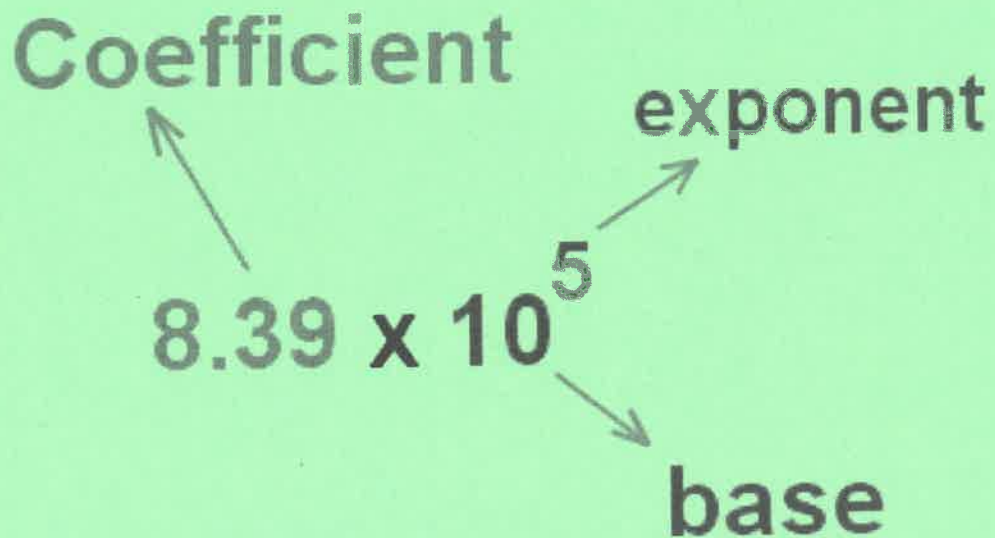


Name: _____

Teacher: Ms. Moser Period: _____

Unit 2:

Scientific Notation



2,540,000

so many digits!

Sometimes with numbers this small or this large, it can be helpful to rewrite without the extra zeroes.

0.008264

So, we ___ the 1st non-zero digit, place a _____ before the next, and use powers of ___ to correctly represent how we moved the decimal point.

The rewritten format is called

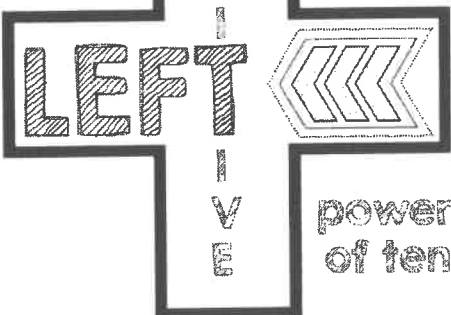
SCIENTIFIC NOTATION

2,540,000

becomes

When converting a number into scientific notation,

If you moved a decimal to the



Careful!

Moving the decimal point to the LEFT represents...

Moving the decimal point to the RIGHT represents...

0.008264

becomes

When writing in scientific notation,

If you moved the decimal to the

RIGHT
NEGATIVE

power of ten

Try It

Write 0.0337 in scientific notation.

Name: _____

Powers of Ten

$$8 \times 100 =$$

$$5 \div 100 =$$

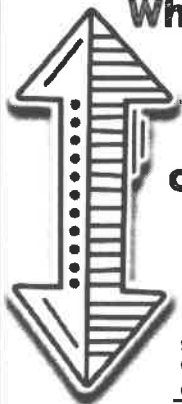
$$0.6 \times 1000 =$$

$$0.9 \div 1000 =$$

Dividing by 100 is the same as multiplying by ten to what power?? _____

SCIENTIFIC NOTATION

-- PRACTICE --



When we UN-DO,
we do the
OPPOSITE
(inverse
operations)!

Working Backwards:

When converting FROM scientific notation INTO standard form, remember that the decimal is moving in the opposite direction. So if the power is **NEGATIVE**, you will move it to the _____, and if the power is **POSITIVE** you will move it to the _____.

