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COMPLETE FORMULA REVIEW & TUTORING GUIDE

ALEKS MATH

Master Placement Formula Guide

A complete placement ladder covering Pre-Algebra, Algebra 1, and Algebra 2 formulas students need for ALEKS, ACT-style, and ACCUPLACER-style math readiness.

Formula Snapshot

PRE-ALGEBRA

$$\frac{a}{b} = \frac{c}{d}, \quad d = rt, \quad A = \pi r^2$$

numbers, units, geometry

ALGEBRA 1

$$y = mx + b, \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

lines, systems, quadratics

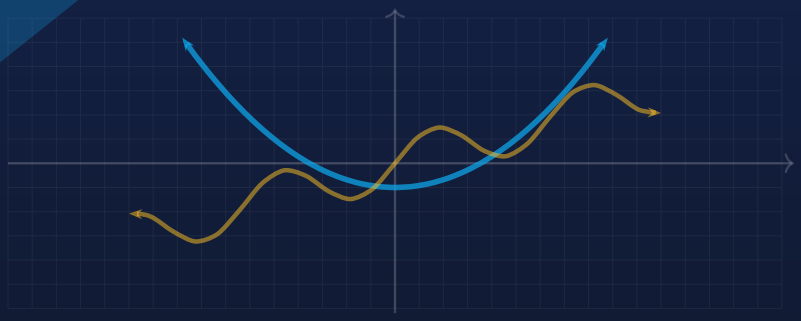
ALGEBRA 2

$$f(g(x)), \quad \log_b x, \quad \sin^2\theta + \cos^2\theta = 1$$

functions, logs, trig

Complete Placement Ladd | Pre-Algebra + Algebra 1 | ACT/ACCUPLACER-Style Breadth

Fractions • Algebra • Functions • Geometry • Conics • Logs • Trigonometry



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Understand it. Practice it. Master it.

Welcome to the ALEKS Math Formula Review

ALEKS Math placement is adaptive, so the exact path changes from student to student. The strongest preparation is broad: Pre-Algebra number sense, Algebra 1 equation and graph fluency, and Algebra 2 function, logarithm, conic, statistics, and trigonometry readiness. Use this guide as a master formula review before practicing mixed ALEKS problems.

USE FIRST
Formula
Read the rule before starting practice.

WATCH FOR
Restrictions
Denominators, signs, units, and the correct whole matter.

THEN TRY
Example
Check one worked example before doing ten problems.

FINISH WITH
Practice
Scan the hub when a topic needs another pass.

Start at the beginning even if you are aiming for a high placement. On ALEKS, small errors with fractions, signs, exponents, units, or restrictions can hide higher-level knowledge. After each section, cover the formulas and explain them out loud before moving on.

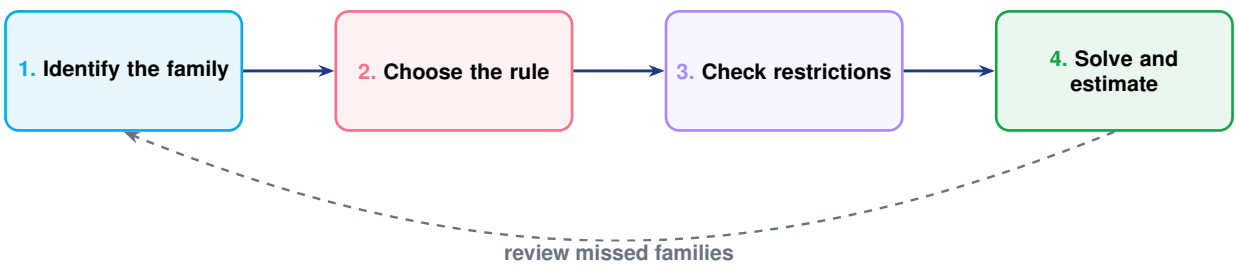
How to read every ALEKS formula section

The tags show how likely the skill is to appear as ALEKS adapts.

CORE	ADVANCED	ADAPTIVE	WATCH
basic placement foundation	college-readiness topic	shows up as the test adjusts	common trap or restriction

The ALEKS placement study loop

The goal is not one memorized sheet; it is flexible recall across levels.



What's Inside

Each section pairs the **formula** with a plain-English **Tutor's Note**, a worked example, and quick watch-outs.

1 ALEKS Placement Roadmap

ALEKS placement map ALEKS can move upward when earlier skills are steady. Review the bridge skills, not only the last topic you studied.

Adaptive means your next question depends on what you have shown. A weak fraction, exponent, or factoring habit can block higher placement even when the advanced idea is familiar.

Best ALEKS strategy: make every setup clean: domain, units, signs, denominator restrictions, and graph behavior before calculating.

