

Quick Formulas & Operations Handbook

Essential Sign Rules, Operational Precedence, and Plane & Solid Geometry Directory

A compact formula reference manual covering signed integer arithmetic, PEMDAS/BODMAS operational precedence, plane geometry relationships, and three-dimensional volume formulas formatted for quick cross-device navigation.

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Arithmetic Sign Rules for Signed Integers

Signed integer arithmetic establishes consistent direction on the standard number line. Addition combines values: adding numbers with identical signs preserves their shared sign, while adding numbers with opposing signs computes the difference between absolute magnitudes and retains the sign of the larger absolute value. Subtraction converts directly into adding the additive inverse (negation). In multiplication and division, matching signs yield a strictly positive result, whereas differing signs yield a strictly negative result.



Which sign rule applies to the integer operation?

Adding or subtracting integers

Rewrite any subtraction as adding the opposite ($a - b = a + (-b)$). If signs match, sum absolute values and keep sign. If signs differ, subtract smaller absolute value from larger and apply the dominant sign.

Multiplying or dividing integers

Count total negative signs across factors: an even count produces a positive result (+), while an odd count produces a negative result (-).

- Addition (Same Signs): $(+a) + (+b) = +(a + b)$ and $(-a) + (-b) = -(a + b)$
- Addition (Different Signs): $(-a) + b = b - a$ (sign aligns with the greater absolute value)
- Subtraction as Negation: $a - (-b) = a + b$ and $a - (+b) = a + (-b)$
- Multiplication: $(+a) \times (+b) = +ab$; $(-a) \times (-b) = +ab$; $(-a) \times (+b) = -ab$
- Division: $(+a) / (+b) = +(a/b)$; $(-a) / (-b) = +(a/b)$; $(-a) / (+b) = -(a/b)$

Subtracted Negatives

Subtracting a negative quantity is structurally identical to adding a positive quantity: $a - (-b) = a + b$. Double negation inverses cancel.



Order of Operations: PEMDAS and BODMAS Frameworks

Mathematical expressions are evaluated using standardized operational hierarchies to ensure unambiguous evaluation. North American curricula predominantly use the acronym PEMDAS (Parentheses, Exponents, Multiplication & Division, Addition & Subtraction), whereas international standards often use BODMAS (Brackets, Orders, Division & Multiplication, Addition & Subtraction). Crucially, Multiplication and Division share identical mathematical priority and must be executed in sequential left-to-right order. Similarly, Addition and Subtraction possess equal priority and evaluate strictly from left to right.

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Step 1: Simplify Grouped Expressions

Isolate and calculate values inside parentheses: in $15 - 2 \times 3 + (30 - 3) \div 3^2$, compute $(30 - 3) = 27$, yielding $15 - 2 \times 3 + 27 \div 3^2$.

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Step 2: Resolve Powers and Exponents

Calculate powers and indices: evaluate $3^2 = 9$, converting the expression to $15 - 2 \times 3 + 27 \div 9$.

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Step 3: Evaluate Multiplication and Division Left to Right

First compute $2 \times 3 = 6$, then compute $27 \div 9 = 3$. Substitute values into the expression to reach $15 - 6 + 3$.

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Step 4: Evaluate Addition and Subtraction Left to Right

Perform $15 - 6 = 9$, then compute $9 + 3 = 12$ to reach the final simplified scalar value.

- Groupings: Evaluate innermost Parentheses () or Brackets [] first.
- Exponents & Orders: Compute powers, roots, and indices second.
- Equal Precedence Tier 1: Multiply and divide sequentially from left to right.
- Equal Precedence Tier 2: Add and subtract sequentially from left to right.

Common Mistake: Strict Left-to-Right Priority

Multiplication does not take precedence over division simply because 'M' precedes 'D' in PEMDAS. Both operations carry identical rank and resolve strictly in the order they appear from left to right.



Core Plane Geometry: Perimeter, Area, and Angle Sums

Plane geometry measures boundaries, surface capacities, and angular divergence on two-dimensional surfaces. Perimeter (P) measures total linear boundary distance, while Area (A) measures the two-dimensional region enclosed within those boundaries in square units. Angles quantify rotation: a straight line spans exactly 180° , complete circular rotation measures 360° , and the interior angles of any planar triangle sum to exactly 180° .

- Square: Perimeter $P = 4s$; Area $A = s^2$ (where s = side length)
- Rectangle: Perimeter $P = 2L + 2W$; Area $A = L \times W$ (L = length, W = width)
- Triangle: Area $A = (1/2) \times b \times h$; Angle sum: $x^\circ + y^\circ + z^\circ = 180^\circ$
- Right Triangle: Pythagorean theorem $a^2 + b^2 = c^2$ (c = hypotenuse opposite 90° angle)
- Circle: Circumference $C = 2\pi r = \pi d$; Area $A = \pi r^2$ (r = radius, $d = 2r$ diameter, $\pi \approx 3.14159$)

Dimensional Measurement Units

Ensure linear measurements (perimeter, circumference) are recorded in single linear units (e.g., cm, m) and area is recorded strictly in square units (e.g., cm^2 , m^2).

Solid Geometry: Surface Area and Enclosed Volume

Solid geometry quantifies three-dimensional objects across exterior surface area (total exposed two-dimensional area of all faces) and interior volume (three-dimensional spatial capacity, expressed in cubic units). Calculating solid measurements requires consistent matching units across all three spatial dimensions (length, width, height, and radius).

- Cube: Volume $V = s^3$; Total Surface Area $SA = 6s^2$
- Rectangular Prism: Volume $V = L \times W \times H$; Surface Area $SA = 2(LW + LH + WH)$
- Cylinder: Volume $V = \pi r^2 h$; Total Surface Area $SA = 2\pi r^2 + 2\pi r h$
- Sphere: Volume $V = (4/3)\pi r^3$; Surface Area $SA = 4\pi r^2$
- Right Circular Cone: Volume $V = (1/3)\pi r^2 h$

Cubic Unit Consistency

Always convert all input linear measurements into identical base units prior to calculating products to prevent cubic unit mismatch errors.

☒ Reference Verification and Practice Log

Tutors, parents, and students can use this verification record to log completed formula applications, confirm proper operational steps, and verify calculations against the reference rules.

- ☐ Verify negative signs are accurately transformed when computing double negatives.
- ☐ Confirm multiplication and division steps were processed left to right before addition/subtraction.
- ☐ Check that two-dimensional areas and three-dimensional volumes use correct dimensional exponents.

Problem Statement or Expression Tested

Rules Applied (Sign Rules, PEMDAS/BODMAS, Geometric Formulas)

Step-by-Step Resolution and Final Calculated Result