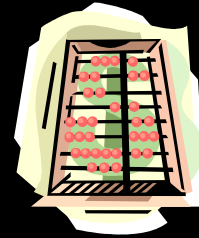
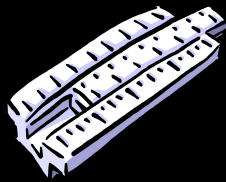


# Exponential Notation: Using Exponents Or Exponentials

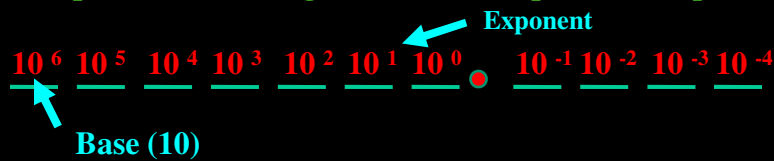


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## Positional Numbering System

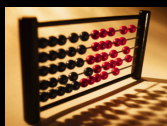
Each position left or right of decimal represents a “power”



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

23 (Base 10)

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## Exponential Notation

Method of expressing numbers

Any number = coefficient x exponential

Example:

Exponent (Positional Value of Base)

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

Base



Coefficient (the digits)

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## Examples

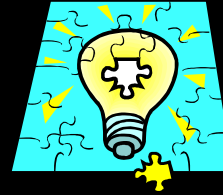
For Number:  $5.91 \times 10^5$

Coefficient: 5.91

Exponential:  $10^5$

Base: 10

Exponent: 5



For Number:  $210 \times 10^{-8}$

Coefficient: 210

Exponential:  $10^{-8}$

Base: 10

Exponent: -8

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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 base<sup>0</sup> = 1

$$4^0 = 1$$

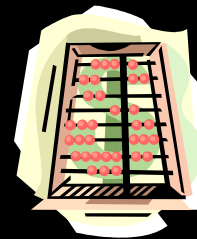
$$2^0 = 1$$

$$5^0 = 1$$

$$10^0 = 1$$

Multiplying by 10<sup>0</sup> 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

$$C \quad \times \quad 10^{\text{exponent}} = n$$

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

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

$$3,370 \quad \times \quad 10^1 = 33,700$$



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## Exponential Notation (+) exponents



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

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

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

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  $10^{-\text{exponent}}$

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

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

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)

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

(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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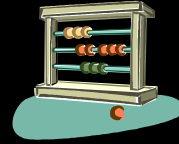
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## Expressing in Scientific Notation

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

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

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



### From the Coefficient

Move to left = less (-)

Move to right = more (+)

No Move = 0

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

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## Fill In The Blanks

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

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### Fill In The Blanks

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

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### Scientific Notation?

Re-write these in scientific notation

$$210 \times 10^{-8} \quad 0.061 \times 10^{-3}$$

$$2.10 \times 10^{-6} \quad 6.1 \times 10^{-5}$$

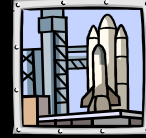


When coefficient gets smaller → exponent gets larger  
When coefficient gets larger → exponent gets smaller

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## Scientific Notation?



Write the following in scientific notation:

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

$$0.00699 = \quad \quad \quad 0.000000311 =$$

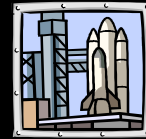
$$958 \times 10^4 = \quad \quad \quad 0.0744 \times 10^{-3} =$$

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:

$$6.18 \times 10^4 =$$

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

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

$$158 \times 10^2 =$$

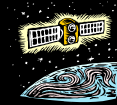
$$3.99 \times 10^{-2} =$$

$$1.64 \times 10^0 =$$

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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