

02: Basic Math for Physics

Algebra

If a number is ___ to a variable	Then to solve ___ that number on both sides to solve for the variable	Example
Added	Subtract	$5 = x + 2$ $- 2 \quad -2$ $5 - 2 = x$
Subtracted	Add	$3 = x - 6$ $+ 6 \quad +6$ $3 + 6 = x$
Multiplied	Divide	$2 = \frac{4x}{4}$ $2/4 = x$
Divided	Multiply	$2 \cdot 6 = \frac{x}{2} \cdot 2$ $2 \cdot 6 = x$

Calculations with Significant Figures

Adding & Subtracting:

- Perform the calculation.
 - Determine which value in the problem has least decimal places.
 - Round answer to that number of decimal places.
- Example:** $10.027 \text{ g} \rightarrow 3 \text{ decimal places}$
 $- 1.5 \text{ g} \rightarrow 1 \text{ decimal place}$
 $8.527 \text{ g} \rightarrow 8.5 \text{ g} (1 \text{ decimal place})$

Multiplying & Dividing:

- Perform the calculation.
 - Determine which value in the problem has least sig fig
 - Round answer to that number of sig. figures.
- Example:** $10.027 \text{ g} \rightarrow 5 \text{ sig figs}$
 $1.50 \text{ mL} \rightarrow 3 \text{ sig figs}$
 $= 6.6847 \text{ g/mL} \rightarrow 6.68 \text{ g/mL} (3 \text{ sig figs})$

Scientific Notation

Scientific Notation—A short hand method of writing numbers using powers of 10.

Writing scientific notation:

- The decimal point is always moved to after the 1st non-zero number.
 - Count the number of times the decimal point is moved and use this as the power of 10.
 - “Big” numbers (>1) have positive exponents. “Small” numbers (<1) have negative exponents.
- Examples:** $1027500.456 \rightarrow 1.027500456 \times 10^6$
 $0.0007543 \rightarrow 7.543 \times 10^4$

Reading scientific notation:

- Power of 10 = number of times to move decimal point.
 - Positive powers = make the number “Big” (>1).
Negative exponents = make the number “Small” (<1).
- Examples:** $3.25 \times 10^{-6} \rightarrow 0.00000325$
 $7.2004 \times 10^4 \rightarrow 7200.4$

Math with Exponents

Calculations with exponents:

- Power of “1”:** Anything to the power of “1” = itself.
 $25^1 = 25$
- Power of “0”:** Anything to the power of “0” = 1
 $25^0 = 1$
- Multiplying** (with the same base): Add the powers.
 $3^2 * 3^8 = 3^{11}$
- Dividing** (with the same base): Subtract the powers.
 $3^2 \div 3^8 = 3^{-6}$
- Power of a power:** Multiply the powers.
 $(3^2)^3 = 3^6$
- Negative powers:** Put the number on the opposite side of the fraction & the power becomes positive.
 $3^{-2} = 1/3^2$ and $1/8^{-2} = 8^2$

Calculations with scientific notation:

- Adding** (with same power of 10): Add numbers and keep power of 10.
 $2 \times 10^3 + 3 \times 10^3 = 5 \times 10^3$
- Subtracting** (with same power of 10): Subtract numbers and keep power of 10.
 $3 \times 10^3 - 1 \times 10^3 = 2 \times 10^3$
- Multiplying:** Multiply numbers & add powers of 10.
 $2 \times 10^6 \cdot 3 \times 10^3 = 6 \times 10^{18}$
- Dividing:** Divide numbers & subtract powers of 10.
 $2 \times 10^6 \div 3 \times 10^3 = 0.67 \times 10^3$
- Taking it to a power:** Take the number to the power and multiply the power of 10 by the power.
 $(2 \times 10^3)^3 = 8 \times 10^9$
- Roots:** Take the number to the root and divide the power of 10 by the root.
 $\sqrt{3 \times 10^2} = \sqrt{3} \times 10^1$

Trigonometric Functions

$$\sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}} \quad \theta = \sin^{-1} \left(\frac{\text{Opposite}}{\text{Hypotenuse}} \right)$$

$$\cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}} \quad \theta = \cos^{-1} \left(\frac{\text{Adjacent}}{\text{Hypotenuse}} \right)$$

$$\tan \theta = \frac{\text{Opposite}}{\text{Adjacent}} \quad \theta = \tan^{-1} \left(\frac{\text{Opposite}}{\text{Adjacent}} \right)$$

To remember the functions use: **SOHCAHTOA**

Quadratic Equation

When $ax^2 + bx + c = 0$, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Example: $1x^2 + 5x - 8 = 0$

Then: $x = \frac{-5 \pm \sqrt{5^2 - 4(1)(-8)}}{2(1)}$

$x = 6.27$ and $x = -1.27$

Note: There are two solutions but they may not both make physical sense, for example time cannot be negative

Calculator Survival

- Always use the \div key to designate a number is on the bottom of an expression.
- Always use the EE (or EXP) key to enter scientific notation.
- Always use parenthesis around addition or subtraction when combining it with other operations
- To make something negative (when taking the number to a power) keep the negative outside of the parenthesis.

How to Use This Cheat Sheet: These are the keys related this topic. Try to read through it carefully twice then write it out on a blank sheet of paper. Review it again before the exams.