SAT MATH FORMULA SHEET

Complete Reference Guide for All Topics

---

1. ALGEBRA I - LINEAR EQUATIONS & INEQUALITIES

Topic	Formula	Description
Slope-Intercept Form	$y = mx + b$	m = slope, b = y-intercept
Point-Slope Form	$y - y_1 = m(x - x_1)$	Line through point (x_1, y_1) with slope m
Standard Form	$Ax + By = C$	A, B, C are constants
Slope Formula	$m = (y_2 - y_1)/(x_2 - x_1)$	Slope between two points
Parallel Lines	$m_1 = m_2$	Same slope
Perpendicular Lines	$m_1 \times m_2 = -1$ or $m_2 = -1/m_1$	Negative reciprocal slopes
Linear Inequality	$y < mx + b$ or $y > mx + b$	Shaded region above/below line
Distance Between Points	$d = \sqrt{[(x_2 - x_1)^2 + (y_2 - y_1)^2]}$	Distance formula
Midpoint Formula	$M = ((x_1 + x_2)/2, (y_1 + y_2)/2)$	Midpoint between two points

---

2. ALGEBRA II - QUADRATICS & POLYNOMIALS

Topic	Formula	Description
Standard Form	$y = ax^2 + bx + c$	$a \neq 0$
Vertex Form	$y = a(x - h)^2 + k$	Vertex at (h, k)
Factored Form	$y = a(x - r_1)(x - r_2)$	r_1, r_2 are x-intercepts/roots
Quadratic Formula	$x = [-b \pm \sqrt{(b^2 - 4ac)}]/(2a)$	Solutions to $ax^2 + bx + c = 0$
Discriminant	$\Delta = b^2 - 4ac$	$\Delta > 0$: two real roots $\Delta = 0$: one real root $\Delta < 0$: no real roots

Topic	Formula	Description
Vertex (x-coordinate)	$x = -b/(2a)$	x-coordinate of vertex
Vertex (y-coordinate)	$y = c - b^2/(4a)$	y-coordinate of vertex
Axis of Symmetry	$x = -b/(2a)$	Vertical line through vertex
Sum of Roots	$r_1 + r_2 = -b/a$	Vieta's formula
Product of Roots	$r_1 \times r_2 = c/a$	Vieta's formula
Completing the Square	$x^2 + bx + (b/2)^2 = (x + b/2)^2$	Add $(b/2)^2$ to both sides
Difference of Squares	$a^2 - b^2 = (a + b)(a - b)$	Factoring pattern
Perfect Square Trinomial	$a^2 \pm 2ab + b^2 = (a \pm b)^2$	Factoring pattern

---

3. EXPONENTIALS & LOGARITHMS

Topic	Formula	Description
Exponential Growth	$y = a(1 + r)^t$ or $y = a \cdot b^t$	a = initial, r = rate, t = time
Exponential Decay	$y = a(1 - r)^t$ or $y = a \cdot b^t$	$0 < b < 1$ for decay
Compound Interest	$A = P(1 + r/n)^{nt}$	P = principal, r = rate, n = times/year, t = years
Continuous Compound	$A = Pe^{rt}$	$e \approx 2.718$
Logarithm Definition	$\log_a(x) = b \leftrightarrow a^b = x$	a is base
Natural Log	$\ln(x) = \log_e(x)$	Base e
Common Log	$\log(x) = \log_{10}(x)$	Base 10
Product Rule	$\log_a(xy) = \log_a(x) + \log_a(y)$	Log of product
Quotient Rule	$\log_a(x/y) = \log_a(x) - \log_a(y)$	Log of quotient
Power Rule	$\log_a(x^n) = n \cdot \log_a(x)$	Log of power

Topic	Formula	Description
Change of Base	$\log_a(x) = \log(x)/\log(a) = \ln(x)/\ln(a)$	Convert to any base

---

4. SYSTEMS OF EQUATIONS

Topic	Formula	Description
Linear System (2×2)	$ax + by = e$ $cx + dy = f$	Solve by substitution or elimination
Consistent System	One or infinite solutions	Lines intersect or coincide
Inconsistent System	No solution	Parallel lines
Cramer's Rule (x)	$x = (ed - bf)/(ad - bc)$	For 2×2 systems
Cramer's Rule (y)	$y = (af - ec)/(ad - bc)$	For 2×2 systems

