The Simple Digital SAT® Math Algebra Cheat Sheet

Linear Equations in 1 Variable

Solving

Goal: get x alone. Distribute, combine like terms, then undo + or − before × or ÷.
Fractions: multiply every term by the LCD first: x/3 + x/4 = 7 → 4x + 3x = 84 → x = 12.
Decimals: multiply by 10 to clear them: 0.2x + 1.5 = 3.1 → 2x + 15 = 31 → x = 8. Fewer errors.
Distribute carefully: −3(2x − 5) = −6x + 15. Watch the sign on the 2nd term; it's a top trap.
Example: 5(x − 2) = 3x + 4 → 5x − 10 = 3x + 4 → 2x = 14 → x = 7. Check it in the original.

How Many Solutions?

Simplifies to	Solutions	Example
x = number	Exactly 1	3x + 2 = 11
a = a (true)	Infinitely many	2(x + 3) = 2x + 6
a = b (false)	None	2x + 1 = 2x + 5

No solution: same x-coefficients on both sides but different constants (2x + 1 = 2x + 5).
Infinitely many: both sides match exactly after simplifying, like 2(x + 3) = 2x + 6.

Solve for an Expression

Shortcut: if 4x + 6 = 18, then 2x + 3 = 9. Divide both sides by 2; no need to find x.
Literal equations: solve for a letter: P = 2l + 2w → w = (P − 2l)/2. Treat other letters as numbers.

⚠ Read what's asked. If the question wants 3x − 1, don't stop once you've found x.

✓ Desmos: graph each side as its own line; the crossing point's x is the answer.

Linear Functions

Function Basics

Linear function: f(x) = mx + b, where m is the slope & b = f(0) is the starting value.
Input & output: x is the input; f(x), also called y, is the output you get back from the rule.
Notation: f(3) is the output when x = 3. If f(x) = 2x − 5, then f(3) = 2(3) − 5 = 1, not 3.
Working backward: if f(a) = 9 for f(x) = 2x − 5, then 2a − 5 = 9, so a = 7 (the input).

From a Table or 2 Points

x	1	3	5
f(x)	4	10	16

Slope: m = (10 − 4)/(3 − 1) = 3. Then 4 = 3(1) + b, so b = 1 & the rule is f(x) = 3x + 1.
Linear check: equal steps in x must give equal changes in y, or it isn't linear at all.
2 points: (2, 7) & (6, 15) → slope = 8/4 = 2; then 7 = 2(2) + b gives b = 3, so f(x) = 2x + 3.

Graphs

Graph reading: f(a) is the y-value at x = a; f(x) = 0 where the line crosses the x-axis.
Shifts: f(x) + k moves the line up k units; the slope stays the same, only b changes.
Direct variation: y = kx is a line through (0, 0); doubling x doubles y, & y/x = k.

⚠ f(x + 1) ≠ f(x) + 1. Replace every x w/ (x + 1).

✓ Desmos table + regression $y_1 \sim mx_1 + b$ finds the line from data points in seconds.

Linear Equations in 2 Variables

Slope

Slope m = $(y_2 - y_1)/(x_2 - x_1)$ = rise over run.
Signs: positive slope rises, negative falls, 0 is flat & a vertical line's slope is undefined.

Forms of a Line

Form	Equation	Shows
Slope-int.	y = mx + b	Slope, y-int
Point-slope	$y - y_1 = m(x - x_1)$	1 point
Standard	Ax + By = C	Intercepts

Standard form: slope = −A/B; 3x + 4y = 24 has slope −3/4 & y-intercept (0, 6).

Parallel & Perpendicular

Parallel: same slope. **Perpendicular**: negative reciprocal slopes, like 2 & −1/2.
Example: perpendicular to slope 2/3 → slope −3/2.
Missing value: if (k, 5) is on y = 2x − 3, then 5 = 2k − 3, so 2k = 8 & k = 4. Plug in what you know.
Line from 2 points: (1, 3) & (4, 12) → slope 9/3 = 3 → y − 3 = 3(x − 1) → y = 3x, through the origin.
On the line? Plug the point into the equation; a point on the line makes the equation true.
Intercepts: set y = 0 to find the x-intercept; set x = 0 to find the y-intercept (b) value.

⚠ Slope is the change in y over the change in x, not the reverse (a common trap).

✓ On a graph, use 2 points where the line crosses grid corners to read the slope.

Linear Models in Context

Interpreting m & b

Slope = rate per unit: "the cost goes up $15 for each extra hour." Include units.
y-intercept = the starting value when x = 0, like a flat fee, starting height or deposit.

Model	Slope means	Intercept means
C = 15h + 40	$15 per hour	$40 fee
W = 500 − 20d	−20 per day	500 at start
T = 0.5m + 68	+0.5° per min	68° at m = 0

Writing the Equation

Translate: "$40 plus $15 per hour" → C = 15h + 40. The rate goes w/ the variable.
Key words: "per" → multiply by the variable; "flat / initial" → constant; "total" → =.
Two totals: 3a + 5b = 120 means a items at $3 & b items at $5 cost $120 altogether.

Using the Model

Reverse: to find x, set y to the target value: 15h + 40 = 145 → 15h = 105 → h = 7 hours.
Example: a 30 cm candle burns 2 cm per hour → h = 30 − 2t; it's gone when h = 0, at t = 15.
Change in y: if x goes up by k, then y changes by m times k (3 more hours → +$45).
Decreasing: W = 500 − 20d starts at 500 & loses 20 units per day (negative slope).

