



$2,543 = 2,543 \times 10^0$

2,54

SCIENTIFIC NOTATION

Writing very big or very small
numbers conveniently

DEALING WITH EXTREME NUMBERS

- **2,000,000,000,000,000** picometers is an awfully large number. (Can you even read it?!)
 - You can change the prefix. Convert to kilometers!
2,000,000,000,000,000 pm = **2** km
 - Whew! That's better!!
- **2,000,000,000,000,000** kilometers is a big number with an even bigger value!
 - What do you do with that? Use a bigger, better prefix?
You *could* do that, or you could...

USE SCIENTIFIC NOTATION

DEFINITION AND EXAMPLES

- Definition – number expressed as two factors,
 - the first being a number between **1** and **10** (1 or more, but less than 10), often called the *mantissa*,
 - multiplied by a second being a power of **10** (10 raised to any whole number ... 10^x).
- Examples:
 - $2,175 = 2.175 \times 10^3$
 - $0.000314 = 3.14 \times 10^{-4}$

INCREDIBLE 10^0

- Definition: $10^0 = 1$
 - $10^2 > 10^1 > 10^0 > 10^{-1} > 10^{-2}$
 - $100 > 10 > 1 > 0.1 > 0.01$

Each one differs by a factor of 10
- Multiplying by 1 (or 10^0) does not change a number's value.
- $2,543 = 2,543 \times 10^0$
- Any number can be written as a multiple of 10^0 .

CONVERTING TO SCIENTIFIC NOTATION

- Imagine every number written as a multiple of 10^0 .
- Convert the mantissa to a number between 1 and 10 by moving the decimal.
[Note: When there is no expressed decimal, the decimal is considered to be at the right of the number.]
- For every place you move the decimal in the mantissa, you have to change the power of 10 by 1.

- $2,543 = 2,543 \times 10^0$
- To get a number between 1 and 10 from 2543, you need to move the decimal three places to the left, making the number smaller.
- You compensate for making the mantissa three decimal places smaller by making the exponent bigger by three ($0 + 3 = 3$).

$$2,543 = 2,543 \times 10^0 = 2.543 \times 10^3$$

CONVERTING TO STANDARD NOTATION

Convert 2.78×10^{-3} to standard notation

- Reverse the process of converting to scientific notation by converting to a multiple of 10^0 .
- For every change of 1 that you make to the exponent, you need to move the decimal in the mantissa one place.

Start with 2.78×10^{-3}

- To get the exponent back to zero, you need to **increase it by three**, making the number bigger.
- Compensate by moving the decimal three places to the left to reduce the product to its original value. (Use zeros as place holders.)

$$2.78 \times 10^{-3} = 0.00278$$

CALCULATIONS WITH SCIENTIFIC NOTATION

Do the following calculations and develop a rule for scientific notation

The results

- Multiply 0.002 by 0.04.
 - Convert each of the numbers *and* the answers to scientific notation.
 - Develop a rule for multiplication.
 - Add 125 and 27.
 - Convert each of the numbers *and* the answers to scientific notation.
 - Develop a rule for addition.
- $0.002 \times 0.04 = 0.00008$
 - $(2 \times 10^{-3})(4 \times 10^{-2}) = 8 \times 10^{-5}$
 - **Rule: Multiply the mantissas and add the exponents.**
 - $125 + 27 = 152$
 - $1.25 \times 10^{-2} + 2.7 \times 10^{-1} = 1.52 \times 10^{-2}$
 - **Rule: Convert all values to the same power of ten before adding.**

CALCULATION RULE SUMMARY

Rules for Multiplication and Division

- Multiplication
 - **Multiply the mantissas and add the exponents**
- Division
 - **Divide the mantissas and subtract the exponents**

Rules for Addition and Subtraction

- Addition
 - **Convert all values to the same power of ten before adding**
- Subtraction
 - **Convert all values to the same power of ten before subtracting**