STANDARD
FORM

56,790

SCIENTIFIC
NOTATION

2.4×10^{-2}

7,000

1.65×10

0.93806

1.469×10^8

Name: _____

© Copyright 2016 Math Giraffe

Introduction to Scientific Notation

Objective: I can use scientific notation to express very large or very small quantities.

Guided Practice:

Scientific Notation- when you are dealing with very **large** or very **small** numbers, it is helpful to be able to write them in a shorter form.

<u>Scientific Notation</u>	=	<u>Standard Form</u>
2.59×10^{11}		259,000,000,000

Rule: A number is in Scientific Notation if:

- 1) The first factor is a single digit followed by a decimal point
- 2) Multiplied by the second factor which is a power of 10.

Exercise 1- Determine if the following numbers are written in scientific notation:

- (1) 3.2×10^4 (2) 78.96×10^4 (3) 456.1×10^{-8} (4) $9. \times 10^{-5}$

Scientific Notation: When to use Positive Exponents and Negative Exponents

A number in scientific notation with _____ exponents represents a number _____ than one (whole number).

A number in scientific notation with _____ exponents represents a number between 0 and 1 (decimal).

Remember:

Positive Exponent → _____

Negative Exponent → _____

Exercise 2- Determine if the following numbers below will be whole numbers or decimals.

- (1) 1.2×10^5 (2) 5.8×10^{-5} (3) 6.8×10^{-9} (4) 3×10^9

Converting Numbers from Scientific Notation and Standard Form

Standard Form to Scientific Notation

1. Write the number placing the decimal point after the first **non-zero** digit
2. Write $\times 10$
3. Count the number of digits you moved the decimal point & write it as the exponent.

Remember:

- If it is a whole number _____
- If it is a decimal _____

Exercise 3- Convert from standard form to scientific notation.

(1) 245,000,000

(3) 500,000

(2) .00084

(4) .000007643

Scientific Notation to Standard Form

1. Move the decimal point to the number the number of places indicated by the exponent
2. If it's a positive exponent, move the decimal point to the right (*Whole number- make the number larger*)... If it's a negative exponent, move the decimal point to the left (*Decimal- make the number smaller*)

Exercise 4- Convert from scientific notation to standard form.

(1) 5.9×10^3

(3) 8.32×10^{-4}

(2) 4.765×10^8

(4) 1.9×10^{-7}

Making Sure a Number is written in Scientific Notation

LARS

Rule:

If a decimal point needs to move to the left, the exponent increases 48.6×10^3

If the decimal point needs to move to the right, the exponent decreases $.48 \times 10^3$

** Be careful when the exponent is negative!

Exercise 5- Write each in Scientific Notation, if necessary:

(1) 68.7×10^9 _____ (2) 6×10^5 _____

(3) $.725 \times 10^8$ _____ (4) $.292 \times 10^{-4}$ _____

(5) 326×10^{-8} _____ (6) 7.5×10^{-9} _____

PROBLEM SET:

- Determine if the numbers below are written in scientific notation. Explain your answer.
(a) 4.1×10^{15} (b) 24.01×10^5 (c) 0.1×10^{-6}
- The speed of light in a vacuum is 299,792,458 meters per second. Which number, written in scientific notation, is the best approximation of the speed of light?
(a) 0.3×10^7 meters per second
(b) 0.3×10^8 meters per second
(c) 3.0×10^7 meters per second
(d) 3.0×10^8 meters per second
- In 2013, JFK Airport had approximately 9.4×10^7 passengers pass through the airport. What is that number written in standard form?
- A virus is viewed under a microscope. Its diameter is 0.00000002 meter. How would this length be expressed in scientific notation?
- Ms. Moser gave her class the following problem: Convert the following number from standard form to scientific notation 1,742,103,000.
Anthony's Answer: 17.42103×10^8
Is Anthony's answer correct? Explain your reasoning.

