1. Algebra

Linear equations, functions, systems, inequalities, and modeling

Core algebra

Properties

$$a(b+c) = ab + ac \qquad \text{distributive}$$
$$a + b = b + a \qquad ab = ba$$
$$(a+b) + c = a + (b+c)$$

For equations, perform the **same valid operation on both sides**. Combine only like terms. A fraction bar groups its entire numerator and denominator.

Fractions and proportions

$$\frac{a}{b} + \frac{c}{d} = \frac{ad+bc}{bd}, \qquad \frac{a}{b} \div \frac{c}{d} = \frac{ad}{bc}$$
$$\frac{a}{b} = \frac{c}{d} \implies ad = bc \quad (b, d \neq 0)$$

Absolute value

$$|x| = \begin{cases} x, & x \geq 0 \\ -x, & x < 0 \end{cases}$$
$$|x-a| = \text{distance from } a$$
$$|x-a| = d \implies x = a \pm d$$
$$|x-a| < d \implies a - d < x < a + d$$
$$|x-a| > d \implies x < a - d \text{ or } x > a + d$$

Linear equations

$$ax + b = c \implies x = \frac{c-b}{a} \quad (a \neq 0)$$

Clear fractions by multiplying every term by the LCD.

Number of solutions

After simplifying:

$x = k$	one solution
$0 = 0$	infinitely many
$0 = k,\ k \neq 0$	no solution

Literal equations

Treat all letters except the requested variable as constants. Isolate the requested variable using inverse operations.

Word translation

sum, increased by, more than	$+$
difference, decreased by, less than	$-$
product, of	$\times$
quotient, per	$\div$
is, equals	$=$

Trap: "5 less than x" is $x - 5$, not $5 - x$.

Lines and linear functions

$$\boxed{y = mx + b}$$
$$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$
$$y - y_1 = m(x - x_1) \qquad \text{(point-slope)}$$
$$Ax + By = C \implies m = -\frac{A}{B}, \quad y\text{-int} = \frac{C}{B}$$

- m: change in output per 1-unit increase in input
- $b = f(0)$: initial value / y-intercept
- x-intercept: set $y = 0$
- y-intercept: set $x = 0$
- increasing: $m > 0$; decreasing: $m < 0$
- horizontal line: $y = k,\ m = 0$
- vertical line: $x = k,\ m$ undefined

Parallel and perpendicular

$$m_{\parallel} = m, \qquad m_{\perp} = -\frac{1}{m}, \qquad m_1 m_2 = -1$$

Horizontal and vertical lines are perpendicular.

Direct variation

$$y = kx, \qquad k = \frac{y}{x}$$

This line passes through the origin.

Average rate of change

$$\boxed{\frac{f(b) - f(a)}{b - a}}$$

For a linear function, this always equals its slope.

Functions

$$y = f(x), \qquad f(a) = \text{output when } x = a$$

- **Domain**: allowed inputs
- **Range**: resulting outputs
- A function gives each input exactly one output.
- A table/function is linear when $\Delta y / \Delta x$ is constant.
- Solve $f(x) = k$: find inputs whose output is k.

Transformations

For $y = f(x)$:

$f(x) + k$	up k
$f(x) - k$	down k
$f(x - h)$	right h
$f(x + h)$	left h
$-f(x)$	reflect over x-axis
$f(-x)$	reflect over y-axis

Systems of equations

A solution satisfies **every equation simultaneously**; graphically, it is an intersection.

intersect once	1 solution
same line	∞ solutions
parallel distinct lines	0 solutions

Methods

- **Substitution**: isolate a variable, then substitute.
- **Elimination**: add/subtract equations to cancel a variable.
- **Graphing**: use intersection coordinates.

Common model systems

total number: $x + y = N$

total value: $p_1 x + p_2 y = V$

distance: $d = rt$

Inequalities

$$a < b \implies a + c < b + c$$
$$a < b,\ c > 0 \implies ac < bc$$
$$a < b,\ c < 0 \implies ac > bc$$

Reverse the inequality when multiplying or dividing by a negative.

$a < x < b$ means both conditions

$x < a$ or $x > b$ means either condition

Linear inequalities in two variables

- Solid boundary for $\leq, \geq$; dashed for $<, >$.
- Test a point to identify the shaded half-plane.
- A system's solution is the overlap.