What ALEKS is really checking

ADAPTIVE

ALEKS is not only checking whether you can remember a formula. It is checking whether you can select the right tool, use it cleanly, and move between representations: table, equation, graph, diagram, unit, and word problem.

Placement Coach

If a question feels too easy, answer it perfectly. If it feels too hard, identify the family first: linear, quadratic, rational, radical, exponential, logarithmic, geometry, or trig.

High-level ALEKS topic families

Pre-Algebra	whole numbers, factors, fractions, decimals, percents, ratios, rates, units, geometry, data
Algebra 1	expressions, equations, inequalities, lines, systems, exponents, factoring, quadratics
Algebra 2	functions, transformations, inverses, rational expressions, radicals, logs, sequences, conics
Geometry and trig	area, volume, coordinate geometry, circles, right triangles, unit circle, trig graphs
Data and modeling	statistics, probability, counting, word-problem translation, growth and decay models

Coverage promise This ALEKS guide intentionally includes the formula base of the Pre-Algebra, Algebra 1, and Algebra 2 guides because ALEKS can climb across all three levels when your answers are strong.

2 Numbers, Fractions, Decimals, and Percents

Core number formulas and conversions

Fraction operations	$\frac{a}{b}+\frac{c}{d}=\frac{ad+bc}{bd}, \quad \frac{a}{b}\cdot\frac{c}{d}=\frac{ac}{bd}, \quad \frac{a}{b}\div\frac{c}{d}=\frac{a}{b}\cdot\frac{d}{c}$
Percent	$\text{part}=\text{percent}\cdot\text{whole}, \quad \text{percent}=\frac{\text{part}}{\text{whole}}\cdot 100\%$
Percent change	$\%\ \text{change}=\frac{\text{new}-\text{old}}{\text{old}}\cdot 100\%$
Ratio/proportion	$\frac{a}{b}=\frac{c}{d}\Rightarrow ad=bc$
Average	$\text{mean}=\frac{\text{sum of values}}{\text{number of values}}$
Distance/rate/time	$d=rt$

Quick Example

If 18 is 30% of a number, then

$$18=0.30x \quad \Rightarrow \quad x=60.$$

The whole is bigger than the part, so 60 is reasonable.

Tutor Check

ALEKS often hides percent questions inside discounts, markups, tax, interest, mixtures, or unit rates. Always name the whole before calculating.

Signed numbers and order

CORE WATCH

Use PEMDAS, but do not ignore signs: $-3^2 = -(3^2) = -9$ while $(-3)^2 = 9$. Absolute value is distance from zero: $|a| \geq 0$.

3 Whole Numbers, Factors, Units, and Pre-Algebra Essentials

Properties, factors, and divisibility

Order of operations	Parentheses, exponents, multiply/divide left to right, then add/subtract left to right
Commutative	$a + b = b + a$ and $ab = ba$
Associative	$(a + b) + c = a + (b + c)$ and $(ab)c = a(bc)$
Distributive	$a(b + c) = ab + ac$
Identity	$a + 0 = a$ and $a \cdot 1 = a$
Inverse	$a + (-a) = 0$ and $a \cdot \frac{1}{a} = 1$ for $a \neq 0$
GCF	largest factor shared by the numbers; use it to simplify or factor
LCM	smallest positive shared multiple; use it for common denominators
GCF-LCM connection	for positive integers, $\gcd(a, b) \cdot \operatorname{lcm}(a, b) = ab$
Prime	whole number greater than 1 with exactly two factors
Divisibility	by 2 if even; by 3 or 9 if digit sum works; by 5 if ending 0 or 5

GCF/LCM

$$24 = 2^3 \cdot 3, \qquad 36 = 2^2 \cdot 3^2$$

$$\gcd = 2^2 \cdot 3 = 12, \qquad \operatorname{lcm} = 2^3 \cdot 3^2 = 72.$$

Pre-Algebra Gatekeeper

When ALEKS gives a simple-looking number problem, treat it seriously. GCF, LCM, place value, and order of operations are often pre-requisites for later algebra questions.

Measurement and unit conversions

Customary length	12 in $= 1$ ft, 3 ft $= 1$ yd, 5280 ft $= 1$ mi
Customary weight	16 oz $= 1$ lb, 2000 lb $= 1$ ton
Customary capacity	8 fl oz $= 1$ cup, 2 cups $= 1$ pt, 2 pt $= 1$ qt, 4 qt $= 1$ gal
Metric length	10 mm $= 1$ cm, 100 cm $= 1$ m, 1000 m $= 1$ km
Metric mass/capacity	1000 mg $= 1$ g, 1000 g $= 1$ kg, 1000 mL $= 1$ L
Metric prefixes	kilo $= 1000$, centi $= \frac{1}{100}$, milli $= \frac{1}{1000}$
Time	60 s $= 1$ min, 60 min $= 1$ hr, 24 hr $= 1$ day
Temperature	$F = \frac{9}{5}C + 32$, $C = \frac{5}{9}(F - 32)$

Unit-conversion habit

CORE ADAPTIVE

Multiply by conversion fractions equal to 1. Put the unit you want to cancel on the bottom and the unit you want to keep on top.