Lesson 2-1 Extra Practice**Converting- Standard Form and Scientific Notation**

Convert into scientific notation.	Write the numbers below in standard form
1) 3,400	5) 1.901×10^{-7}
2) 0.000023	6) 8.65×10^{-1}
3) 101,000	7) 2.30×10^4
4) 0.010	8) 9.11×10^3

Comparing Numbers in Scientific Notation**Objective:** I can compare numbers written in scientific notation.**Warm Up:** Are the following numbers written in scientific notation? If not, state the reason.

(a) $4.0701 + 10^7$

(b) $.325 \times 10^{-2}$

Investigation 1: Express each scientific notation in standard form-

(a) 4.3×10^2

(b) 2.5×10^3

Which number is smaller?

Which number is larger?

**Investigation 2:** Express each scientific notation in standard form-

(a) 2.1×10^4

(b) 1.5×10^4

Which number is smaller?

Which number is larger?

Is there a relationship between the value of the coefficient and which number is larger or smaller?

**Guided Practice:** Steps for Comparing Numbers in Scientific Notation Form

1. To compare two numbers given in scientific notation, first compare the _____.

The one with the greater exponent will be _____.

2. If the exponents are _____, then compare the decimals.

Compare the quantities in the following exercises using $<$, $>$, or $=$.

Exercise 1: 1.06×10^{16} _____ 2.4×10^{15}

Exercise 2: 2.78×10^7 _____ 278×10^7

Exercise 3- Order the countries shown in the accompanying table according to the amount of money their visitors spent in the United States from *least to greatest*.

Dollars Spent by International Visitors in the U.S	
Country	Dollars Spent
Canada	1.03×10^7
India	1.83×10^6
Mexico	7.15×10^6
United Kingdom	1.06×10^7

Problem Set:

For the following problems, use $>$, $<$, or $=$ to make the statement true.

(1) 9.74×10^{21} _____ 2.1×10^{22}

(2) 5.28×10^{12} _____ 95.4×10^{12}

(3) 2.33×10^{10} _____ 7.6×10^{10}

(4) 4.4×10^7 _____ 44,000,000

(5) 548,000,000 _____ 5.48×10^7

(6) 1.2×10^{-3} _____ 4.7×10^{-3}

(7) 6.23×10^{14} _____ 8.912×10^{12}

(8) 5.15×10^{-4} _____ 6.35×10^{-5}

(9) 3.28×10^{17} _____ 4.25×10^{17}

(10) -1.2×10^5 _____ -1.7×10^5

(11) Compare the following problem. *Be sure to explain your reasoning.*

12.8×10^3 _____ 1.4×10^3

More work with comparing...

The Solar System in Scientific Notation ☺

Complete the chart.

Planet	Approximate distance from the Sun	Distance written in Scientific Notation
<i>Earth</i>	93,000,000	
<i>Jupiter</i>	484,000,000	
<i>Mars</i>	142,000,000	
<i>Mercury</i>	36,300,000	
<i>Neptune</i>	2,800,000,000	
<i>Saturn</i>	888,000,000	
<i>Uranus</i>	1,780,000,000	
<i>Venus</i>	67,200,000	

List the planets in order from **greatest to least**, using scientific notation.

Planet	Distance from the Sun in scientific notation

**Comparing Numbers:
Standard Form vs Scientific Notation Homework**

Directions- Compare the following numbers using $>$, $<$, or $=$.

(1) 2.56×10^5 _____ 4.2×10^{-7}

(2) 4.3×10^4 _____ 1.6×10^6

(3) 7.1×10^{-2} _____ 2.9×10^{-6}

(4) 5.27×10^5 _____ 2.139×10^5

Directions- Order the numbers from least to greatest:

2.81×10^{-7} ; 2.01×10^3 ; 2.72×10^{-7} ; 9.45×10^{-4}

Directions- The table lists the populations of five countries. List the countries from least to greatest.

