

■ EDUQUEST EXCLUSIVE 8-PAGE MASTER GUIDE

SAT Math Shortcuts & Formula Cheat Sheet

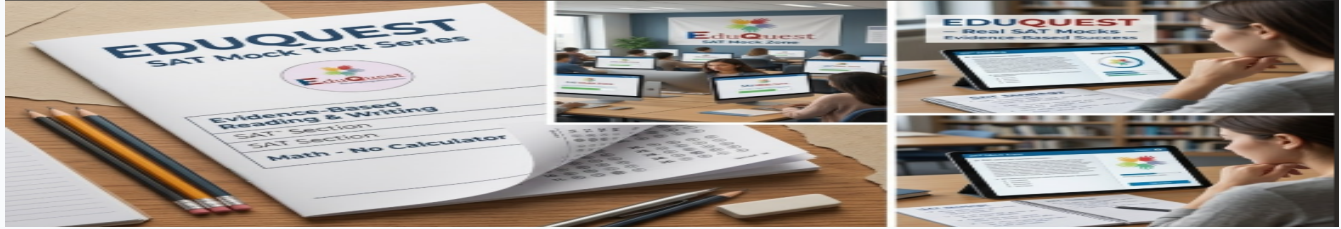
Essential Formulas, Coordinate Geometry Shortcuts, Quadratic Discriminants & Fast Mental Elimination Hacks

1. Heart of Algebra & Linear Functions

Linear equations and inequalities represent 35% of SAT Math. Memorize these foundational formulas:

- Slope Formula: $m = (y_2 - y_1) / (x_2 - x_1)$. Slope-Intercept Form: $y = mx + b$ (m = slope, b = y-intercept).
- Standard Form: $Ax + By = C \Rightarrow$ Slope $m = -A/B$, y-intercept $= C/B$, x-intercept $= C/A$.
- Point-Slope Form: $y - y_1 = m(x - x_1)$. Useful when given a point and a slope.
- Parallel Lines: $m_1 = m_2$. Identical slopes, different y-intercepts (Zero solutions in a system).
- Perpendicular Lines: $m_1 \cdot m_2 = -1$ (Negative reciprocal slopes).
- System with Infinitely Many Solutions: Equations are algebraically identical (same slope, same y-intercept).

Figure 1: Digital Coordinate Geometry & Systems Analysis Framework



■ Fast Slope Hack

For equation $3x - 4y = 12$, slope is immediately $-3 / (-4) = 3/4$. No need to isolate y !

Module 2: Advanced Math: Quadratics, Roots & Parabolas

1. The 3 Forms of a Quadratic Equation

Recognize which form reveals key geometric attributes:

Quadratic Form	Algebraic Formula	Geometric Feature Revealed Directly
Standard Form	$y = ax^2 + bx + c$	y-intercept is (0, c); parabola opens up if $a > 0$, down if $a < 0$.
Vertex Form	$y = a(x - h)^2 + k$	Vertex coordinates are (h, k); axis of symmetry is $x = h$.
Factored Form	$y = a(x - r_1)(x - r_2)$	x-intercepts (roots) are (r1, 0) and (r2, 0); vertex $x = (r_1 + r_2)/2$.

2. Discriminant & Vieta's Formulas

- Discriminant $\Delta = b^2 - 4ac$: If $\Delta > 0$: 2 distinct real roots; If $\Delta = 0$: 1 real root (tangent to x-axis); If $\Delta < 0$: 0 real roots.
- Vieta's Formulas: For $ax^2 + bx + c = 0$, Sum of roots = $-b/a$, Product of roots = c/a .

Module 3: Advanced Math: Polynomials & Exponential Functions

1. Remainder Theorem & Polynomial Division

When polynomial $f(x)$ is divided by $(x - c)$, the remainder is simply $f(c)$. If $f(c) = 0$, then $(x - c)$ is a factor of $f(x)$.

2. Exponential Growth and Decay Models

Standard formula: $f(t) = a(1 \pm r)^t$ or $f(t) = a \cdot b^{(t/k)}$

- Initial Value: 'a' represents the starting amount when $t = 0$.
- Growth Factor: $(1 + r)$ where r is the percentage growth rate per period (e.g. 5% growth $\Rightarrow 1.05$).
- Decay Factor: $(1 - r)$ where r is the percentage decay rate (e.g. 12% decay $\Rightarrow 0.88$).
- Half-Life Model: $A(t) = A_0 \cdot (1/2)^{(t / t_{\text{half}})}$ where t_{half} is the time for half-life.