⚠ Interpret the number (15), not the letter (h).

✓ Check units: the slope is dollars per hour & the intercept is a dollar amount (the fee).

Systems of Linear Equations

Methods

Substitution: solve 1 equation for a variable & plug it into the other; best if 1 is alone.
Elimination: add or subtract the equations so 1 variable cancels out; scale first if needed.
Scaling: multiply 1 equation by a number so a variable will cancel when you add.
Example: 2x + 3y = 12 & 4x − 3y = 6 → add: 6x = 18 → x = 3, then 3y = 6, so y = 2.

Number of Solutions

Lines	Slopes & intercepts	Solutions
Intersect	Different slopes	Exactly 1
Parallel	Same m, different b	None
Same line	Same m, same b	Infinitely many

No solution: same slope but different intercepts, so the lines are parallel & never meet.
Infinitely many: 1 equation is a multiple of the other, so both are the same line.
Find k: for no solution, make the slopes equal & keep the y-intercepts different.

Shortcuts

Asked for x + y? Add the equations: 3x + y = 11 & x + 3y = 9 → 4x + 4y = 20 → x + y = 5.
Asked for x − y? Subtract the equations instead: 5x + 2y = 20 & 4x + 3y = 13 → x − y = 7.

⚠ Finish the job: if it asks for y, don't stop at x.

✓ Desmos: graph both equations & click the point where they cross to read (x, y).

Systems in Word Problems

Setting Up

Rule: write 1 equation per fact, usually 1 for the COUNT & 1 for the VALUE (money).
Tickets: 200 sold at $8 & $5 for $1,300 total → a + s = 200 & 8a + 5s = 1,300 (in dollars).
Solve: s = 200 − a → 8a + 5(200 − a) = 1,300 → 3a = 300 → a = 100 adults & s = 100 students.

Problem type	Count eq.	Value eq.
Tickets/items	a + b = total	pa + qb = $
Coins	n + d = coins	5n + 10d = ¢
Test questions	x + y = qs	2x + 4y = pts
Mixtures	a + b = amount	ra + sb = total

Reading the Question

Define variables clearly (a = adults) & check which one the question asks for.
Choose the system: some questions only ask which system models the story.
Coins: 30 nickels & dimes worth $2.10 → n + d = 30 & 0.05n + 0.10d = 2.10, so d = 12.

Comparing Plans

Break-even: Plan A = 20 + 5x & Plan B = 50 + 2x → 3x = 30, so they're equal when x = 10.
After break-even: the plan w/ the smaller rate (slope) costs less for every extra use.

⚠ Match each price to the right item: 8a + 5s, not 5a + 8s. Swapped prices are a trap choice.

✓ Check your answer in both facts: the count of items & the total amount paid in dollars.

Linear Inequalities

One Variable

Solve like an equation, but flip the sign when you multiply or divide by a negative.
Example: −2x > 8 → divide by −2 → x < −4. The inequality sign reverses direction.
Compound: −3 ≤ 2x + 1 < 9 → −4 ≤ 2x < 8 → −2 ≤ x < 4. Do each step to all 3 parts.
Greatest integer: if x < 4.5, the greatest integer x can be is 4; if x ≤ 4, it's also 4 itself.

Two Variables

Symbol	Line	Shade
y > mx + b	Dashed	Above
y ≥ mx + b	Solid	Above
y < mx + b	Dashed	Below
y ≤ mx + b	Solid	Below

Test a point: plug in (0, 0); if the inequality is true, then (0, 0) is in the shaded region.
Systems: the solution is where the shaded regions of both inequalities overlap each other.
Graph rules: dashed line for < or >; solid line for ≤ or ≥; shade above for y >, below for y <.

Word Problems

Key words: "at least" → ≥; "at most / no more than" → ≤; "more than" → >; "fewer" → <.
Example: $40 fee + $25/hour ≤ $500 → 25h ≤ 460 → h ≤ 18.4, so at most 18 full hours.
Hidden limits: counts can't be negative, so x ≥ 0 & y ≥ 0 are often implied in word problems.

⚠ "At least" means ≥ (a minimum), not ≤.

Test Strategy & Desmos

The Math Section

Format: 2 modules of 22 questions & 35 minutes each; Algebra is about 35% of questions.
Adaptive: doing well in Module 1 leads to a harder, higher-scoring Module 2 of questions.
Calculator: Desmos is built in & allowed on every math question; you can bring your own.
Pacing: about 1.5 minutes per question; move fast on easy algebra to save time for hard ones.

Student-Produced Responses

Rule	Detail
Length	5 chars (+), 6 (−)
Fractions	OK if they fit: 7/3
Decimals	Fill space or round
Mixed numbers	Not allowed
Multiple answers	Enter just 1

Long decimals: for 2/3, enter 2/3, .6666 or .6667; 0.66 or 0.67 is marked wrong (too short).

Fast Methods

Backsolve: plug in the answer choices, starting w/ a middle value, to find the one that works.
Plug in numbers: pick x = 2, then evaluate the original & each answer choice to match.
Sliders: for "what value of k...", add a slider for k in Desmos & watch how the graph changes.

⚠ No penalty for guessing. Answer every question, even if you have to guess.

✓ The reference sheet covers geometry only. Memorize slope, forms & systems.