Unit Conversion

$$3 \text{ yd} \times \frac{3 \text{ ft}}{1 \text{ yd}} \times \frac{12 \text{ in}}{1 \text{ ft}} = 108 \text{ in}$$

4 Algebra Foundations

Expression and equation toolkit

Distributive property	$a(b+c) = ab + ac$
Like terms	combine terms with the same variable and exponent
One-step equations	$x + a = b \Rightarrow x = b - a, \quad ax = b \Rightarrow x = \frac{b}{a}$
Multi-step equations	clear parentheses, combine like terms, then isolate the variable
Inequality rule	flip the inequality when multiplying or dividing by a negative
Absolute value	$\lvert x - a \rvert = b \Rightarrow x = a \pm b$ when $b \geq 0$

Equation Example

$$3(x-4)+2=17$$

$$3x-12+2=17, \quad 3x=27, \quad x=9.$$

Inequality Example

$$-2x+5<13 \Rightarrow -2x<8 \Rightarrow x>-4.$$

The symbol flips because we divided by -2.

Adaptive Trap

An algebra mistake early can make ALEKS stop offering stronger topics. Show clean steps even on simple equations so every sign and inverse operation is under control.

5 Literal Equations, Inequalities, and Absolute Value

Equation-solving patterns

Two-step linear equation	$ax + b = c \Rightarrow ax = c - b \Rightarrow x = \frac{c-b}{a}$, $a \neq 0$
Variables on both sides	collect variable terms on one side and constants on the other
Literal equation	solve for one variable by undoing operations while treating other letters as constants
Formula rearranging	$d = rt \Rightarrow r = \frac{d}{t}$ and $t = \frac{d}{r}$ when denominators are nonzero
Inequality interval	$a < x < b$ means x is between a and b
Union	"or" means combine solution regions
Intersection	"and" means overlap solution regions
Absolute value equation	$\lvert x - a \rvert = b \Rightarrow x = a - b$ or $x = a + b$ when $b \geq 0$
Absolute value less than	$\lvert x - a \rvert < b \Rightarrow a - b < x < a + b$ when $b > 0$
Absolute value greater than	$\lvert x - a \rvert > b \Rightarrow x < a - b$ or $x > a + b$ when $b > 0$
No solution case	$\lvert x - a \rvert = b$ has no solution if $b < 0$

Literal Formula

Solve $A = \frac{1}{2}bh$ for h:

$$2A = bh, \qquad h = \frac{2A}{b} \quad (b \neq 0).$$

Absolute Value

$$\lvert x - 5 \rvert \leq 3$$

means x is within 3 units of 5, so

$$2 \leq x \leq 8.$$

Graphing inequality answers

CORE WATCH

Closed dots mean the endpoint is included: $\leq$ or $\geq$. Open dots mean the endpoint is not included: $<$ or $>$.

6 Lines, Slope, and Systems

Linear formulas

Slope	$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{rise}}{\text{run}}$
Slope-intercept form	$y = mx + b$
Point-slope form	$y - y_1 = m(x - x_1)$
Standard form	$Ax + By = C$
Parallel lines	same slope
Perpendicular lines	slopes multiply to -1
Midpoint	$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
Distance	$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Line Example

Through $(2, 5)$ with slope -3:

$$y - 5 = -3(x - 2) \Rightarrow y = -3x + 11.$$

System Example

If $y = 2x + 1$ and $y = -x + 7$, then

$$2x + 1 = -x + 7 \Rightarrow 3x = 6 \Rightarrow x = 2,\ y = 5.$$

Graph meaning

ADAPTIVE

Slope is rate of change. The y-intercept is the starting value when $x = 0$. The solution to a system is the intersection point of the graphs.