Model interpretation checklist

- Define variables and attach units.
- Translate each number in context.
- Check whether zero is meaningful.
- Reject impossible values: negative counts, noninteger objects, values outside stated bounds.
- Distinguish an exact equation from a line of best fit.

SAT efficiency

- Substitute answer choices when solving backward is faster.
- Graph both sides of an equation; intersections solve it.
- In a table, compare successive differences.
- Estimate first to catch sign and scale errors.

2. Advanced Math

Exponents, polynomials, quadratics, nonlinear functions, radicals, rational expressions, and nonlinear systems

Exponents and radicals

$$a^m a^n = a^{m+n}, \quad \frac{a^m}{a^n} = a^{m-n}$$
$$(a^m)^n = a^{mn}, \quad (ab)^n = a^n b^n$$
$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, \quad a^0 = 1, \quad a^{-n} = \frac{1}{a^n}$$
$$a^{m/n} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$$

Restrictions: $a \neq 0$ where it is a denominator; an even root requires a nonnegative radicand for real values.

$$\sqrt{ab} = \sqrt{a}\sqrt{b}, \qquad \sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$$

$$\sqrt{x^2} = |x| \quad \text{(not always } x\text{)}$$

Radical equations

Isolate the radical, raise both sides to the needed power, solve, then **check every answer** in the original equation. Squaring can create extraneous solutions.

Polynomial identities

$$(a+b)^2 = a^2 + 2ab + b^2$$
$$(a-b)^2 = a^2 - 2ab + b^2$$
$$(a+b)(a-b) = a^2 - b^2$$
$$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$$
$$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$$

Factoring patterns

$$ax + ay = a(x+y)$$

$$x^2 + (p+q)x + pq = (x+p)(x+q)$$

For $ax^2 + bx + c$, seek factors whose product is ac and sum is b, or use the quadratic formula.

Polynomial operations

Add/subtract like terms. Multiply every term. Polynomial long division or synthetic division gives

$$P(x) = D(x)Q(x) + R(x).$$

Remainder and factor theorems

$$\text{remainder of } P(x) \div (x-a) = P(a)$$

$$(x-a) \text{ is a factor} \iff P(a) = 0$$

Quadratics

Three useful forms

$ax^2 + bx + c$	standard
$a(x-r_1)(x-r_2)$	factored
$a(x-h)^2 + k$	vertex

- $a > 0$: opens up; $a < 0$: opens down.
- Larger $|a|$: narrower graph.
- $c = f(0)$: y-intercept.
- Roots/zeros/x-intercepts solve $f(x) = 0$.
- Vertex is a minimum if $a > 0$, maximum if $a < 0$.

Quadratic formula and discriminant

$$\boxed{x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}}$$

$$D = b^2 - 4ac$$

$D > 0$	2 distinct real roots
$D = 0$	1 repeated real root
$D < 0$	0 real roots

Vertex and axis

$$\boxed{x_{\text{vertex}} = -\frac{b}{2a}}, \qquad y_{\text{vertex}} = f\left(-\frac{b}{2a}\right)$$

$$\text{axis of symmetry: } x = -\frac{b}{2a}$$

If the roots are r_1, r_2, the axis is

$$x = \frac{r_1 + r_2}{2}.$$

Completing the square

$$x^2 + bx = \left(x + \frac{b}{2}\right)^2 - \left(\frac{b}{2}\right)^2$$

Vieta's relationships

For $ax^2 + bx + c = 0$:

$$r_1 + r_2 = -\frac{b}{a}, \qquad r_1 r_2 = \frac{c}{a}$$

Nonlinear equations

Zero-product property

$$AB = 0 \implies A = 0 \text{ or } B = 0$$

Move all terms to one side before factoring.

Equations reducible to quadratics

Use substitution, e.g. $u = x^2$ in $x^4 - 5x^2 + 4 = 0$, solve for u, then return to x.

Exponential functions

$$\boxed{f(x) = a(b)^x}$$

- $a = f(0)$: initial value
- b: growth/decay factor per interval
- $b > 1$: growth; $0 < b < 1$: decay
- Equal x-increments produce equal output ratios.

$$\text{percent growth: } A = P(1+r)^t$$
$$\text{percent decay: } A = P(1-r)^t$$
$$\text{multiplier} = 1 \pm \frac{p}{100}$$
$$\text{compound interest: } A = P\left(1 + \frac{r}{n}\right)^{nt}$$
$$\text{continuous growth: } A = Pe^{rt}$$
$$\text{half-life: } A = P\left(\frac{1}{2}\right)^{t/h}$$
$$\text{doubling: } A = P(2)^{t/d}$$

For $a(b)^{x/k}$, the factor b applies every k input units.