Country	Population
Australia	2.0×10^7
Brazil	1.9×10^8
Egypt	7.7×10^7
Luxemburg	4.7×10^5
Singapore	4.4×10^6

Multiply and Divide Scientific Notation**Objective:** I can find the product and quotient of numbers written in scientific notation.**Warm Up:** Answer the following questions (without a calculator)

(a) 2.7×3.4

(b) $8.04 \div 6.7$

(c) $10^3 \times 10^5$

(d) $\frac{10^{12}}{10^4}$

To find the **product** of numbers that are in scientific notation:

1. Multiply the first _____ (the numbers before the multiplication sign)
2. Keep the _____ of ten
3. _____ the exponents

Exercise 1- Evaluate the following $(7 \times 10^3) (2 \times 10^4)$

Exercise 2- Evaluate the following $(8.4 \times 10^2) (2.5 \times 10^6)$

To find the **quotient** of numbers that are in scientific notation:

1. _____ the first factors (the numbers before the multiplication sign)
2. Keep the _____ of ten
3. _____ the exponents

Exercise 3- Evaluate the following $\frac{9 \times 10^{10}}{3 \times 10^6}$

Exercise 4- Evaluate the following $\frac{1.14 \times 10^6}{4.8 \times 10^3}$

PROBLEM SET:

1. Evaluate the following

a. $(2.63 \times 10^4) (1.2 \times 10^{-3})$

b. $\frac{9 \times 10^{-11}}{2.4 \times 10^8}$

c. $(9 \times 10^{-4}) (4.34 \times 10^{-3})$

d. $\frac{1.24 \times 10}{4 \times 10^{-2}}$

2. Neurons are cells in the nervous system that process and transit information. An average neuron is about 5×10^{-6} meter in diameter. A standard table tennis ball is 0.04 meter in diameter. About *how many times* as great is the diameter of a ball than a neuron?

3. Central Park in New York City is rectangular in shape and measures approximately 1.37×10^4 feet by 2.64×10^2 feet. If one acre is equal to 4.356×10^4 square feet, how many acres does Central Park cover? *Round to the nearest hundredth.* [HINT: space covered is area]

4. In 2005, 8.1×10^{10} text messages were sent in the United States. In 2010, the number of annual text messages had risen to 1,810,000,000,000. About *how many times* as great was the number of text messages in 2010 than 2005?

5. Which one does not belong? Prove your reasoning.

$$14.28 \times 10^9; (3.4 \times 10^6)(4.2 \times 10^3); 1.4 \times 10^9; (3.4)(4.2) \times 10^{(6+3)}$$

6. Enrique is finding the *quotient* of 6.63×10^{-6} and 5.1×10^{-2} . Circle his mistake and correct it.

$$\begin{aligned} \frac{6.63 \times 10^{-6}}{5.1 \times 10^{-2}} &= \left(\frac{6.63}{5.1} \right) \left(\frac{10^{-6}}{10^{-2}} \right) \\ &= 1.3 \times 10^{-6 - (-2)} \\ &= 1.3 \times 10^{-4} \end{aligned}$$

7. The New York Knicks play in Madison Square Garden, the Los Angeles Lakers play in the Staples Center, and the Miami Heat play in American Airlines Arena. Madison Square Garden is about 2.8×10^3 miles from the Staples Center and Madison Square Garden is about 1.4×10^3 miles from American Airlines Arena. *How many times* of the distance the Knicks travel to play the Heat is the distance the Knicks travel to play the Lakers?

8. An airplane traveled 5.7×10^2 miles per hour for 1.4×10^1 hours. How far did the airplane travel?

Mixed Practice with Scientific Notation...

1. The table below shows the 2019-2020 salaries for four New York Knicks players. Order the players from highest salary to lowest salary.

