



PrepPals | CSCA Mathematics Formula Sheet

Complete · Systematic · High-Frequency · Syllabus-Aligned

How to Use

Welcome to the CSCA Mathematics Formula Sheet! 🎉

This resource reorganizes the formulas most likely to be useful for revision according to the CSCA syllabus and the PrepPals 21-day study plan.

After finishing each topic, spend 10-15 minutes with this sheet: cover the explanation, recall when the formula applies, then return to practice questions to use it actively.

Do not memorize formulas in isolation. Learn the meaning of each variable, the unit, the domain or condition, and the common traps.

PrepPals will help you move from “I recognize it” to “I can use it accurately.” 🚀❤️

Formula Quick-Check Checklist

- Review by module first, then use your mistakes to decide which formulas to revisit.
 - Memorize conditions together with formulas, such as $q \neq 1$, $|q| < 1$, and $a > 0$ with $a \neq 1$.
 - In multiple-choice questions, the most common traps are units, signs, domains, and special cases.
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MODULE 1 | Sets and Inequalities

Set operations:

- $A \cap B$: elements in both A and B; $A \cup B$: elements in A or B; A^c : elements not in A within universal set U
- $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ - counting formula for two sets
- $(A \cup B)^c = A^c \cap B^c$, $(A \cap B)^c = A^c \cup B^c$ - De Morgan's laws
- $A \subseteq B$ iff every $x \in A$ is also in B; $A = B$ iff $A \subseteq B$ and $B \subseteq A$

Inequalities:

- If $a > b$, then $a + c > b + c$; if $c > 0$, $ac > bc$; if $c < 0$, $ac < bc$
 - $|x| < a$ iff $-a < x < a$; $|x| > a$ iff $x > a$ or $x < -a$ ($a > 0$)
 - For $ax^2 + bx + c = 0$: $\Delta = b^2 - 4ac$, $x = \frac{-b \pm \sqrt{\Delta}}{2a}$
 - For rational inequalities, move all terms to one side, factor, then use a sign chart
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MODULE 2 | Functions and Elementary Functions

Domains and properties:

- Denominator condition: denominator $\neq 0$; even root: radicand ≥ 0 ; $\log_a f(x)$: $f(x) > 0$, $a > 0$, $a \neq 1$
- Odd function: $f(-x) = -f(x)$; even function: $f(-x) = f(x)$
- Inverse function: swap x and y in $y = f(x)$, then solve for y; graphs are symmetric about $y = x$
- Composite function: $(f \circ g)(x) = f(g(x))$; first make sure $g(x)$ lies in the domain of f

Linear and quadratic functions:

- Slope: $k = \frac{y_2 - y_1}{x_2 - x_1}$; linear function: $y = kx + b$
- Quadratic form: $y = ax^2 + bx + c = a(x - h)^2 + k$
- Vertex: $x = -b/(2a)$, $y = (4ac - b^2)/(4a)$; axis of symmetry: $x = -b/(2a)$
- Discriminant: $\Delta > 0$ two real roots, $\Delta = 0$ repeated root, $\Delta < 0$ no real roots

Exponential and logarithmic rules:

- $a^m \cdot a^n = a^{m+n}$; $a^m / a^n = a^{m-n}$; $(a^m)^n = a^{mn}$; $a^0 = 1$

- $\log_a(MN) = \log_a M + \log_a N$; $\log_a(M/N) = \log_a M - \log_a N$
 - $\log_a(M^k) = k \log_a M$; $\log_a b = \frac{\log_{cb} b}{\log_{ca} a}$
 - When $a > 1$, exponential/log functions increase; when $0 < a < 1$, they decrease
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MODULE 3 | Trigonometry

Radians and identities:

- $180^\circ = \pi$ rad; arc length $s = r\theta$; sector area $S = \frac{1}{2} r^2 \theta$ (θ in radians)
- $\sin^2 x + \cos^2 x = 1$; $\tan x = \sin x / \cos x$; $1 + \tan^2 x = \sec^2 x$
- $\sin(-x) = -\sin x$; $\cos(-x) = \cos x$; $\tan(-x) = -\tan x$
- Memorize $\sin/\cos/\tan$ for $0, \pi/6, \pi/4, \pi/3$, and π

Sum, difference, double-angle, general solutions:

- $\sin(\alpha \pm \beta) = \sin \alpha \cos \beta \pm \cos \alpha \sin \beta$
 - $\cos(\alpha \pm \beta) = \cos \alpha \cos \beta \mp \sin \alpha \sin \beta$
 - $\tan(\alpha \pm \beta) = (\tan \alpha \pm \tan \beta) / (1 \mp \tan \alpha \tan \beta)$
 - $\sin 2x = 2 \sin x \cos x$; $\cos 2x = \cos^2 x - \sin^2 x = 1 - 2 \sin^2 x = 2 \cos^2 x - 1$
 - For $\sin x = a$, $\cos x = a$, and $\tan x = a$, use the unit circle and periodicity
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MODULE 4 | Sequences and Derivatives

