



Scientific notation

Correct format for large and small values

SACE Stage 2 Physics

Comparing the universe

- If you want to compare the size of a supermassive black hole with a quark, it makes no sense to just write the two numbers next to each other
 - 12 000 000 000 m
 - 0.0000000000000000000043 m
- But comparing magnitudes can make sense
- 1.2×10^{10} vs 4.3×10^{-20}
- Looking at the exponents we know that the black hole is 30 orders of magnitude greater than the quark without having to count the zeros

Rules for scientific notation

- Scientific notation is used for numbers greater than 1000 or less than $\frac{1}{1000}$
- To be in correct scientific notation a number should be written with;
 - a number between 1 and 10
 - and multiplied by a power of ten
 - 53×10^5 is not in proper scientific notation.
 - 5.3×10^6 is

Example

- 137 000 000
- Can should be written in scientific notation as
- 1.37×10^8

When to use scientific notation

- We leave any number between 1000 and 0.001 as a “normal” number.
 - Examples; 12, 682, 23.8
- Bigger than 1000 – use scientific notation
- Smaller than $\frac{1}{1000}$ and we use scientific notation

Examples of 'large' numbers

- 347,000.
 - 3.47×10^5
- 902,000,000.
 - 9.02×10^8
- 61,400.
 - 6.14×10^4

Note; all significant figures are shown, but no 'trailing' zeros



- In Tasmania, 15,000,000 litres of water are used in hydro power every day.
- Written in scientific notation;
 - 1.5×10^7

Negative exponent = small number

not a negative number

- $10000 = 10 \times 10 \times 10 \times 10 = 10^4$
- $1000 = 10 \times 10 \times 10 = 10^3$
- $100 = 10 \times 10 = 10^2$
- $10 = 10^1$
- $1 = 10^0$
- Do you see a pattern?

Therefore

$$0.1 = \frac{1}{10} = 10^{-1}$$

$$0.01 = \frac{1}{100} = \frac{1}{10^2} = 10^{-2}$$

$$0.001 = \frac{1}{1000} = \frac{1}{10^3} = 10^{-3}$$

$$0.0001 = \frac{1}{10000} = \frac{1}{10^4} = 10^{-4}$$

Examples

Using Scientific Notation,

$$0.000882 = 8.82 \times 10^{-4}$$

$$0.00000674 = 6.74 \times 10^{-6}$$

$$0.00000000366 = 3.66 \times 10^{-9}$$

*note: if this was $3.66 \times 10^{-9}m$
it could also be 3.66nm (for nanometre)*

Summary

- We use scientific notation when a number is smaller than $\frac{1}{1000}$ OR bigger than 1000
- To be in correct scientific notation the number must be written as
 - a number between 1 and 10
 - and multiplied by a power of ten
 - For example 2.3×10^6