RJ Barrett	7.84×10^6
Julius Randle	1.8×10^7
Bobby Portis	1.5×10^7
Joakim Noah	6.431×10^6

2. Circle the lower number: 2.1×10^{-8} 1.2×10^{-5}

Explain:

3. Write the following numbers in scientific notation:

A. 62,000,000,000

B. 0.0000044

4. *Multiply (leave answer in scientific notation).*

A. $(2.2 \times 10^{-4})(4 \times 10^{-3})$

B. $(3 \times 10^3)(8 \times 10^3)$

5. *Divide (leave answer in scientific notation).*

A. $\frac{8 \times 10^6}{4 \times 10^4}$

B. $\frac{6 \times 10^9}{2 \times 10^5}$

Multiplying & Dividing Scientific Notation Homework

1. Determine the product of $800.5 \times (2 \times 10^6)$.
2. One terabyte of data storage is approximately 1,100,000,000,000 bytes of data. About how many bytes are in four terabytes? Express your answer in scientific notation.
3. Three billionaires chipped in to buy an island worth $\$3.66 \times 10^{12}$. How much did each billionaire spend?
4. On weekdays, the average number of subway riders in City X is approximately 1×10^6 . The average number of subway riders in City Y is approximately 50,000. How many times as great is the average number of riders in City X as in City Y?

Adding and Subtracting Scientific Notation

Objective: I can add and subtract very small and very large numbers in scientific notation.

Warm Up: Simplify each expression

1. $(1.1 \times 10^{-3})(2.5 \times 10^9)$

2. $\frac{9.9 \times 10^{11}}{1.1 \times 10^8}$

3. Can we simplify the following expressions? [Just answer Yes or No]

(a) $2x^2 + 3x$

(b) $4x - x$

(c) $x^3 + 3x^2 + 7x$

Steps for Adding and Subtracting with Scientific Notation

- the
1. Look to see if the _____ are the _____.
(If they are, skip to step 3)
 2. If the exponents are different, move the decimal point in the coefficient to change the exponent.
 - a) If you moved the decimal to the *left*, _____ the exponent
 - b) If you moved the decimal to the *right*, _____ the exponent.
 3. **Add** or **subtract** the coefficients. Keep the power of 10.
 4. Check to make sure your answer is in Scientific Notation; if it's not, convert it!!

3.6×10^3	\Rightarrow	3.6×10^3
$+ 9.7 \times 10^2$		$+ 0.97 \times 10^3$
		4.57×10^3
		\Uparrow final answer

Exercise 1- Find the sum:

a. $(2.3 \times 10^3) + (6.9 \times 10^3)$

b. $(4.81 \times 10^3) + (7.913 \times 10^5)$

Exercise 2- Find the difference:

a. $(6.1 \times 10^4) - (2.43 \times 10^2)$

b. $(7.61 \times 10^6) - (2.87 \times 10^4)$

Exercise 3-Evaluate the following expression: $(6.3 \times 10^5) + 2,700,000$

Problem Set:

1) $(7.38 \times 10^8) - (1.61 \times 10^7)$	2) $(8.41 \times 10^3) + (9.71 \times 10^4)$
3) $(1.263 \times 10^9) - (1.525 \times 10^7)$	4) $(2.85 \times 10^7) + (1.61 \times 10^9)$

5. In 2018, the US had a Gross Domestic Product (GDP) of 1.948×10^{13} . The United Kingdom had a GDP of 2.68×10^{12} . What were the *combined* GDPs of the US and the UK, in 2018?

6. Factories A and B produced potato chips. Last year, each factory reported the amount of each ingredient. Factory A reported their amounts in scientific notation and Factory B reported their amounts in standard form.

Ingredient	Factory A (amount used in pounds)	Factory B (amount used in pounds)
Potato	4.87×10^6	3,309,000
Oil	5.61×10^5	356,000
Salt	2.87×10^5	193,500

Show your work or explain, leaver your answers in scientific notation.

a) Which factory used more oil last year? By how much?

b) What is the total amount of salt used by both factories?

c) What is the total weight of all the ingredients in Factory A?

Add and Subtract Scientific Notation Homework

Evaluate each expression. Express the result in scientific notation. Show all work!

