Math Formula Sheet

SAT · ACT · EST — algebra, functions and numbers

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LINES AND COORDINATES

Slope	$m = \dfrac{y_2 - y_1}{x_2 - x_1}$
Slope-intercept form	$y = mx + b$
Point-slope form	$y - y_1 = m(x - x_1)$
Standard form	$Ax + By = C$, slope $= -\dfrac{A}{B}$
Parallel lines	$m_1 = m_2$
Perpendicular lines	$m_1 \cdot m_2 = -1$
Midpoint	$\left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}\right)$
Distance	$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

QUADRATICS

Standard form	$y = ax^2 + bx + c$
Quadratic formula	$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Discriminant	$D = b^2 - 4ac$
$D > 0$: two real roots · $D = 0$: one · $D < 0$: none	
Vertex (x-value)	$x = -\dfrac{b}{2a}$
Vertex form	$y = a(x - h)^2 + k$, vertex (h, k)
Factored form	$y = a(x - r_1)(x - r_2)$
Sum of roots	$r_1 + r_2 = -\dfrac{b}{a}$
Product of roots	$r_1 r_2 = \dfrac{c}{a}$
Difference of squares	$a^2 - b^2 = (a - b)(a + b)$
Perfect squares	$(a \pm b)^2 = a^2 \pm 2ab + b^2$

ABSOLUTE VALUE

Less than	$\lvert x \rvert < a \iff -a < x < a$
Greater than	$\lvert x \rvert > a \iff x < -a$ or $x > a$
Both hold for $a > 0$.	

COMPLEX NUMBERS

Imaginary unit	$i^2 = -1$
Conjugates	$(a + bi)(a - bi) = a^2 + b^2$

EXPONENTS AND ROOTS

Product	$a^m \cdot a^n = a^{m+n}$
Quotient	$\dfrac{a^m}{a^n} = a^{m-n}$
Power of a power	$(a^m)^n = a^{mn}$
Power of a product	$(ab)^n = a^n\, b^n$
Zero and negative	$a^0 = 1, \quad a^{-n} = \dfrac{1}{a^n}$ $(a \neq 0)$
Fractional	$a^{m/n} = \sqrt[n]{a^m}$
Roots	$\sqrt{ab} = \sqrt{a}\,\sqrt{b}$ $(a, b \geq 0)$

LOGARITHMS

Definition	$\log_b x = y \iff b^y = x$
Product	$\log_b(xy) = \log_b x + \log_b y$
Quotient	$\log_b \dfrac{x}{y} = \log_b x - \log_b y$
Power	$\log_b(x^n) = n \log_b x$
Change of base	$\log_b x = \dfrac{\log x}{\log b}$
For $x, y > 0$ and base $b > 0, b \neq 1$.	

PERCENT, RATES AND GROWTH

Percent change	$\dfrac{\text{new} - \text{old}}{\text{old}} \times 100\%$
Change by $r\%$	multiply by $\left(1 \pm \dfrac{r}{100}\right)$
Distance	$d = rt$ (rate × time)
Average speed	$\dfrac{\text{total distance}}{\text{total time}}$
Simple interest	$I = Prt$
Growth and decay	$y = a(1 \pm r)^t$
Compound interest	$A = P\left(1 + \dfrac{r}{n}\right)^{nt}$
In the last three formulas r is a decimal ($5\% = 0.05$). In compound interest, n = times compounded per year and t = years.	

SEQUENCES

Arithmetic term	$a_n = a_1 + (n - 1)d$
Arithmetic sum	$S_n = \dfrac{n(a_1 + a_n)}{2}$
Geometric term	$a_n = a_1\, r^{\,n-1}$
Geometric sum	$S_n = \dfrac{a_1(1 - r^n)}{1 - r}$ $(r \neq 1)$

Math Formula Sheet

SAT · ACT · EST — geometry, trigonometry and statistics

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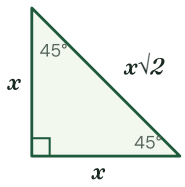
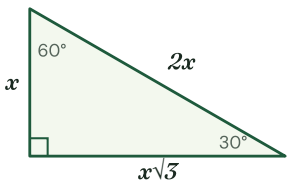
TRIANGLES

Area	$A = \frac{1}{2}bh$
Angle sum	180°
Pythagorean theorem	$a^2 + b^2 = c^2$ (right triangle)
Common triples: 3-4-5 · 5-12-13 · 8-15-17 · 7-24-25	

45°-45°-90°



30°-60°-90°



QUADRILATERALS AND POLYGONS

Rectangle	$A = lw$
Parallelogram	$A = bh$
Trapezoid	$A = \frac{1}{2}(b_1 + b_2)\,h$
Interior angle sum	$(n-2)\cdot 180^\circ$ (n sides)
Regular polygon angle	$\frac{(n-2)\cdot 180^\circ}{n}$

CIRCLES

Area	$A = \pi r^2$
Circumference	$C = 2\pi r$
Arc length	$\frac{\theta}{360^\circ}\cdot 2\pi r$
Sector area	$\frac{\theta}{360^\circ}\cdot \pi r^2$
With θ in radians	$s = r\theta, \quad A = \frac{1}{2}r^2\theta$
Equation	$(x-h)^2 + (y-k)^2 = r^2$
Center (h, k), radius r	

SOLIDS

Box	$V = lwh$
Cylinder	$V = \pi r^2 h,\ SA = 2\pi r^2 + 2\pi rh$
Cone	$V = \frac{1}{3}\pi r^2 h$
Pyramid	$V = \frac{1}{3}Bh$ (B = base area)
Sphere	$V = \frac{4}{3}\pi r^3,\ SA = 4\pi r^2$

Similar figures with scale factor k: lengths $\times k$, areas $\times k^2$, volumes $\times k^3$

TRIGONOMETRY

Sine	$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$
Cosine	$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$
Tangent	$\tan\theta = \frac{\text{opposite}}{\text{adjacent}} = \frac{\sin\theta}{\cos\theta}$
Pythagorean identity	$\sin^2\theta + \cos^2\theta = 1$
Complementary	$\sin\theta = \cos(90^\circ - \theta)$
Degrees and radians	$180^\circ = \pi$ radians
Law of sines	$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
Law of cosines	$c^2 = a^2 + b^2 - 2ab\cos C$
Triangle area	$A = \frac{1}{2}ab\sin C$

VALUES TO KNOW

	0°	30°	45°	60°	90°
radians	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$
$\sin\theta$	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	$\sqrt{3}$	undefined

STATISTICS

Mean	$\frac{\text{sum of the values}}{\text{number of values}}$
Median	middle value of the ordered list
With an even number of values, the median is the mean of the two middle values.	
Mode	most frequent value
Range	largest value - smallest value

PROBABILITY AND COUNTING

Probability	$\frac{\text{favorable outcomes}}{\text{total outcomes}}$
A or B	$P(A) + P(B) - P(A \text{ and } B)$
Independent A and B	$P(A)\cdot P(B)$
Not A	$1 - P(A)$
Permutations	${}_nP_r = \frac{n!}{(n-r)!}$
Combinations	${}_nC_r = \frac{n!}{r!\,(n-r)!}$