SAT Math Formula Sheet: Expanded

Three forms of a line

Slope-intercept	$y = mx + b$
Point-slope	$y - y_1 = m(x - x_1)$
Standard	$Ax + By = C$

Read m and b in slope-intercept form. Use point-slope when a point and slope are given.
A and B are not both zero. A vertical line cannot be written as y = mx + b.

Linear equations and systems

Slope-intercept	$y = mx + b$
Point-slope	$y - y_1 = m(x - x_1)$
Example intersection	$y = 2x + 1;\ y = x + 4$

For the example, set the expressions equal: x = 3 and y = 7.
A solution must work in both equations.

Flip the sign when needed

Divide both sides by −3	$-3x \le 12 \Rightarrow x \ge -4$
Check the endpoint	$-3(-4) = 12$
Check one allowed value	$x = 0$ gives $0 \le 12$

Reverse the comparison only when multiplying or dividing both sides by a negative number.

Quadratic forms

Standard	$y = ax^2 + bx + c$
Vertex	$y = a(x - h)^2 + k$
Factored if real roots exist	$y = a(x - r_1)(x - r_2)$
Axis in standard form	$x = -b/(2a)$

a is nonzero. The vertex is (h, k). Factored form shows real roots, including a repeated root.

Find and count roots

Discriminant	$D = b^2 - 4ac$
Roots when D is nonnegative	$x = (-b \pm \sqrt{(D)})/(2a)$
Sum of roots	$r_1 + r_2 = -b/a$
Product of roots	$r_1\, r_2 = c/a$

For real coefficients, D > 0 gives two real roots, D = 0 one repeated root, D < 0 no real roots.

Fractional powers & roots

Square root	$a^{1/2} = \sqrt{(a)}$
General positive base	$a^{m/n} = (a^{1/n})^m$
Example	$27^{2/3} = 3^2 = 9$
Square root of a square	$\sqrt{(x^2)} = \lvert x \rvert$

For the general rule use a > 0 and positive integer n. An even real root cannot have a negative radicand.

Exponential models

General form	$y = a \times b^t$
Growth	$b = 1 + r$
Decay	$b = 1 - r$
Example: 10% growth	$y = 40 \times 1.1^t$

a is the initial value, t counts equal periods, and r is a per-period rate as a decimal. Use 0 < r < 1 for decay.

Rational expressions & equations

Exclude original denominator zeros
$(x^2 - 4)/(x - 2) = x + 2,\ x \ne 2$

Equation example	$6/(x - 1) = 2 \Rightarrow x = 4$
Check candidate	$6/(4 - 1) = 2$

Cancel factors after factoring, and keep the restrictions from the original expression.

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Rates and percent models

Distance at a constant rate	**$d = rt$**
Scale a quantity	**$\text{new} = \text{old} \times (1 + r)$**
Find signed change	**$r = (\text{new} - \text{old})/\text{old}$**
Example: 80 to 68	**$r = -12/80 = -15\%$**

For a positive original value, a negative r is a decrease. Compare units before solving.

Center and spread

Mean	**sum / count**
Median	**middle of the ordered data**
Range	**maximum − minimum**

For an even count, the median is the mean of the two middle values.
Example: 1, 4, 7, 8 has median 5.5.

Basic probability

Equally likely outcomes	**$P(A) = \text{favorable} / \text{total}$**
Complement	**$P(\text{not } A) = 1 - P(A)$**
Example: fair die	**$P(\text{even}) = 3/6 = ½$**

The favorable count comes from the group named in the question.

Coordinate geometry

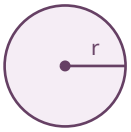
Slope	**$m = (y_2 - y_1) / (x_2 - x_1)$**
Midpoint	**$((x_1 + x_2)/2, (y_1 + y_2)/2)$**
Squared distance	**$d^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$**

Take the nonnegative square root to get d. A vertical line has no defined slope.

Circles

Circumference	**$C = 2\pi r = \pi d$**
Area	**$A = \pi r^2$**

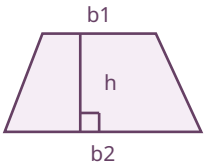
The radius r runs from center to edge.
Diameter d = 2r.
Circumference uses length units; area uses square units.



Area of plane figures

Triangle	**$A = ½bh$**
Rectangle or parallelogram	**$A = bh$**
Trapezoid	**$A = ½(b_1 + b_2)h$**

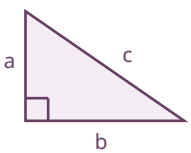
Measure h perpendicular to the base.
The trapezoid bases are parallel.
Use square units.



Special triangles and angle rules

45°–45°–90° side ratios	**$1 : 1 : \sqrt{2}$**
30°–60°–90° side ratios	**$1 : \sqrt{3} : 2$**
Triangle interior sum	**$A + B + C = 180°$**
Polygon interior sum	**$(n - 2)180°$**

In a 30°–60°–90° triangle, the shortest side is opposite 30°.



Right triangle trigonometry

Sine	**$\sin(\text{angle}) = \text{opposite} / \text{hypotenuse}$**
Cosine	**$\cos(\text{angle}) = \text{adjacent} / \text{hypotenuse}$**
Tangent	**$\tan(\text{angle}) = \text{opposite} / \text{adjacent}$**
Side lengths	**$a^2 + b^2 = c^2$**

Choose the acute angle before naming the legs. In the side rule, c is the hypotenuse.