1. $(5.69 \times 10^5) + (6.97 \times 10^5) =$

2. $(9.47 \times 10^8) - (4.9 \times 10^8) =$

3. $(3.67 \times 10^7) + (6.4 \times 10^7) =$

4. $(9.87 \times 10^7) - 10,510,000 =$

5. In 2012, 1.9×10^7 people visited Central Park. That same year, 9.3×10^6 people visited Yellowstone Park. How many more people visited Central Park than Yellowstone?

6. In 2006, China had 1.311×10^8 internet users. That same year, Japan had 9.09×10^7 internet users. How many Internet users did the two countries have combined?

Scientific Notation – Mixed Operations

Objective: I can evaluate expressions in scientific notation using all operations.

Warm Up: Evaluate the following: What is the product of $(2.2 \times 10^4)(1.5 \times 10^3)$

Guided Practice: Mixed Practice

<p>1) $(8 \times 10^5) + (5 \times 10^4)$</p>	<p>2) $\frac{7 \times 10^6}{2 \times 10^3}$</p>
<p>3) $(3 \times 10^4) - (5 \times 10^2)$</p>	<p>4) $(4 \times 10)(2 \times 10^3)$</p>

Problem Set:

<p>1) $\frac{9.8 \times 10^3}{2 \times 10^2}$</p>	<p>2) $(8 \times 10^3)(3 \times 10^4)$</p>
--	---

3) $(51.3 \times 10^8) - (2.7 \times 10^6)$	4) $(7 \times 10^5) + (6 \times 10^7)$
5) $(4 \times 10^2) + (9 \times 10^4)$	6) $(2 \times 10^3)(5 \times 10^4)$

7) The mass of the moon is about 9.3×10^{22} kg. It would take approximately 15,000,000 moons to equal the mass of the sun. Determine the mass of the sun.

8) The two largest mammals on Earth are the blue whale and the African elephant. An average blue whale weighs approximately 5,000 kg.

A. Express the weight of a blue whale in scientific notation.

Answer: _____

B. An average male African elephant weighs about 12.27×10^4 kg. About how many times heavier is a blue whale than an African elephant?

**** Challenge **** Find the perimeter of the rectangle, if the area is 5.612×10^{14} cm².



9.2×10^7 cm

MORE REVIEW SCIENTIFIC NOTATION

1. The approximate distance from Saturn to the Sun is 888,000,000 miles. Convert this number to scientific notation.	2. Bill Gates' estimated net worth is 42.2 billion dollars. Express this value in scientific notation.
3. The thickness of a strand of human hair is 3×10^6 millimeters. Express this number in standard form.	4. The Earth has been around for 4.6×10^9 years! How old is the Earth?



REAL WORLD APPLICATIONS

5. The length of a rectangle is 4.7×10^2 centimeters and the width measures 3.6×10^1 centimeters. Calculate the <u>area</u> of this rectangle.	6. The length of an <u>equilateral</u> triangle is 5.1×10^1 cm. Find the <u>perimeter</u> .
7. The lowest salary of a teacher in New York is 4.5×10^4 dollars and the highest salary is 1.19×10^5 dollars. Find the <u>range</u> of teacher's salaries in New York.	8. The thickness of a cat's hair is 1×10^{-4} millimeters and the thickness of a dog's hair is 1×10^{-2} millimeters. a) Which animal has thicker hair? b) <u>How many times</u> thicker is it?

Name : _____

Score : _____

Scientific Notation

Mixed operations: ES1

Simplify each problem and express the answer in scientific notation.

1) $(8 \times 10^5) + (5 \times 10^4)$

Answer : _____

2) $\frac{7 \times 10^6}{2 \times 10^3}$

Answer : _____

3) $(3 \times 10^4) - (5 \times 10^2)$

Answer : _____

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

Answer : _____

5) $\frac{9 \times 10^3}{2 \times 10}$

Answer : _____

6) $(8 \times 10^3) (3 \times 10^4)$

Answer : _____

7) $(5 \times 10^8) - (3 \times 10^6)$

Answer : _____

8) $(7 \times 10^5) + (6 \times 10^7)$

Answer : _____

9) $(4 \times 10^2) + (9 \times 10^4)$

Answer : _____

10) $(2 \times 10^3) (5 \times 10^4)$

Answer : _____

Lesson 7 Homework Practice

Compute with Scientific Notation

Evaluate each expression. Express the result in scientific notation.