---

5. FUNCTIONS

Topic	Formula	Description
Function Notation	$f(x) = ...$	Output for input x
Domain	All possible x-values	Input values
Range	All possible y-values	Output values
Composite Functions	$(f \circ g)(x) = f(g(x))$	Function of a function
Inverse Function	$f^{-1}(f(x)) = x$	Reflects over y = x
Even Function	$f(-x) = f(x)$	Symmetric about y-axis
Odd Function	$f(-x) = -f(x)$	Symmetric about origin
Absolute Value	$\|x\| = x$ if $x \geq 0$ $\|x\| = -x$ if $x < 0$	Distance from zero

Topic	Formula	Description
Piecewise Function	f(x) = {g(x) if condition 1 h(x) if condition 2}	Different rules for different domains

---

6. POLYNOMIALS & RATIONAL EXPRESSIONS

Topic	Formula	Description
FOIL Method	$(a + b)(c + d) = ac + ad + bc + bd$	First, Outer, Inner, Last
Difference of Cubes	$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$	Factoring pattern
Sum of Cubes	$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$	Factoring pattern
Rational Expression	$P(x)/Q(x)$, $Q(x) \neq 0$	Polynomial over polynomial
Vertical Asymptote	$x = a$ where $Q(a) = 0$	Denominator = 0
Horizontal Asymptote	$y = \lim(x \to \infty) f(x)$	Behavior as $x \to \infty$

---

7. RADICALS & RATIONAL EXPONENTS

Topic	Formula	Description
Square Root	$\sqrt{(x^2)} = \|x\|$	Principal square root
Rational Exponent	$x^{(m/n)} = \sqrt[n]{(x^m)} = (\sqrt[n]{x})^m$	Fractional exponent
Product Rule	$x^a \cdot x^b = x^{(a+b)}$	Same base
Quotient Rule	$x^a/x^b = x^{(a-b)}$	Same base
Power Rule	$(x^a)^b = x^{(ab)}$	Power of a power
Negative Exponent	$x^{-n} = 1/x^n$	Reciprocal
Zero Exponent	$x^0 = 1$	$x \neq 0$
Distributive Power	$(xy)^n = x^n y^n$	Power of product

Topic	Formula	Description
Quotient Power	$(x/y)^n = x^n/y^n$	Power of quotient
Simplifying Radicals	$\sqrt{(ab)} = \sqrt{a} \cdot \sqrt{b}$	Product property
Rationalizing	$1/\sqrt{a} = \sqrt{a}/a$	Multiply by $\sqrt{a}/\sqrt{a}$

---

8. GEOMETRY - LINES & ANGLES

Topic	Formula	Description
Supplementary Angles	$\alpha + \beta = 180°$	Angles on a straight line
Complementary Angles	$\alpha + \beta = 90°$	Angles in right angle
Vertical Angles	$\alpha = \beta$	Opposite angles are equal
Sum of Triangle Angles	$\alpha + \beta + \gamma = 180°$	Interior angles of triangle
Exterior Angle	Exterior = sum of remote interior angles	Triangle exterior angle theorem
Parallel Lines (Corresponding)	Angles are equal	Same position
Parallel Lines (Alternate Interior)	Angles are equal	Z-pattern
Parallel Lines (Co-interior)	Angles sum to 180°	C-pattern

---

9. GEOMETRY - TRIANGLES

Topic	Formula	Description
Area	$A = \frac{1}{2}bh$	b = base, h = height
Area (Heron's Formula)	$A = \sqrt{[s(s-a)(s-b)(s-c)]}$	s = (a+b+c)/2 (semi-perimeter)
Perimeter	$P = a + b + c$	Sum of all sides
Pythagorean Theorem	$a^2 + b^2 = c^2$	Right triangle, c = hypotenuse

Topic	Formula	Description
Pythagorean Triples	3-4-5, 5-12-13, 8-15-17, 7-24-25	Common right triangles
45-45-90 Triangle	Sides: x, x, x√2	Isosceles right triangle
30-60-90 Triangle	Sides: x, x√3, 2x	Special right triangle
Isosceles Triangle	Two sides equal, two angles equal	Base angles are equal
Equilateral Triangle	All sides equal, all angles = 60°	All sides equal
Area (Equilateral)	$A = (s^2\sqrt{3})/4$	s = side length
Similar Triangles	$a_1/a_2 = b_1/b_2 = c_1/c_2$	Corresponding sides proportional
Triangle Inequality	a + b > c	Sum of two sides > third side

