

The Math of Chemistry

Scientific Notation
Percent Error
Significant Digits
Conversions

Scientific Notation

Scientific Notation is used to express very large or very small numbers.

The math rules can be used, however, it is easier to use your calculator to solve calculations involving numbers with scientific notation.

Scientific Notation

- a 87.073 meters $8.7073 \times 10^1 \text{ m}$
- b 0.01552 meters $1.552 \times 10^{-2} \text{ m}$
- c 9009 meters $9.009 \times 10^3 \text{ m}$
- d 629.55 meters $6.2955 \times 10^2 \text{ m}$

Scientific Notation

Most calculators use either the **EE** or **EXP** key for scientific notation.

To enter 6.02×10^{23}

Press the keys in order.

6.02 **EE** 23 or 6.02 **EXP** 23

Calculations with Scientific Notation

1. $(7.01 \times 10^{14}) \times (5.82 \times 10^4)$

$$7.01 \text{ EE } 14 \times 5.82 \text{ EE } 4 = \\ 4.0798 \text{ E } 19 = 4.08 \times 10^{19}$$

2. $(2.45 \times 10^7) \times (9.13 \times 10^3)$

$$2.45 \text{ EE } 7 \times 9.13 \text{ EE } 3 = \\ 2.2369 \text{ E } 11 = 2.24 \times 10^{11}$$

Calculations with Scientific Notation

3. $(4.74 \times 10^3) + (6.29 \times 10^4)$

$$4.74 \text{ EE } 3 + 6.29 \text{ EE } 4 = \\ 6.764 \text{ E } 04 = 6.76 \times 10^4$$

4. $(3.08 \times 10^{-4}) - (5.82 \times 10^{-5})$

$$3.08 \text{ EE } -4 - 5.82 \text{ EE } -5 = \\ 2.498 \text{ E } -04 = 2.50 \times 10^{-4}$$

Significant Digits

The measurements you use in scientific calculations are only as accurate as your least accurate measuring tool

In chemistry the significance of a digit is a direct reflection of its accuracy

Percent of Error

The mass of an object is recorded as 7.35 grams by one scale. The actual mass of the object is 7.29 grams. Determine the percent of error.

$$\frac{7.29 - 7.35}{7.29} = 0.823\%$$

Percent of Error

The Law of Conservation of Matter tells us that in a chemical reactions matter cannot be created or destroyed, however, we can 'lose' some.

Hence, we measure our loss using percent of error.

Percent of Error

$$\frac{\text{Expected value} - \text{Experimental value}}{\text{Expected value}} \times 100$$

$$= \% \text{ error}$$

How to measure



- Let's look at the difference in weight measurement using difference scales.



- I can 'gestimate' the + at the end but it can not be used in my calculations.



Significant Digits

All non-zero numbers are significant

Zeros are special

- Zeros between significant digits ARE significant
- Zeros to the right of a decimal and are after a non-zero number ARE significant
- Zeros that are 'placeholders' are not significant

300	= 1 significant digit (sd)
40.1	= 3 sd
0.024	= 2 sd
50.90	= 4 sd

Multiplying and Dividing using Significant Figures

- Multiplication / Division
 - Multiply or divide as normal
 - The lowest number of SD in either multiplier is the number of SD in the answer.
 - Round off to the number of significant digits in that multiplier

For Example

- For instance, using significant figures rules:
 - $8\text{m} \times 8 = 60\text{m}$
 - $8.0\text{m} \times 8 = 64\text{m}$
 - $8.02\text{m} \times 8.02 = 64.3\text{m}$

Multiply

$$34.567 \times 98.7 = 3,411.7629$$

SD = 3

Therefore, your answer will have 3 SD.

3,410

Addition/Subtraction

The least exact addend controls decimal point placement.
Round-off as needed.

$$12.34 + 3.658 + 0.5738 =$$

12.34 is the least exact, therefore, your answer will only go to the hundredths place.

For Example

- For instance, using significant figures rules:
- $1\text{m} + 1.1\text{m} = 2\text{m}$
- $1.0\text{m} + 1.1\text{m} = 2.1\text{m}$
- $100\text{m} + 110\text{m} = 210\text{m}$
- $1.0 \times 102\text{m} + 111\text{m} = 213\text{m}$

Your Turn 😊

- 1) 0.0631
- 2) 50
- 3) 5,731.02
- 4) 81.0
- 5) 600.
- 6) 34.8
- 7) 120.7

Your Turn

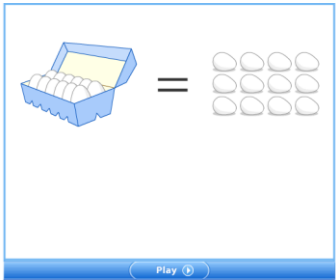
• $35.08 \times 3.7 = 129.796$

130

• $53 \times 78.90 = 4,181.70$

4,200

Conversion factors



Sample Conversion

44,700 meters = ____ km

1 kilo = 1,000

$\frac{44,700 \text{ meters}}{1000 \text{ meters}} = 44.7 \text{ km}$

44.7 km

Sample conversions

3.9 meters = _____ cm

51.7 grams = _____ mg

4,730 liters = _____ kL

2.589 mL = _____ cm³