Rational expressions

$$\frac{A}{B} \cdot \frac{C}{D} = \frac{AC}{BD}, \qquad \frac{A}{B} \div \frac{C}{D} = \frac{AD}{BC}$$
$$\frac{A}{B} + \frac{C}{D} = \frac{AD + BC}{BD}$$

Factor before canceling. Cancel factors, never terms.

$$\frac{x^2 - 9}{x - 3} = x + 3, \quad x \neq 3$$

The original denominator restrictions remain even after simplification.

Rational equations

List excluded values, multiply by the LCD, solve, and check against the original restrictions.

Nonlinear functions and systems

- Solutions of $f(x) = g(x)$ are graph intersections.
- A line and quadratic can meet 0, 1, or 2 times.
- Substitute the linear expression into the nonlinear equation.
- A repeated intersection corresponds to tangency.

Structure and equivalence

Equivalent expressions have the same value for every allowed input. Choose the form that reveals what the question asks:

factored	zeros
vertex	maximum/minimum
standard	y-intercept
exponential	initial value and rate

Trap: A calculator solution is only a candidate. Check domain restrictions and the original equation.

3. Problem Solving & Data Analysis

Ratios, rates, percentages, statistics, probability, models, inference, and study design

Ratios, rates, and units

$$a : b = \frac{a}{b}, \qquad \frac{a}{b} = \frac{c}{d} \Rightarrow ad = bc$$

$$\text{unit rate} = \frac{\text{quantity}}{1 \text{ unit}}$$

$$\boxed{d = rt}, \qquad r = \frac{d}{t}, \qquad t = \frac{d}{r}$$

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$\text{flow rate} = \frac{\text{amount}}{\text{time}}$$

Conversions

Multiply by conversion factors equal to 1 so unwanted units cancel:

$$72\frac{\text{mi}}{\text{h}}\left(\frac{1\text{ h}}{60\text{ min}}\right) = 1.2\frac{\text{mi}}{\text{min}}.$$

For area and volume conversions, square or cube the conversion:

$$1\text{ ft}^2 = (12\text{ in})^2 = 144\text{ in}^2.$$

Scale

$$\text{scale factor } k = \frac{\text{new length}}{\text{old length}}$$

$$\text{lengths} \times k, \quad \text{areas} \times k^2, \quad \text{volumes} \times k^3.$$

Percentages

$$\boxed{\text{part} = (\text{percent as decimal})(\text{whole})}$$

$$\text{percent} = \frac{\text{part}}{\text{whole}} \times 100\%$$

$$\boxed{\%\text{ change} = \frac{\text{new} - \text{old}}{\text{old}} \times 100\%}$$

$$\text{new} = \text{old}\left(1 \pm \frac{p}{100}\right)$$

Successive changes multiply:

$$\text{final} = \text{initial}(1 + r_1)(1 + r_2)\cdots$$

Trap: A 20% increase followed by a 20% decrease is $1.2(0.8) = 0.96$, a 4% decrease.

Markup, discount, tax, tip

$$\text{selling price} = \text{original}(1 + \text{markup rate})$$

$$\text{sale price} = \text{original}(1 - \text{discount rate})$$

$$\text{total} = \text{price}(1 + \text{tax/tip rate})$$

$$\text{simple interest: } I = Prt, \qquad A = P + I$$

One-variable statistics

$$\bar{x} = \frac{\sum x_i}{n}$$

$$\text{weighted mean} = \frac{\sum w_i x_i}{\sum w_i}$$

$$\text{range} = \max - \min$$

- **Median**: middle after sorting.
- **Mode**: most frequent.
- **Quartiles**: medians of lower/upper halves.
- $\text{IQR} = Q_3 - Q_1$.
- Possible outliers: below $Q_1 - 1.5\text{IQR}$ or above $Q_3 + 1.5\text{IQR}$.

Mean and median effects

- Add c to every value: mean and median $+c$; range, IQR, SD unchanged.
- Multiply every value by c: mean/median multiply by c; spread measures multiply by $|c|$.
- Mean is pulled toward outliers; median is resistant.

Standard deviation

$$\text{SD} = \text{typical distance from the mean}$$

Larger SD means more spread. Adding a constant does not change SD; multiplying all values by c multiplies SD by $|c|$. The SAT focuses on interpretation, not hand calculation.