Module 4: Problem Solving & Data Analysis: Rates & Statistics

1. Percentages & Unit Conversions

- Percentage Change: $\% \text{ Change} = \frac{(\text{New Value} - \text{Old Value})}{\text{Old Value}} \times 100$.
- Percentage Above/Below: 'x is 20% greater than y' $\Rightarrow x = 1.20y$. 'x is 30% less than y' $\Rightarrow x = 0.70y$.
- Speed / Rate Formula: $\text{Distance} = \text{Speed} \times \text{Time}$. $\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$.

2. Statistics: Mean, Median, Standard Deviation & Margin of Error

- Mean vs Median: Outliers pull the mean toward extreme values; median remains robust.
- Standard Deviation: Measures spread/dispersion. A dataset with values clustered close to the mean has smaller standard deviation.
- Margin of Error: Decreases when sample size (N) increases. Valid only if sample is randomly selected from target population.

Module 5: Geometry & Trigonometry: Circles, Angles & Triangles

1. Circle Theorems & Equations

- Standard Circle Equation: $(x - h)^2 + (y - k)^2 = r^2$ with centre (h, k) and radius r .
- Completing the Square: Group x and y terms; add $(b/2)^2$ to both sides.
- Arc Length: $s = r \cdot \theta$ (θ in radians) OR $s = (\theta/360) \cdot 2\pi r$ (θ in degrees).
- Sector Area: $A = (1/2) \cdot r^2 \cdot \theta$ (radians) OR $A = (\theta/360) \cdot \pi r^2$ (degrees).

2. Trigonometry & Special Right Triangles

- SOH CAH TOA: $\sin(\theta) = \text{Opp}/\text{Hyp}$, $\cos(\theta) = \text{Adj}/\text{Hyp}$, $\tan(\theta) = \text{Opp}/\text{Adj}$.
- Cofunction Identity: $\sin(x) = \cos(90^\circ - x)$ OR $\sin(x) = \cos(\pi/2 - x)$.
- 30-60-90 Triangle: Side ratio is $x : x\sqrt{3} : 2x$. 45-45-90 Triangle: Side ratio is $x : x : x\sqrt{2}$.

Module 6: Top 10 SAT Math Traps & Distractor Heuristics

1. The Most Common Distractor Patterns

Trap Name	How College Board Fools Students	Actionable Avoidance Rule
Solving for x instead of $(2x + 1)$	Question asks for $2x + 1$; choice A contains value of x.	Underline what the question is asking for before selecting.
Units Misalignment	Given speed in miles/hr; asks for feet per second.	Write down unit conversion chain explicitly.
Sign Errors in Distributing	Expanding $-(2x - 5)$ as $-2x - 5$ instead of $-2x + 5$.	Circle negative signs outside parentheses.
Extraneous Solutions	Squaring both sides introduces false solutions in radical equations.	Plug solutions back into original equation.
Percentage Stacking	Applying a 20% discount then 10% tax is NOT a net 10% discount.	Multiply factors sequentially: $(0.80)(1.10) = 0.88$.

Module 7: Desmos Graphing Calculator Ninja Shortcuts

1. Rapid Calculator Protocols

- Circle Centre & Radius: Type the expanded equation directly into Desmos; click circle center.
- System with No Solutions: Parallel lines with 0 intersections. In Desmos, type equations and zoom out to verify parallel slopes.
- Inequality Feasible Regions: Type inequalities into Desmos; shaded overlap reveals all valid coordinate points.
- Absolute Value Equations: Type $y = |ax + b|$ and $y = c$ to find all intersection points instantly.

Module 8: Formula Memorization Drill & Coaching Booking

1. Quick-Fire Formula Self-Test

- What is the sum of roots for quadratic $2x^2 - 8x + 5 = 0$? (Answer: $-(-8)/2 = 4$)
- What is the relationship between $\sin(25^\circ)$ and $\cos(65^\circ)$? (Answer: Exactly equal)
- What happens to margin of error when sample size quadruples? (Answer: It is halved, $1/\sqrt{N}$)

■ 800 Math Target

EduQuest math students achieve an average SAT Math score of 780+ through formula mastery and Desmos automation.

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