---

10. GEOMETRY - CIRCLES

Topic	Formula	Description
Circumference	$C = 2\pi r = \pi d$	r = radius, d = diameter
Area	$A = \pi r^2$	r = radius
Arc Length	$s = r\theta$	θ in radians
Arc Length (degrees)	$s = (\theta/360°) \times 2\pi r$	θ in degrees
Sector Area	$A = \frac{1}{2}r^2\theta$	θ in radians
Sector Area (degrees)	$A = (\theta/360°) \times \pi r^2$	θ in degrees
Chord Length	$c = 2r \sin(\theta/2)$	θ = central angle
Circle Equation (Standard)	$(x - h)^2 + (y - k)^2 = r^2$	Center (h, k), radius r
Circle Equation (General)	$x^2 + y^2 + Dx + Ey + F = 0$	Expand to find center/radius
Inscribed Angle	θ = ½ × central angle	Angle on circumference
Tangent Line	Perpendicular to radius at point	Forms 90° with radius

11. GEOMETRY - QUADRILATERALS

Topic	Formula	Description
Rectangle Area	$A = lw$	l = length, w = width
Rectangle Perimeter	$P = 2l + 2w$	Sum of all sides
Square Area	$A = s^2$	s = side length
Square Perimeter	$P = 4s$	Four equal sides
Square Diagonal	$d = s\sqrt{2}$	Diagonal of square
Parallelogram Area	$A = bh$	b = base, h = height
Parallelogram (alt)	$A = ab \sin(\theta)$	a, b = sides, θ = angle
Trapezoid Area	$A = \frac{1}{2}(b_1 + b_2)h$	b_1, b_2 = parallel sides, h = height
Rhombus Area	$A = \frac{1}{2}d_1d_2$	d_1, d_2 = diagonals
Kite Area	$A = \frac{1}{2}d_1d_2$	d_1, d_2 = diagonals
Sum of Interior Angles	$(n - 2) \times 180°$	n = number of sides

12. GEOMETRY - 3D SHAPES (SOLID GEOMETRY)

Topic	Formula	Description
Rectangular Prism Volume	$V = lwh$	l = length, w = width, h = height
Rectangular Prism SA	$SA = 2(lw + lh + wh)$	Surface area
Cube Volume	$V = s^3$	s = side length
Cube Surface Area	$SA = 6s^2$	Six square faces
Cylinder Volume	$V = \pi r^2 h$	r = radius, h = height
Cylinder Surface Area	$SA = 2\pi r^2 + 2\pi rh = 2\pi r(r + h)$	Two circles + lateral area

Topic	Formula	Description
Cone Volume	$V = \frac{1}{3}\pi r^2 h$	r = radius, h = height
Cone Surface Area	$SA = \pi r^2 + \pi r l$	l = slant height
Sphere Volume	$V = (4/3)\pi r^3$	r = radius
Sphere Surface Area	$SA = 4\pi r^2$	r = radius
Pyramid Volume	$V = \frac{1}{3}Bh$	B = base area, h = height

---

13. TRIGONOMETRY - RIGHT TRIANGLE

Topic	Formula	Description
Sine	$\sin(\theta)$ = opposite/hypotenuse	SOH
Cosine	$\cos(\theta)$ = adjacent/hypotenuse	CAH
Tangent	$\tan(\theta)$ = opposite/adjacent	TOA
Cosecant	$\csc(\theta) = 1/\sin(\theta)$ = hypotenuse/opposite	Reciprocal of sine
Secant	$\sec(\theta) = 1/\cos(\theta)$ = hypotenuse/adjacent	Reciprocal of cosine
Cotangent	$\cot(\theta) = 1/\tan(\theta)$ = adjacent/opposite	Reciprocal of tangent

---

14. TRIGONOMETRY - IDENTITIES

Topic	Formula	Description
Pythagorean Identity	$\sin^2(\theta) + \cos^2(\theta) = 1$	Fundamental identity
Pythagorean (tan/sec)	$1 + \tan^2(\theta) = \sec^2(\theta)$	Divide by $\cos^2(\theta)$
Pythagorean (cot/csc)	$1 + \cot^2(\theta) = \csc^2(\theta)$	Divide by $\sin^2(\theta)$
Quotient Identity (tan)	$\tan(\theta) = \sin(\theta)/\cos(\theta)$	Definition
Quotient Identity (cot)	$\cot(\theta) = \cos(\theta)/\sin(\theta)$	Definition

Topic	Formula	Description
Co-function (sine/cosine)	sin(90° - θ) = cos(θ)	Complementary angles
Co-function (tan/cot)	tan(90° - θ) = cot(θ)	Complementary angles

---

15. TRIGONOMETRY - SPECIAL ANGLES

Angle	sin	cos	tan
0°	0	1	0
30°	1/2	√3/2	√3/3 = 1/√3
45°	√2/2	√2/2	1
60°	√3/2	1/2	√3
90°	1	0	undefined