Shape

- Symmetric: mean ≈ median.
- Right-skewed: mean > median.
- Left-skewed: mean < median.

Two-variable data

Line of best fit

$$\hat{y} = mx + b$$

$$\text{residual} = y - \hat{y}$$

- Positive residual: point above model.
- Negative residual: point below model.
- Interpolate within data range; extrapolation is less reliable.

Association

- Direction: positive, negative, or none.
- Form: linear or nonlinear.
- Strength: how tightly points follow the form.
- An outlier can strongly affect a model.
- Association/correlation does **not** prove causation.

Probability

$$\boxed{P(A) = \frac{\text{favorable outcomes}}{\text{total outcomes}}}$$

$$0 \le P(A) \le 1, \qquad P(A^c) = 1 - P(A)$$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

If mutually exclusive, $P(A \cap B) = 0$.

$$\boxed{P(A \mid B) = \frac{P(A \cap B)}{P(B)}}$$

For independent events:

$$P(A \cap B) = P(A)P(B)$$

In general:

$$P(A \cap B) = P(A)P(B \mid A)$$

$$\text{expected count} = nP(A)$$

Trap: "At least one" is usually fastest by complement: $1 - P(\text{none})$.

Two-way tables

Conditional probability uses the condition as the denominator:

$$P(A \mid B) = \frac{\text{count in both } A \text{ and } B}{\text{total count in } B}.$$

Sampling and inference

- **Population**: entire group of interest.
- **Sample**: observed subset.
- **Parameter**: population number.
- **Statistic**: sample number.

A random, representative sample supports generalization to its population. Larger random samples generally reduce sampling variability and margin of error.

Margin of error

$$\text{plausible interval} \approx \text{sample estimate} \pm \text{margin of error}$$

$$\text{MOE roughly scales as } \frac{1}{\sqrt{n}}$$

To cut MOE in half, use about 4 times the sample size.

Study design and conclusions

- **Random sampling** supports generalizing to the population sampled.
- **Random assignment** supports cause-and-effect conclusions.
- Both are needed for both conclusions.
- An observational study can show association, not causation.
- A control/placebo and blinding reduce alternative explanations and bias.
- Confounding: another variable may explain the observed effect.
- Voluntary response, convenience samples, undercoverage, nonresponse, and leading questions create bias.

Model selection

constant differences constant ratios constant second differences	linear exponential quadratic

Always interpret slope, intercept, rates, and predictions with **units and context**.

4. Geometry and Trigonometry: Plane Geometry

Angles, triangles, similarity, coordinate geometry, polygons, perimeter, area, and transformations

Lines and angles

complementary: $a + b = 90°$

supplementary / linear pair: $a + b = 180°$

angles around a point: sum $= 360°$

- Vertical angles are congruent.
- With parallel lines, corresponding and alternate interior/exterior angles are congruent.
- Same-side interior angles are supplementary.
- Perpendicular lines form four right angles.

Triangles

$$\boxed{A + B + C = 180°}$$

exterior angle = two remote angles' sum

$|a - b| < c < a + b$ (triangle inequality)

The largest side is opposite the largest angle; equal sides are opposite equal angles.

Congruence

Valid tests: SSS, SAS, ASA, AAS, HL (right triangles). AAA and SSA do not prove congruence.

Similarity

Valid tests: AA, SSS, SAS similarity. Corresponding angles are equal and corresponding sides are proportional.

$$k = \frac{\text{new side}}{\text{old side}}, \quad \frac{P_2}{P_1} = k, \quad \frac{A_2}{A_1} = k^2$$

$$\frac{V_2}{V_1} = k^3$$

Midsegment theorem

The segment joining midpoints of two triangle sides is parallel to the third side and half its length.

Angle bisector theorem

If AD bisects $\angle A$ in $\triangle ABC$:

$$\frac{BD}{DC} = \frac{AB}{AC}.$$

Triangle area

$$\boxed{A = \frac{1}{2}bh} \quad \text{GIVEN}$$

The height is perpendicular to the chosen base and may lie outside an obtuse triangle.

$$A = \frac{1}{2}ab\sin C$$

Special right triangles

Pythagorean theorem

$$\boxed{a^2 + b^2 = c^2} \quad \text{GIVEN}$$

c is the hypotenuse, opposite the right angle.

$45° - 45° - 90°$

$$x : x : x\sqrt{2}$$

$30° - 60° - 90°$

$$x : x\sqrt{3} : 2x$$

opposite $30°$	x
opposite $60°$	$x\sqrt{3}$
hypotenuse	$2x$

Common triples: $3-4-5$, $5-12-13$, $7-24-25$, $8-15-17$, and multiples.

Coordinate geometry

$$\boxed{d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}}$$

$$\boxed{M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)}$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$(x - h)^2 + (y - k)^2 = r^2$$

Circle center (h, k), radius r.

Transformations

reflection over x-axis	$(x, y) \to (x, -y)$
reflection over y-axis	$(x, y) \to (-x, y)$
reflection over $y = x$	$(x, y) \to (y, x)$
$90°$ CCW	$(x, y) \to (-y, x)$
$180°$	$(x, y) \to (-x, -y)$
$270°$ CCW	$(x, y) \to (y, -x)$
translation	$(x, y) \to (x + a, y + b)$
dilation at origin	$(x, y) \to (kx, ky)$

Translations, rotations, and reflections preserve lengths and angles. Dilations preserve angles and multiply lengths by $|k|$.

Polygons

$$\boxed{\text{interior-angle sum} = (n - 2)180°}$$

$$\text{each regular interior angle} = \frac{(n - 2)180°}{n}$$

$$\text{exterior-angle sum} = 360°$$

$$\text{each regular exterior angle} = \frac{360°}{n}$$

$$\text{number of diagonals} = \frac{n(n - 3)}{2}$$

Perimeter and area

rectangle	$P = 2l + 2w$, $A = lw$ GIVEN
square	$P = 4s$, $A = s^2$
parallelogram	$A = bh$
triangle	$A = \frac{1}{2}bh$ GIVEN
trapezoid	$A = \frac{1}{2}(b_1 + b_2)h$
rhombus/kite	$A = \frac{1}{2}d_1 d_2$
regular polygon	$A = \frac{1}{2}aP$

For a regular polygon, a is the apothem and P is the perimeter.

Quadrilateral facts

- Interior angles sum to $360°$.
- Parallelogram: opposite sides parallel/congruent, opposite angles congruent, consecutive angles supplementary, diagonals bisect each other.
- Rectangle: parallelogram with four right angles; diagonals congruent.
- Rhombus: parallelogram with four congruent sides; diagonals perpendicular and bisect opposite angles.
- Square: both rectangle and rhombus.
- Trapezoid midsegment: $m = \frac{b_1 + b_2}{2}$.

Trap: Congruent diagonals imply a rectangle only after the quadrilateral is known to be a parallelogram; perpendicular diagonals similarly identify a rhombus.

SAT geometry habits

- Never assume a diagram is drawn to scale.
- Mark equal lengths, parallel lines, right angles, and shared sides.
- Match corresponding vertices in congruent/similar figures.
- If dimensions scale, area and volume do not scale linearly.
- Use algebra when dimensions or angles contain variables.

5. Geometry and Trigonometry: Circles and 3D

Circles, trigonometry, three-dimensional geometry, and official SAT reference formulas

Circles

$$\boxed{C = 2\pi r = \pi d} \quad \text{GIVEN}$$

$$\boxed{A = \pi r^2} \quad \text{GIVEN}$$

$$\boxed{\text{arc length} = \frac{\theta}{360^\circ}(2\pi r)}$$

$$\boxed{\text{sector area} = \frac{\theta}{360^\circ}(\pi r^2)}$$

In radians:

$$s = r\theta, \qquad A_{\text{sector}} = \frac{1}{2}r^2\theta$$

$$180^\circ = \pi \text{ radians}, \quad \theta_{\text{rad}} = \theta_{\text{deg}}\frac{\pi}{180}$$

Circle angle theorems

- Central angle measure = intercepted arc measure.
- Inscribed angle = $\frac{1}{2}$(intercepted arc).
- An angle inscribed in a semicircle is 90°.
- Radius to a point of tangency is perpendicular to the tangent.
- Tangent segments from the same exterior point are congruent.

Angles from two chords

$$m\angle = \frac{1}{2}(\text{sum of intercepted arcs})$$

Angles outside a circle

$$m\angle = \frac{1}{2}(\text{larger arc} - \text{smaller arc})$$

Power of a point

$$(\text{part}_1)(\text{part}_2) = (\text{part}_3)(\text{part}_4) \quad \text{(two chords)}$$

$$(\text{external}_1)(\text{whole}_1) = (\text{external}_2)(\text{whole}_2)$$

$$(\text{tangent})^2 = (\text{external})(\text{whole})$$

Circle equation

$$\boxed{(x-h)^2 + (y-k)^2 = r^2}$$

Complete the square to convert a general equation to center-radius form.

