8th Grade Math
Lesson: **April 9, 2020**

Objective:
I can use and interpret Scientific Notation.

I wonder:
What do you think "Scientific Notation" is? Where have you heard those words before? What do you think they mean?

Warm Up:

On a piece of paper, write the following vocabulary terms and define them in your own words, using what you remember:

Base   Exponent (Power)

Next, watch the video at the bottom of the page and try to define the vocabulary terms using your own words:

Standard Form   Scientific Notation   Coefficient

Video Link

Prior Knowledge:

When you multiply a decimal by a positive power of ten, the decimal point moves to the right (and makes the number ten times bigger).

Examples:

$1.47 \cdot 10 = 14.7$ Multiply by 10^1.

$1.47 \cdot 100 = 147$ Multiply by 10^2.

$-1.47 \cdot 100 = -147$ Multiply by 10^2.

Now You Try:

1 $1.8 \cdot 100$

2 $-0.28 \cdot 10^3$

3 $1.3 \cdot 10^4$

Define: Standard Form

Numbers in Standard Form are written with no powers (exponents), even if they are big or small. This form is probably the way you are familiar with looking at numbers.

It looks like: 830,000   or   0.0002

Define: Scientific Notation

Really large or really small numbers can be lengthy (lots of zeros), so sometimes we write them in a shorter way that still represents the entire number.
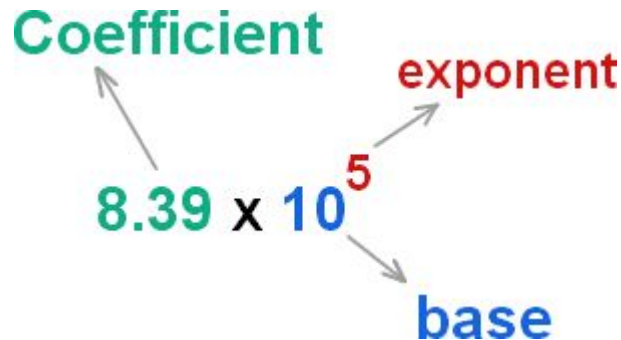
It looks like: $8.3 \cdot 10^5$

Define: Coefficient

When we write a number in Scientific Notation, the coefficient is the number in front of the power of ten.
The coefficient **must be between 1 and 10.**

$$4.5 \cdot 10^7$$

Coefficient   exponent

8.39×10^5

base
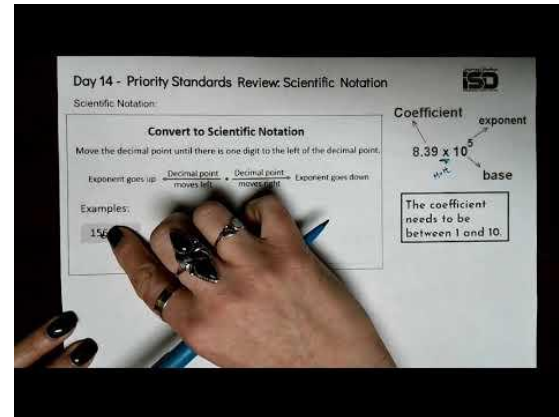
How to: Convert Between Scientific & Standard Notation

Convert to Scientific Notation

Move the decimal point until there is one digit to the left of the decimal point.

Exponent goes up ← Decimal point moves left • Decimal point moves right → Exponent goes down

Examples:

Standard Form	Scientific Notation
150,000,000	$1.5 \cdot 10^8$
0.00000741	$7.41 \cdot 10^{-6}$

Now You Try!   Practice: Part 1

#1-2: Convert the numbers into Standard Form,

and #3-6: Convert the numbers into Scientific Notation.

*__**Answers on the next page.**__*

1) 9.51×10^4

2) 9.9×10^{-3}

3) 53000

4) 0.000059

Challenge Problems

5) 0.92

6) 42002000

Practice: Part 1 Answer Key

1) 9.51×10^{4} 95100

2) 9.9×10^{-3} 0.0099

3) 53000   5.3×10^{4}

4) 0.000059   5.9×10^{-5}

Challenge Problems

5) 0.92   9.2×10^{-1}

6) 42002000 $4.2002 \cdot 10^{7}$

How to: Add & Subtract Numbers in Scientific Notation

- **Convert all numbers into Standard Form**
- **Add or Subtract**
- **Convert the solution back into Scientific Notation**

Example

$9.57 \times 10^3 - 3.8 \times 10^3$

$= 9{,}570 - 3{,}800$

$= 5{,}770$

$5{,}770 = 5.77 \times 10^3$

Example

$3.45 \times 10^{-2} - 4.8 \times 10^{-3}$

$= 0.345 - 0.0048$

$= 0.3402$

$0.3402 = 3.402 \times 10^{-1}$

Example

$1.8 \times 10^2 - 3.4 \times 10^{-1}$

$= 180 - 0.34$

$= 179.66$

$179.66 = 1.7966 \times 10^2$

How to: Multiply & Divide Numbers in Scientific Notation

- **Multiply or Divide the coefficients**
- **Add or Subtract the powers/exponents** (*Remember: Product/Quotient Rule of Exponents*)
- **Write your final answer in correct Scientific Notation** (*Coefficient has to be between 1 and 10*)

Example

$8.5 \times 10^2 \bullet 3.2 \times 10^3$

$= (8.5 \times 3.2) \bullet (10^2 \bullet 10^3)$

$= 27.2 \times 10^5$

$= 2.72 \times 10^6$

Correct Scientific Notation !!!

Example

$6.8 \times 10^3 \div 3.4 \times 10^{-2}$

$= (6.8 \div 3.4) \times (10^3 \div 10^{-2})$

$= 2 \times 10^{3-(-2)}$

$= 2 \times 10^5$

Correct Scientific Notation !!!