---

16. TRIGONOMETRY - UNIT CIRCLE & RADIANS

Topic	Formula	Description
Radian Conversion	radians = (π/180°) × degrees	Degree to radian
Degree Conversion	degrees = (180°/π) × radians	Radian to degree
Common Conversions	π rad = 180°, π/2 = 90°, π/3 = 60°, π/4 = 45°, π/6 = 30°	Key angles
Arc Length	s = rθ	θ in radians
Unit Circle	$x^2 + y^2 = 1$	Radius = 1
Coordinates	(cos(θ), sin(θ))	Point on unit circle

---

17. COORDINATE GEOMETRY

Topic	Formula	Description
Distance Formula	$d = \sqrt{[(x_2 - x_1)^2 + (y_2 - y_1)^2]}$	Distance between points
Midpoint Formula	$M = ((x_1 + x_2)/2, (y_1 + y_2)/2)$	Midpoint between points
Section Formula (Internal)	$x = (mx_2 + nx_1)/(m + n)$ $y = (my_2 + ny_1)/(m + n)$	Divides segment m:n internally
Slope Formula	$m = (y_2 - y_1)/(x_2 - x_1)$	Rise over run
Collinear Points	Slope AB = Slope BC	Three points on same line
Area of Triangle	$A = ½\|x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)\|$	Using coordinates

---

18. STATISTICS - MEASURES OF CENTRAL TENDENCY

Topic	Formula	Description
Mean (Average)	$\bar{x} = (\Sigma x)/n$	Sum divided by count
Weighted Mean	$\bar{x} = (\Sigma wx)/(\Sigma w)$	w = weights
Median	Middle value when ordered	50th percentile
Mode	Most frequent value	Can have multiple modes
Range	Range = Max - Min	Spread of data

---

19. STATISTICS - MEASURES OF SPREAD

Topic	Formula	Description
Variance (Population)	$\sigma^2 = \Sigma(x - \mu)^2/N$	N = population size
Variance (Sample)	$s^2 = \Sigma(x - \bar{x})^2/(n - 1)$	n = sample size
Standard Deviation (Pop)	$\sigma = \sqrt{[\Sigma(x - \mu)^2/N]}$	Square root of variance
Standard Deviation (Sample)	$s = \sqrt{[\Sigma(x - \bar{x})^2/(n - 1)]}$	Square root of variance

Topic	Formula	Description
Interquartile Range	$IQR = Q_3 - Q_1$	Middle 50% spread
Outlier (Lower)	$x < Q_1 - 1.5(IQR)$	Below lower fence
Outlier (Upper)	$x > Q_3 + 1.5(IQR)$	Above upper fence

---

20. PROBABILITY

Topic	Formula	Description
Basic Probability	P(A) = (favorable outcomes)/(total outcomes)	$0 \leq P(A) \leq 1$
Complement Rule	$P(A') = 1 - P(A)$	Probability of NOT A
Addition Rule (Mutually Exclusive)	P(A or B) = P(A) + P(B)	Events cannot occur together
Addition Rule (General)	P(A or B) = P(A) + P(B) - P(A and B)	Avoid double counting
Multiplication Rule (Independent)	$P(A \text{ and } B) = P(A) \times P(B)$	Events don't affect each other
Conditional Probability	$P(A \mid B) = P(A \text{ and } B)/P(B)$	Probability of A given B
Permutations	${}_nP_r = n!/(n - r)!$	Order matters
Combinations	${}_nC_r = n!/[r!(n - r)!]$	Order doesn't matter
Factorial	$n! = n \times (n-1) \times (n-2) \times \ldots \times 1$	0! = 1 by definition

---

21. SEQUENCES & SERIES

Topic	Formula	Description
Arithmetic Sequence	$a_n = a_1 + (n - 1)d$	d = common difference
Arithmetic Sum	$S_n = n(a_1 + a_n)/2$	Sum of n terms

Topic	Formula	Description
Arithmetic Sum (alt)	$S_n = n[2a_1 + (n - 1)d]/2$	Alternative formula
Geometric Sequence	$a_n = a_1 \cdot r^{(n-1)}$	r = common ratio
Geometric Sum (finite)	$S_n = a_1(1 - r^n)/(1 - r)$	$r \neq 1$
Geometric Sum (infinite)	$S = a_1/(1 - r)$	$\|r\| < 1$ only

---

22. COMPLEX NUMBERS (Advanced)

Topic	Formula	Description
Imaginary Unit	$i = \sqrt{(-1)}, i^2 = -1$	Definition
Complex Number	$z = a + bi$	a = real part, b = imaginary part
Complex Conjugate	$\bar{z} = a - bi$	Conjugate of z
Addition	$(a + bi) + (c + di) = (a + c) + (b + d)i$	Add real and imaginary parts
Multiplication	$(a + bi)(c + di) = (ac - bd) + (ad + bc)i$	FOIL and use $i^2 = -1$
Modulus	$\|z\| = \sqrt{(a^2 + b^2)}$	Distance from origin

---

23. MATRICES (Advanced)

Topic	Formula	Description
Matrix Addition	$[a_{ij}] + [b_{ij}] = [a_{ij} + b_{ij}]$	Add corresponding elements
Scalar Multiplication	$k[a_{ij}] = [k \cdot a_{ij}]$	Multiply each element by k
Matrix Multiplication	$(AB)_{ij} = \Sigma(a_{ik} \cdot b_{kj})$	Row × column
Identity Matrix	I = [1 0; 0 1] for 2×2	AI = IA = A
Determinant (2×2)	det(A) = ad - bc	For A = [a b; c d]

---

24. RATIO, PROPORTION & VARIATION

Topic	Formula	Description
Ratio	a:b or a/b	Comparison of quantities
Proportion	a/b = c/d or a:b = c:d	Equal ratios
Cross Multiplication	If a/b = c/d, then ad = bc	Solving proportions
Direct Variation	y = kx or y/x = k	k = constant of variation
Inverse Variation	y = k/x or xy = k	Product is constant
Joint Variation	z = kxy	z varies with both x and y
Combined Variation	z = kx/y	Direct with x, inverse with y
Scale Factor	New/Original = k	For similar figures

---

25. PERCENT, PERCENT CHANGE & APPLICATIONS

Topic	Formula	Description
Percent	Percent = (Part/Whole) × 100%	Convert to percentage
Percent of a Number	Part = (Percent/100) × Whole	Find the part
Percent Change	% Change = [(New - Old)/Old] × 100%	Increase or decrease
Percent Increase	New = Old × (1 + r/100)	r = percent increase
Percent Decrease	New = Old × (1 - r/100)	r = percent decrease
Simple Interest	I = Prt	P = principal, r = rate, t = time
Total with Interest	A = P(1 + rt)	Simple interest
Markup	Selling Price = Cost × (1 + markup%)	Retail pricing
Discount	Sale Price = Original × (1 - discount%)	Reduced price

---

26. RATE, WORK & MIXTURE PROBLEMS

Topic	Formula	Description
Distance = Rate × Time	$d = rt$	Uniform motion
Average Speed	Average = Total Distance/Total Time	NOT average of speeds
Work Rate	Work = Rate × Time	$W = rt$
Combined Work	$1/t = 1/t_1 + 1/t_2$	Two workers together
Mixture Formula	Amount × Concentration = Pure quantity	For solutions

---

27. IMPORTANT CONSTANTS & VALUES

Constant	Value	Description
π (Pi)	≈ 3.14159 or 22/7	Circle constant
e (Euler's number)	≈ 2.71828	Natural exponential base
√2	≈ 1.414	Square root of 2
√3	≈ 1.732	Square root of 3
Golden Ratio (ϕ)	≈ 1.618	$(1 + √5)/2$

---

28. USEFUL CALCULATION SHORTCUTS

Topic	Formula	Description
Sum of First n Integers	$1 + 2 + 3 + ... + n = n(n + 1)/2$	Quick sum
Sum of First n Odd	$1 + 3 + 5 + ... + (2n-1) = n^2$	Odd numbers
Sum of First n Even	$2 + 4 + 6 + ... + 2n = n(n + 1)$	Even numbers
Sum of Squares	$1^2 + 2^2 + ... + n^2 = n(n + 1)(2n + 1)/6$	Squared integers
Difference of Squares	$a^2 - b^2 = (a + b)(a - b)$	Quick factoring

---

TIPS FOR SAT MATH SUCCESS

1. **Memorize special right triangles**: 30-60-90 and 45-45-90
2. **Know Pythagorean triples**: 3-4-5, 5-12-13, 8-15-17
3. **Remember the quadratic formula** - it's not given on SAT
4. **Practice unit circle values** for common angles
5. **Understand slope concepts** - parallel, perpendicular lines
6. **Master percent change** and growth/decay problems
7. **Know circle equation forms** - standard and general
8. **Be comfortable with function notation** and transformations
9. **Review exponent rules** thoroughly
10. **Practice word problems** - translate English to equations

---

This formula sheet covers all SAT Math topics. Review regularly and practice applying these formulas in different contexts.