

Pre-Calculus Formula and Strategy Guide

Functions, trigonometry, polynomial and rational behavior, exponentials and logs, and the vocabulary of limits that calculus assumes you already know. Work a section, then try the matching questions in the practice worksheet.

SECTIONS	5	WORKED EXAMPLES	4	FORMAT	Print friendly
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How to use this guide

A formula you cannot place is not knowledge yet. Work the recall drill below before the questions.

- Sketch the graph before answering a question about it — Pre-Calculus rewards a visual first step.
- Know the unit circle exactly; guessing decimal approximations creates avoidable errors.
- Say which function family you're in before choosing a technique.

1. Functions and transformations

NAME	FORMULA	WHEN TO USE
Vertical shift	$f(x) + k$ shifts up k units	A graph moves straight up or down.
Horizontal shift	$f(x - h)$ shifts right h units	A graph moves left or right.
Reflection	$-f(x)$ flips over the x -axis	A graph is mirrored vertically.
Composition	$(f \circ g)(x) = f(g(x))$	One function's output feeds another.
Inverse function	swap x and y , then solve for y	Undoing what a function does.

WORKED EXAMPLE

If $f(x) = x^2$ and $g(x) = x + 3$, find $(f \circ g)(2)$.

1. $g(2) = 2 + 3 = 5$
2. $f(5) = 5^2 = 25$

Check: Composition applies g first, then f , matching the order read right to left.

2. Trigonometric functions

NAME	FORMULA	WHEN TO USE
sin, cos, tan (right triangle)	opposite/hyp, adjacent/hyp, opposite/adjacent	A right triangle's angle is known.
Unit circle: 30-45-60	sin/cos take values $1/2$, $\sqrt{2}/2$, $\sqrt{3}/2$	Exact trig values without a calculator.

NAME	FORMULA	WHEN TO USE
Pythagorean identity	$\sin^2(x) + \cos^2(x) = 1$	Converting between sine and cosine.
Period of sin/cos	2π	How often the graph repeats.
Period of tan	π	Tangent repeats twice as often as sine or cosine.

WORKED EXAMPLE

Find $\sin(60 \text{ degrees})$ and $\cos(60 \text{ degrees})$ exactly.

- 60 degrees is a standard angle
- $\sin(60) = \sqrt{3}/2$
- $\cos(60) = 1/2$

Check: $\sin^2 + \cos^2 = 3/4 + 1/4 = 1$.

3. Polynomial and rational functions

NAME	FORMULA	WHEN TO USE
End behavior (even degree, positive leading coeff.)	both ends rise	Predicting a graph's far-left and far-right behavior.
End behavior (odd degree, positive leading coeff.)	left falls, right rises	Odd-degree polynomials with a positive leading term.
Vertical asymptote	where the denominator = 0 (and numerator doesn't)	A rational function's undefined input.
Horizontal asymptote (deg num = deg denom)	y = ratio of leading coefficients	Predicting long-run behavior of a rational function.
Hole in a graph	a factor cancels from numerator and denominator	A rational function has a removable discontinuity.

WORKED EXAMPLE

Find the vertical asymptote(s) of $f(x) = (x+1)/(x^2-4)$.

- Set denominator to 0: $x^2 - 4 = 0$
- $x = 2$ or $x = -2$
- Numerator does not cancel either factor

Check: Both $x = 2$ and $x = -2$ are vertical asymptotes.

4. Exponential and logarithmic functions

NAME	FORMULA	WHEN TO USE
Exponential growth/decay	$y = a \times b^x$	Growth or decay by a percentage.
Natural exponential	$y = a \times e^{kx}$	Continuous growth or decay, common in science.

NAME	FORMULA	WHEN TO USE
Logarithm as inverse	$\log_b(y) = x \Leftrightarrow b^x = y$	Solving for an exponent.
Change of base	$\log_b(x) = \ln(x)/\ln(b)$	A calculator only computes $\ln$ or $\log$ base 10.

5. Sequences, limits, and modeling

NAME	FORMULA	WHEN TO USE
Limit notation	$\lim$ as x approaches a of $f(x)$	Describing a function's behavior near a point.
Limit at infinity	the value a function approaches as x grows without bound	Long-run behavior of a function.
Arithmetic sequence	$a_n = a_1 + (n-1)d$	A quantity that changes by a constant amount.
Geometric sequence	$a_n = a_1 \times r^{n-1}$	A quantity that changes by a constant ratio.

WORKED EXAMPLE

Find $\lim$ as x approaches infinity of $(3x^2 + 1)/(x^2 - 5)$.

- Degrees of numerator and denominator are equal (both 2)
- Take the ratio of leading coefficients: $3/1$

Check: The limit is 3, matching the horizontal asymptote rule.

Notes and tutor hand-off

Bring this page to your next session so the tutor can start from what actually blocked you.

Which trig value did you have to look up?

One function transformation you keep mixing up:

Worksheet question numbers to review with a tutor:
