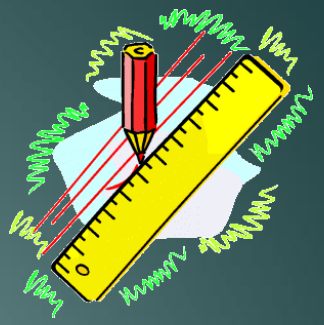


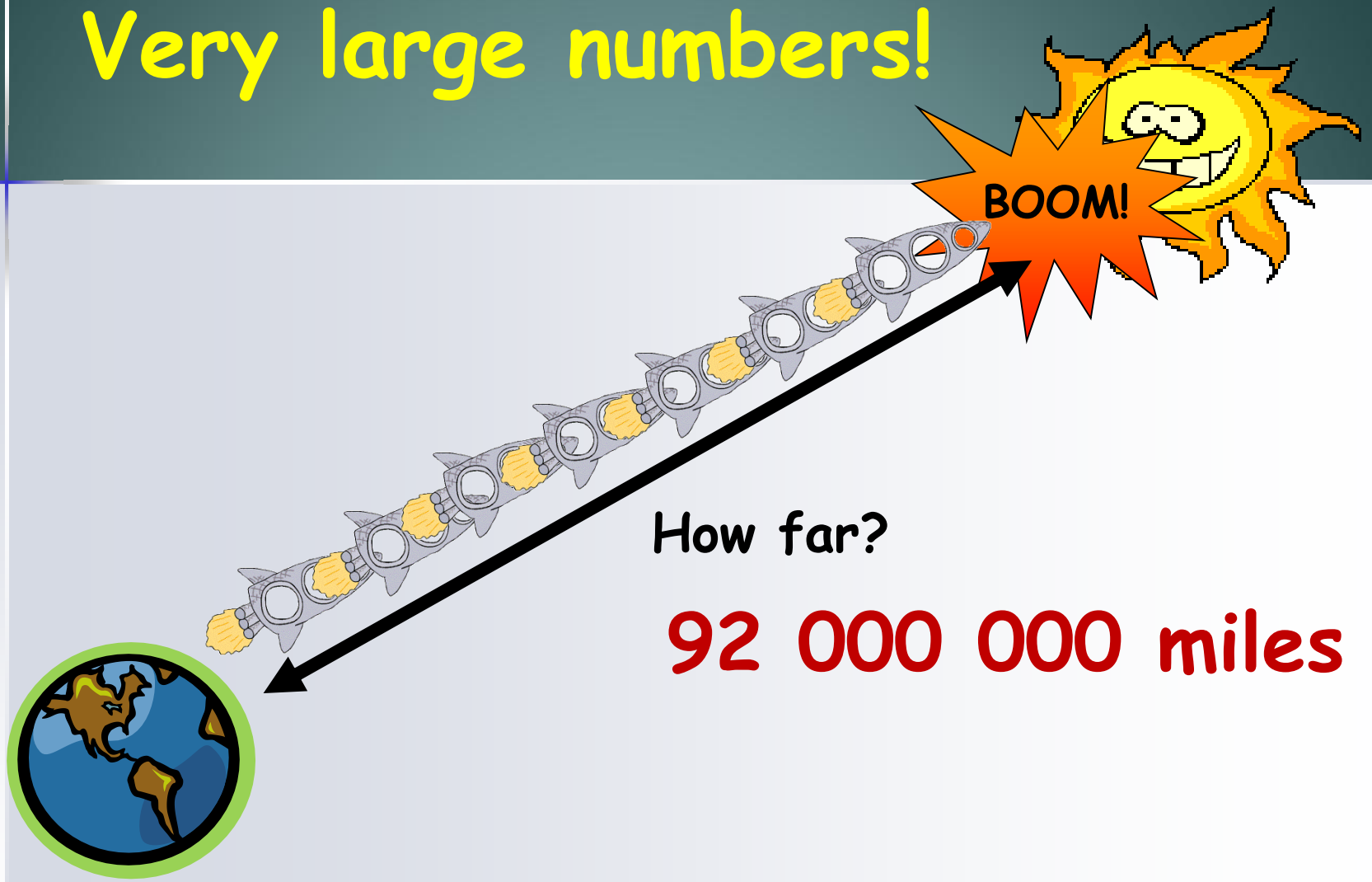
SCIENTIFIC NOTATION

September 7, 2014

SCIENTIFIC NOTATION

A METHOD OF DEALING WITH VERY LARGE AND VERY SMALL NUMBERS IN SCIENCE

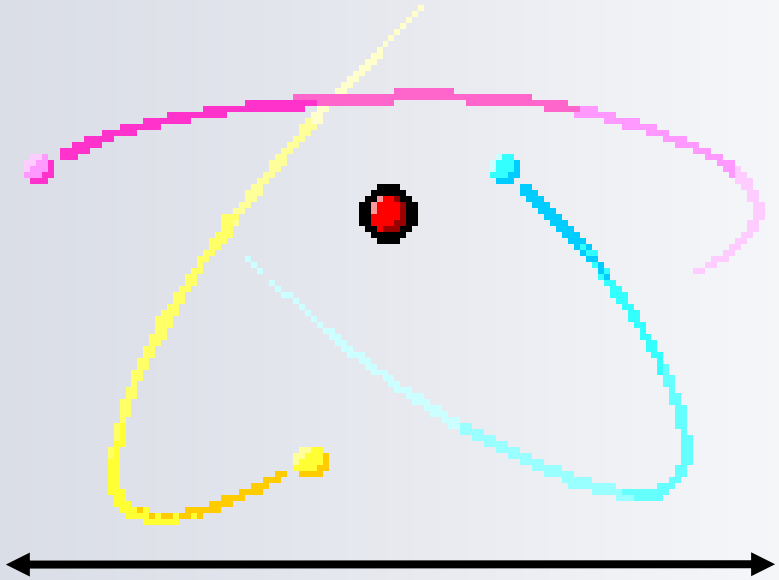
Very large numbers!



How far?

92 000 000 miles

Very small numbers!



How wide is an atom?

0.000 000 000 1 metres wide!

Writing Numbers in Scientific Notation

$$5.67 \times 10^{5}$$

coefficient base exponent

Numbers in scientific notation are made up of three parts: coefficient, base and exponent.

Writing a Number in Scientific Notation

THE CORRECT FORM

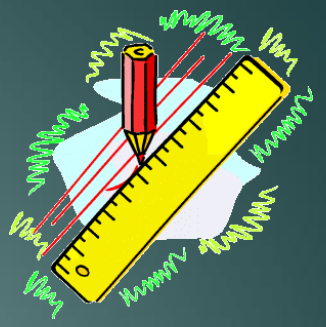
- Coefficient: written so the first **significant figure** is placed to the **left** of the decimal point and all other sig figs are placed to the **right**
  - Must be a number between 1 to 9.9
- The rest of the number is expressed **as a power of 10**
- The **exponent** is determined by how many places you moved the decimal point

Writing Numbers in Scientific Notation

RULES of Exponents

- For numbers larger than 1, the exponent is **positive**
  - Example: **838,000** = 8.38 x 10^{5}
- For numbers smaller than 1, the exponent is **negative**
  - Example: **0.00503** = 5.03 x 10^{-3}

