
 $134 = \text{no}$


 

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Which is in scientific notation?

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

**All expressions express same value
But only one is scientific notation**



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Express 15,208 in scientific notation 1

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



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Express 15,208 in scientific notation 2

3. Determine correct exponent (both number & sign)

$$1.5208 \times 10^{4?} \rightarrow 15,208$$

(What does 1.5208 need to be multiplied by?)

Count number of places the decimal needs to be moved
coefficient \rightarrow number

Move to right 4 places ... so, exponent is 4

When coefficient gets smaller \rightarrow exponent gets larger
When coefficient gets larger \rightarrow exponent gets smaller



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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

When coefficient gets smaller \rightarrow exponent gets larger
When coefficient gets larger \rightarrow exponent gets smaller

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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				

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Fill In The Blanks

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

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Scientific Notation?

Re-write these in scientific notation

210×10^{-8} 0.061×10^{-3}

2.10×10^{-6} 6.1×10^{-5}

When coefficient gets smaller → exponent gets larger
 When coefficient gets larger → exponent gets smaller

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Scientific Notation?



Write the following in scientific notation:

$$570,000 = \quad 4,820 =$$

$$0.00699 = \quad 0.000000311 =$$

$$958 \times 10^4 = \quad 0.0744 \times 10^{-3} =$$

When coefficient gets smaller → exponent gets larger
When coefficient gets larger → exponent gets smaller

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Scientific Notation?



Write the following in scientific notation:

$$570,000 = 5.7 \times 10^5 \quad 4,820 = 4.82 \times 10^3$$

$$0.00699 = 6.99 \times 10^{-3} \quad 0.000000311 = 3.11 \times 10^{-7}$$

$$958 \times 10^4 = 9.58 \times 10^6 \quad 0.0744 \times 10^{-3} = 7.44 \times 10^{-5}$$

When coefficient gets smaller → exponent gets larger
When coefficient gets larger → exponent gets smaller

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Scientific Notation?



Write the following in ordinary decimal notation:

$$6.18 \times 10^4 = \quad 225 \times 10^{-1} =$$

$$3.86 \times 10^{-5} = \quad 158 \times 10^2 =$$

$$3.99 \times 10^{-2} = \quad 1.64 \times 10^0 =$$

When coefficient gets smaller → exponent gets larger
When coefficient gets larger → exponent gets smaller

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Scientific Notation?



Write the following in ordinary decimal notation:

$$6.18 \times 10^4 = 61,800$$

$$225 \times 10^{-1} = 22.5$$

$$3.86 \times 10^{-5} = 0.0000386$$

$$158 \times 10^2 = 15,800$$

$$3.99 \times 10^{-2} = 0.0399$$

$$1.64 \times 10^0 = 1.64$$

When coefficient gets smaller → exponent gets larger
When coefficient gets larger → exponent gets smaller

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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



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