Now You Try!　　Practice: Part 2

On your paper, perform the indicated operations (Add, Subtract, Multiply, Divide).

Don't forget to write your answer in Scientific Notation!

$**$Answers on the next page.

1. $8.94 \cdot 10^5 + 1.1 \cdot 10^3$

2. $3.4 \cdot 10^4 - 9.8 \cdot 10^3$

3. $(2 \times 10^4)(8.66 \times 10^2)$

4. $\dfrac{5.5 \cdot 10^2}{1.1 \cdot 10^6}$

5. $7.7 \cdot 10^8 - 8.4 \cdot 10^6$

6. $(4.76 \times 10^{-5})(9 \times 10^{-4})$

7. $5 \cdot 10^{-2} + 2.9 \cdot 10^{-4}$

8. $\dfrac{7 \cdot 10^5}{7 \cdot 10^2}$

Practice: Part 2 — Answer Key

1. $8.94 \cdot 10^5 + 1.1 \cdot 10^3$ 8.951×10^5

2. $3.4 \cdot 10^4 - 9.8 \cdot 10^3$ 2.42×10^4

3. $(2 \times 10^4)(8.66 \times 10^2)$ 17.32×10^6

4. $\dfrac{5.5 \cdot 10^2}{1.1 \cdot 10^6}$ 5×10^{-4}

5. $7.7 \cdot 10^8 - 8.4 \cdot 10^6$ 7.616×10^8

6. $(4.76 \times 10^{-5})(9 \times 10^{-4})$ 4.284×10^{-8}

7. $5 \cdot 10^{-2} + 2.9 \cdot 10^{-4}$ 5.029×10^{-2}

8. $\dfrac{7 \cdot 10^5}{7 \cdot 10^2}$ $1 \times 10^3 = 10^3$

If you missed any, you can click on the videos on the the last slide for further explanations!

How to: <u>Compare</u> Numbers in Scientific Notation

1. First, look at the <u>exponents</u> and compare them. The bigger exponent is the bigger number, even in Scientific Notation.

2. If the exponents are the same, *then* compare the <u>coefficients</u>. The bigger coefficient is the bigger number.

Example

$$1.25 \times 10^8 > 4.8 \times 10^3$$

$$125{,}000{,}000 > 4{,}800$$

Example

$$4.37 \times 10^{-3} < 4.54 \times 10^{-3}$$

$$0.00437 < 0.00454$$

Now You Try!   Practice: Part 3

For numbers 1-2: Decide which number in the set is largest and explain.
For numbers 3-5: List the numbers in order from least to greatest.

*__**Answers on the next page.**__*

1) 7.2×10^3 or 8.5×10^2 **2)** 4.5×10^{-3} or 3.9×10^{-4}

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3) 3.2×10^{-2} 4.1×10^{-3} 3.7×10^{-3}

4) 1.6×10^4 1.8×10^{-1} 1.32×10^5

5) 5.2×10^3 4.43×10^{-2} 5.3×10^{-2} 4.4×10^4

Practice: Part 3   Answer Key

1) 7.2×10^{3} bigger exponent, $7200 > 850$ **2)** 4.5×10^{-3} bigger exponent, $0.0045 > 0.00039$

3) 3.7×10^{-3} 4.1×10^{-3} 3.2×10^{-2}

  order exponents & compare coefficients, $0.0037 < 0.0041 < 0.032$

4) 1.8×10^{-1} 1.6×10^{4} 1.32×10^{5} ; order exponents, $0.18 < 16{,}000 < 132{,}000$

5) 4.43×10^{-2} 5.3×10^{-2} 5.2×10^{3} 4.4×10^{4} ;

  order exponents & compare coefficients, $0.0443 < 0.053 < 5{,}200 < 44{,}000$

Extension: Real World & "How Many Times Larger?"

A rectangular tulip garden is about $4 \cdot 10^2$ meters long and $2 \cdot 10^3$ meters wide. Find the approximate area of the garden.

Answer: **$8 \cdot 10^5$**
(Area means <u>multiply</u>! Multiply the coefficients $4 \cdot 2$ to get 8. Then, use the Product Rule of Exponents for $10^2 \cdot 10^3$ and get 10^5.)

How many times larger is...

$$9 \cdot 10^5 \quad \text{than} \quad 4.5 \cdot 10^2 \quad ?$$

Answer: **2,000 times bigger!**
(First, the coefficient 9 is twice as big as the coefficient 4.5. Secondly, 10^5 and 10^2 have a difference of 10^3. That gives us $2 \cdot 10^3$, or 2000.)

Find the perimeter of the rectangular tulip garden mentioned above.

Answer: **$4.8 \cdot 10^3$**
(Perimeter means <u>add</u>! First, convert the length and width into standard form, then add <u>two</u> of each together. You will get: 400 + 400 + 2000 + 2000 = 4800. Lastly, convert your answer into Scientific Notation.)

How many times larger is...

$$5.5 \cdot 10^4 \quad \text{than} \quad 1.1 \cdot 10^{-5} \quad ?$$

Answer: **5,000,000,000 times bigger!**
(First, the coefficient 5.5 is five times bigger than the coefficient 1.1. Secondly, 10^4 and 10^{-5} have a difference of 10^9. That gives us $5 \cdot 10^9$, or 5,000,000,000.)

Additional Resources:

Click on the links below to get additional practice and to check your understanding!

If you need more explanation:

[Khan Academy](#)

[Convert Standard form to Scientific Notation](#)

[Compare and Order Numbers in Scientific Notation](#)

[Scientific Notation - All you need to know](#)

If you need more practice:

[Converting Standard Form and Scientific Notation](#)

[Compare Numbers Written in Scientific Notation](#) (May need to click on twice)