Arithmetic and geometric sequences:

- Arithmetic: $a_n = a_1 + (n-1)d$; $S_n = n(a_1 + a_n)/2 = n[2a_1 + (n-1)d]/2$
- Arithmetic mean: $A = (a+b)/2$
- Geometric: $a_n = a_1 q^{n-1}$; $S_n = a_1(1 - q^n)/(1 - q)$ ($q \neq 1$); $S_n = na_1$ ($q = 1$)
- Infinite geometric sum: $S_\infty = a_1/(1 - q)$, where $|q| < 1$; geometric mean: $G^2 = ab$

Derivatives and applications:

- Definition: $f'(x) = \lim_{h \rightarrow 0} [f(x+h) - f(x)]/h$
 - $(x^n)' = nx^{n-1}$; $(e^x)' = e^x$; $(a^x)' = a^x \ln a$; $(\ln x)' = 1/x$
 - $(\sin x)' = \cos x$; $(\cos x)' = -\sin x$; $(\tan x)' = \sec^2 x$
 - $(uv)' = u'v + uv'$; $(u/v)' = (u'v - uv')/v^2$; chain rule: $[f(g(x))]' = f'(g(x))g'(x)$
 - Tangent line: $y - y_0 = f'(x_0)(x - x_0)$; $f' > 0$ increasing, $f' < 0$ decreasing
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MODULE 5 | Analytic Geometry and Conics

Coordinates and lines:

- Distance: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$; midpoint: $((x_1 + x_2)/2, (y_1 + y_2)/2)$
- Line: $y - y_1 = k(x - x_1)$; $Ax + By + C = 0$; intercept form: $x/a + y/b = 1$
- Parallel lines: $k_1 = k_2$; perpendicular lines: $k_1 k_2 = -1$
- Distance from point to line: $d = |Ax_0 + By_0 + C| / \sqrt{A^2 + B^2}$

Circles and conic sections:

- Circle: $(x-a)^2+(y-b)^2=r^2$; general form $x^2+y^2+Dx+Ey+F=0$
 - Ellipse: $x^2/a^2+y^2/b^2=1$ ($a>b>0$), $c^2=a^2-b^2$, $e=c/a$
 - Hyperbola: $x^2/a^2-y^2/b^2=1$, $c^2=a^2+b^2$, $e=c/a$
 - Parabola: $y^2=2px$ or $x^2=2py$; identify focus and directrix by the opening direction
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MODULE 6 | Vectors, Complex Numbers, and Solid

Vectors:

- For $a=(x_1,y_1)$, $b=(x_2,y_2)$: $a+b=(x_1+x_2,y_1+y_2)$, $\lambda a=(\lambda x_1,\lambda y_1)$
- Dot product: $a \cdot b = x_1x_2 + y_1y_2 = |a||b|\cos\theta$
- Perpendicular: $a \cdot b = 0$; parallel: $x_1y_2 - x_2y_1 = 0$
- Magnitude: $|a| = \sqrt{x^2+y^2}$; 3D distance: $d = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2+(z_2-z_1)^2}$

Complex numbers and solids:

- $z=a+bi$; conjugate $\bar{z}=a-bi$; modulus $|z|=\sqrt{a^2+b^2}$
 - $(a+bi)(c+di)=(ac-bd)+(ad+bc)i$; $i^2=-1$
 - Cuboid $V=abc$; cylinder $V=\pi r^2h$; cone $V=1/3\pi r^2h$; sphere $V=4/3\pi r^3$, $S=4\pi r^2$
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MODULE 7 | Probability and Statistics

Counting and probability:

- Permutations: $P(n,r)=n!/(n-r)!$; combinations: $C(n,r)=n!/([r!](n-r)!]$
- Binomial theorem: $(a+b)^n=\sum C(n,k)a^{n-k}b^k$
- Classical probability: $P(A)=\text{favorable outcomes}/\text{total outcomes}$
- $P(A \cup B)=P(A)+P(B)-P(A \cap B)$; independent events: $P(A \cap B)=P(A)P(B)$
- Conditional probability: $P(A|B)=P(A \cap B)/P(B)$

Statistics:

- Mean: $\bar{x}=(x_1+x_2+\dots+x_n)/n$
 - Variance: $s^2=\sum(x_i-\bar{x})^2/n$; standard deviation: $s=\sqrt{s^2}$
 - Weighted mean: $\bar{x}=\sum w_i x_i / \sum w_i$
 - Normal distribution: $X \sim N(\mu, \sigma^2)$, standard score $z=(x-\mu)/\sigma$
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Closing Note

You have now reviewed the core formulas for this subject. Score improvement comes not only from memorizing formulas, but from quickly deciding which formula fits the question and whether its conditions are satisfied.

PrepPals wishes you a calm, confident, and successful exam performance.

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