Right-triangle trigonometry

$$\boxed{\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}}$$

$$\boxed{\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}}$$

$$\boxed{\tan\theta = \frac{\text{opposite}}{\text{adjacent}} = \frac{\sin\theta}{\cos\theta}}$$

Opposite/adjacent depend on the chosen acute angle; the hypotenuse does not.

$$\sin\theta = \cos(90^\circ - \theta)$$

$$\cos\theta = \sin(90^\circ - \theta)$$

$$\tan\theta = \frac{1}{\tan(90^\circ - \theta)}$$

Exact common values

θ	0°	30°	45°	60°	90°
$\sin\theta$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
$\cos\theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
$\tan\theta$	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	undef.

Finding angles

$$\theta = \sin^{-1}\left(\frac{\text{opp}}{\text{hyp}}\right), \quad \theta = \cos^{-1}\left(\frac{\text{adj}}{\text{hyp}}\right)$$

$$\theta = \tan^{-1}\left(\frac{\text{opp}}{\text{adj}}\right)$$

Calculator mode must match the requested unit, usually degrees on the SAT.

Unit circle essentials

At angle θ, the point is

$$(\cos\theta, \sin\theta), \qquad \sin^2\theta + \cos^2\theta = 1.$$

Signs by quadrant:

I	$\sin, \cos, \tan : +$
II	$\sin : +$
III	$\tan : +$
IV	$\cos : +$

Reference angles use the same absolute trig values.

Three-dimensional geometry

rectangular prism	$V = lwh$ GIVEN
general prism	$V = Bh$
cylinder	$V = \pi r^2 h$ GIVEN
pyramid	$V = \frac{1}{3}Bh$
cone	$V = \frac{1}{3}\pi r^2 h$ GIVEN
sphere	$V = \frac{4}{3}\pi r^3$ GIVEN

rectangular prism SA	$2lw + 2lh + 2wh$
cylinder SA	$2\pi r^2 + 2\pi rh$
cone lateral area	$\pi r\ell$
cone total SA	$\pi r^2 + \pi r\ell$
sphere SA	$4\pi r^2$

For a right square pyramid with base side s:

$$\boxed{V = \frac{1}{3}s^2 h}, \qquad \boxed{LA = 2s\ell}$$

$$\boxed{SA = s^2 + 2s\ell}$$

$$\ell = \sqrt{h^2 + \left(\frac{s}{2}\right)^2}.$$

Here B is base area, h is perpendicular height, and ℓ is slant height.

$$\ell = \sqrt{r^2 + h^2}$$

3D diagonal

For a rectangular prism:

$$d = \sqrt{l^2 + w^2 + h^2}.$$

Official SAT reference box

The digital SAT provides these formulas:

$$A_\triangle = \frac{1}{2}bh, \quad c^2 = a^2 + b^2, \quad A_{\text{rect}} = lw$$

$$C = 2\pi r, \quad A_{\text{circle}} = \pi r^2$$

$$V_{\text{rect}} = lwh, \quad V_{\text{cyl}} = \pi r^2 h$$

$$V_{\text{sphere}} = \frac{4}{3}\pi r^3, \quad V_{\text{cone}} = \frac{1}{3}\pi r^2 h$$

$$V_{\text{pyramid}} = \frac{1}{3}lwh$$

It also displays the 30°–60°–90° and 45°–45°–90° side ratios, and:

circle $360^\circ = 2\pi$ radians

triangle angle sum $= 180^\circ$.

Everything else on these five pages must be recognized and applied without relying on the reference box.

Final SAT checklist

- Write units; convert before substituting.
- Identify what each variable represents.
- Use exact values until the last step; round only as directed.
- Check reasonableness, signs, domain restrictions, and extraneous roots.
- Use π unless a decimal is requested.
- A diagram can hide information but cannot override stated facts.
- Graphing is excellent for intersections and verification; reasoning is still needed to select the requested value.

Scope: current digital SAT Math domains. Official-reference labeling follows the College Board SAT Math reference sheet. This master sheet is designed as a companion to Mathelingua's four detailed SAT lecture decks.