1. $(7.3 \times 10^8)(2.4 \times 10^3)$

2. $\frac{4.62 \times 10^7}{1.2 \times 10^4}$

3. $\frac{8.64 \times 10^6}{4.32 \times 10^3}$

4. $(5.32 \times 10^8) - (4.6 \times 10^6)$

5. $(9.67 \times 10^6) + (3.45 \times 10^5)$

6. $(4.5 \times 10^3)(1.6 \times 10^5)$

7. $(2.82 \times 10^9) + (6.3 \times 10^7)$

8. $(3.64 \times 10^6) - (2.18 \times 10^4)$

9. $\frac{2.144 \times 10^7}{3.2 \times 10^4}$

10. $(7.2 \times 10^7)(1.82 \times 10^2)$

11. $(9.8 \times 10^5) - (6.7 \times 10^3)$

12. $(6.98 \times 10^6) + (1.65 \times 10^7)$

13. $(2.46 \times 10^7)(1.78 \times 10^2)$

14. $\frac{3.936 \times 10^6}{2.4 \times 10^2}$

15. **MARS** The diameter of Mars is about 6.8×10^3 kilometers. The diameter of Earth is about 1.2763×10^4 kilometers. About how much greater is Earth's diameter than the diameter of Mars?

16. **WAREHOUSE** A factory builds a new warehouse that is approximately 1.28×10^5 square feet. Later, they add on 1.13×10^3 more square feet for offices. Use scientific notation to write the total size of the new building.

Lesson 7 Problem-Solving Practice

Compute with Scientific Notation

<p>1. OCEAN Humpback whales are known to weigh as much as 8×10^4 pounds. The tiny krill they eat weigh only 2.1875×10^{-3} pounds. How many times greater than krill are humpback whales?</p>	<p>2. MEASUREMENT One inch is equal to 1.5782×10^{-5} miles. One centimeter is equal to 6.2137×10^{-6} miles. How many miles greater is one inch than one centimeter?</p>										
<p>3. MONUMENT The Statue of Liberty is about 1.5108×10^2 feet tall from the base to the torch. The pedestal is 1.54×10^2 feet tall. How tall is the Statue of Liberty from the foundation of the pedestal to the top of the torch?</p>	<p>4. FUNDRAISER The table shows the amount of money raised by each region for cancer awareness. How much money did the North and South raise together?</p> <table border="1" style="margin: 10px auto; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 5px;">Region</th> <th style="padding: 5px;">Amount Raised (\$)</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">East</td> <td style="padding: 5px;">1.46×10^4</td> </tr> <tr> <td style="padding: 5px;">North</td> <td style="padding: 5px;">2.38×10^4</td> </tr> <tr> <td style="padding: 5px;">South</td> <td style="padding: 5px;">6.75×10^3</td> </tr> <tr> <td style="padding: 5px;">West</td> <td style="padding: 5px;">8.65×10^3</td> </tr> </tbody> </table>	Region	Amount Raised (\$)	East	1.46×10^4	North	2.38×10^4	South	6.75×10^3	West	8.65×10^3
Region	Amount Raised (\$)										
East	1.46×10^4										
North	2.38×10^4										
South	6.75×10^3										
West	8.65×10^3										
<p>5. TURKEYS When the National Wild Turkey Federation was formed in 1973, there were only about 1.3×10^6 wild turkeys in North America. Now there are over 7×10^6 wild turkeys in North America. About how many more turkeys are there now than there were in 1973?</p>	<p>6. MONEY A bank starts the day with 2.93×10^4 dollars in the vault. At the end of the day, the bank has 3.5×10^5 dollars in the vault. How much more money is in the vault at the end of the day than there was in the morning?</p>										