

AM-01.03 — Powers of ten and scientific notation: write the huge and the tiny

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Course compass

Guiding question: How do you read 3.2×10^6 without treating the exponent like a secret code?

Markers: MEASURED · CONVENTION · CALCULATED · TEACHING ASSUMPTION · APPROXIMATION

- understand the concept
- do a simple calculation
- explain every symbol
- check a result

1 — A power repeats multiplication

10^3 means $10 \times 10 \times 10 = 1,000$. The exponent 3 counts factors of ten.

For a negative exponent, $10^{-3} = 1/10^3 = 0.001$.

2 — Scientific notation

A number is written $a \times 10^n$ with a usually between 1 and 10. 320,000 becomes 3.2×10^5 .

The form makes order of magnitude visible.

3 — Multiply powers

$10^3 \times 10^4 = 10^7$ because three and four factors of ten are combined. Exponents add.

For division, exponents subtract.

4 — Prefixes and powers

kilo = 10^3 , mega = 10^6 , giga = 10^9 , milli = 10^{-3} . Understanding exponents makes prefix conversion logical.

The prefix is part of the written unit.

Three complete examples: change one assumption to understand

Before each calculation, identify where every number comes from and whether it is measured, conventional, assumed, or calculated.

Example A — 4,500,000

$4,500,000 = 4.5 \times 10^6$.

The decimal point moved six places left.

Example B — 0.00072

$0.00072 = 7.2 \times 10^{-4}$.

A negative exponent represents a small value.

Example C — product

$(3 \times 10^4)(2 \times 10^3) = 6 \times 10^7$.

$3 \times 2 = 6$ and $10^4 \times 10^3 = 10^7$.

Inverse calculation

If $6 \times 10^7 = 3 \times 10^4 \times x$, then $x = (6/3) \times 10^{(7-4)} = 2 \times 10^3$.

Common trap and result check

Trap: confusing 10^6 with 6×10 . 10^6 is one million.

Always check units, order of magnitude, and physical meaning before accepting a result.

Exercises and answers

Understand

Explain the relationship in your own words.

Change an assumption

Modify one input and predict the direction of change before calculating.

Verify

Name two checks after a calculation.

Primary and educational sources

- NIST - International System of Units (SI)
- NASA Science - Basics of Space Flight Glossary