Examples of Scientific Notation



$363{,}000{,}000{,}000 = 3.63 \times 10^{11}$

$206{,}000 = 2.06 \times 10^{5}$

$.000000305 = 3.05 \times 10^{-7}$

$.0003500 = 3.500 \times 10^{-4}$

Scientific Notation for Large Numbers

Move the point to get a number between 1 and 9

$92\,000\,000. = 9.2 \times 10^{7}$

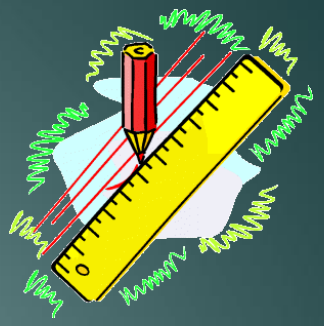
The point moved 7 places

Add the decimal **point**

Between 1 and 9

9.2×10^{7} *miles*

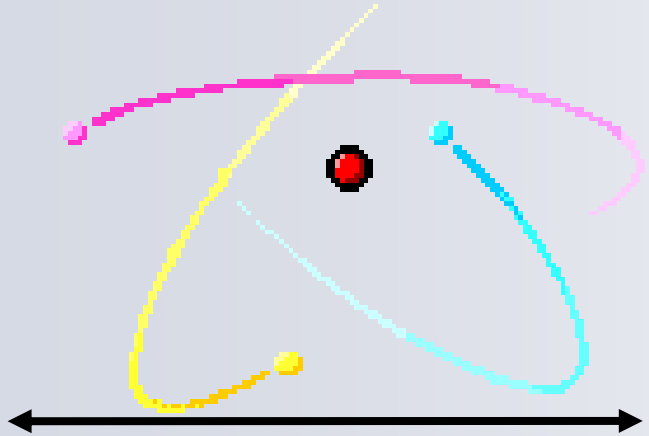
Scientific Notation for Small Numbers



Move the point to get a number between 1 and 10

$$0\ 000\ 000\ 000\ 1. = 1 \times 10^{-10}$$

The point moved 10 places. Negative sign for small numbers.



1×10^{-10} metres wide

Going from Scientific Notation back to Decimal Form

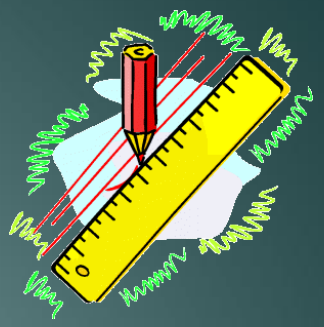
Helpful Hint

The sign of the exponent tells which direction to move the decimal:

- A positive exponent means move the decimal to the right

- A negative exponent means move the decimal to the left

Changing back large numbers



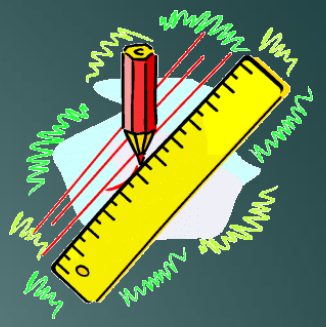
The point moves 7 places to the right

$8.6 \times 10^7 = 8\,6000000 = 86\,000\,000$

Hint:
Add 7 zeros, although you probably won't need them all.

Zeros after the point aren't needed.

Changing back small numbers



-6 so remember to move point <u>left</u> for small numbers.

<u>Hint:</u>
Add 6 zeros to the left of the number.

$5.16 \times 10^{-6} = 0.000005\,16$

$= 0.000\ 00516$

Multiplying and Dividing using Scientific Notation

- To multiply numbers in scientific notation, multiply the coefficients, then add the powers of 10
- Move the decimal point so that the number is in scientific notation
  - Need to move the decimal right, -1
  - Need to move the decimal left, +1

Multiplying and Dividing using Scientific Notation

- To divide numbers written in scientific notation, divide the numbers as usual, then subtract the powers of 10
- Express the final answer in scientific notation
  - Need to move the decimal right, -1
  - Need to move the decimal left, +1

Examples: Multiplying and Dividing Numbers in Scientific Notation

Suppose you are asked to solve the following problems.

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

Multiply the first factors.
$2 \times 3 = 6$

Add the exponents.
$3 + 2 = 5$

Combine the factors.
6×10^5

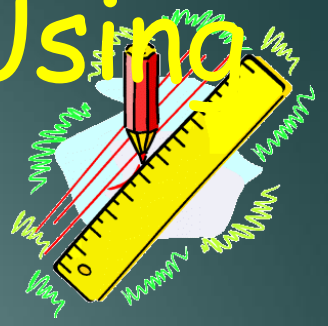
$(9 \times 10^8) \div (3 \times 10^{-4})$

Divide the first factors.
$9 \div 3 = 3$

Subtract the exponents.
$8 - (-4) = 8 + 4 = 12$

Combine the factors.
3×10^{12}

Adding and Subtracting Using Scientific Notation



- If the quantities are expressed to the same power of ten you can add/subtract the numbers directly:

  $7.35 \times 10^2 + 2.43 \times 10^2 = 9.78 \times 10^2$ m

- If the quantities are not expressed to the same power of ten, change one of the numbers to match the power of ten of the other number

  $7.35 \times 10^3 + 2.43 \times 10^2 \ldots\ldots (.243 \times 10^3)$

  $7.35 \times 10^3 + .243 \times 10^3 = 7.59 \times 10^3$