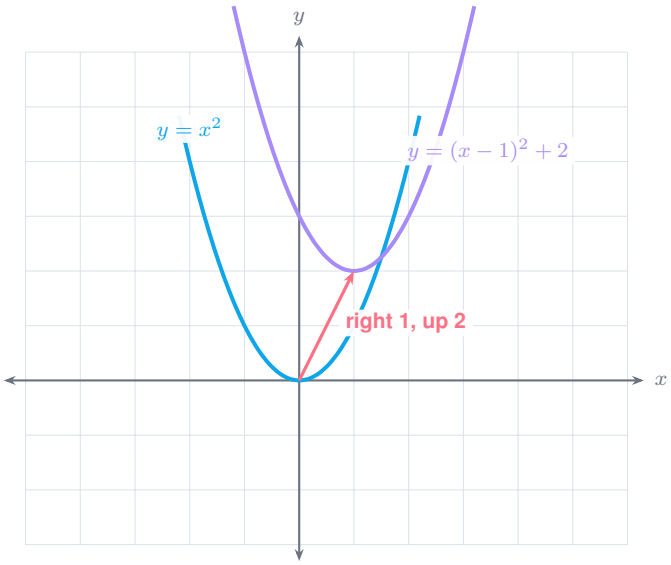
7 Parent Functions, Piecewise Rules, and Graph Behavior

Parent functions and key features

Constant	$f(x) = c$; horizontal line, slope 0
Linear	$f(x) = x$; domain and range are all real numbers
Absolute value	$f(x) = \lvert x \rvert$; V-shape with vertex $(0, 0)$ and range $y \geq 0$
Quadratic	$f(x) = x^2$; parabola with vertex $(0, 0)$ and range $y \geq 0$
Cubic	$f(x) = x^3$; increasing S-shape through the origin
Square root	$f(x) = \sqrt{x}$; domain $x \geq 0$, range $y \geq 0$
Cube root	$f(x) = \sqrt[3]{x}$; domain and range are all real numbers
Reciprocal	$f(x) = \frac{1}{x}$; domain $x \neq 0$, vertical asymptote $x = 0$, horizontal asymptote $y = 0$
Exponential	$f(x) = a^x$ with $a > 0$, $a \neq 1$; domain all real, range $y > 0$
Logarithmic	$f(x) = \log_a x$ with $a > 0$, $a \neq 1$; domain $x > 0$, range all real

Function transformations

Use the parent graph first, then apply shifts, stretches, and reflections.



Transformation rules

$f(x) + k$: up k, $f(x - h)$: right h

$-f(x)$: reflect over x-axis

$f(-x)$: reflect over y-axis

Tip: Inside changes affect x-values and often feel backward.

Graph transformations and function operations

Vertical shift	$f(x)+k$ moves up k; $f(x)-k$ moves down k
Horizontal shift	$f(x-h)$ moves right h; $f(x+h)$ moves left h
Vertical reflection	$-f(x)$ reflects over the x-axis
Horizontal reflection	$f(-x)$ reflects over the y-axis
Vertical stretch	$af(x)$ stretches if $\lvert a\rvert > 1$ and shrinks if $0 < \lvert a\rvert < 1$
Piecewise function	use the formula whose condition contains the input
Increasing/decreasing	read left to right: outputs rise for increasing and fall for decreasing
Intercepts	y-intercept: set $x=0$; x-intercepts or zeros: set $y=0$
Average rate of change	$\frac{f(b)-f(a)}{b-a}$ compares output change to input change

Piecewise

If

$$f(x)=\begin{cases}2x+1, & x<3\\ x^2, & x\geq 3,\end{cases}$$

then $f(2)=5$ but $f(3)=9$.

Function Coach

On ALEKS, a graph question may be asking for domain, range, intercepts, zeros, maximum, minimum, or behavior. Name the feature before calculating.

8 Exponents, Radicals, and Scientific Notation

Power and radical rules

Product rule	$a^m a^n = a^{m+n}$
Quotient rule	$\frac{a^m}{a^n} = a^{m-n}$, $a \neq 0$
Power rule	$(a^m)^n = a^{mn}$
Negative exponent	$a^{-n} = \frac{1}{a^n}$, $a \neq 0$
Zero exponent	$a^0 = 1$, $a \neq 0$
Rational exponent	$a^{m/n} = \sqrt[n]{a^m}$
Radical product	$\sqrt{ab} = \sqrt{a}\sqrt{b}$ for nonnegative a, b
Scientific notation	$a \times 10^n$ where $1 \leq a < 10$

Simplify

$$\frac{x^5 y^{-2}}{x^2 y^3} = x^3 y^{-5} = \frac{x^3}{y^5}.$$

Restriction Check

Even roots usually need nonnegative radicands in real-number ALEKS questions. Denominators cannot be zero.

Rational exponents bridge

ADVANCED

Rational exponents connect algebra and radicals: $27^{2/3} = (\sqrt[3]{27})^2 = 3^2 = 9$.

9 Advanced Radicals and Rational Exponents

Radical rules ALEKS can build on

Root-index meaning	$\sqrt[n]{a} = b$ means $b^n = a$
Even roots	for real numbers, $\sqrt[n]{x}$ with even n requires $x \geq 0$
Odd roots	odd roots allow negative radicands, such as $\sqrt[3]{-8} = -2$
nth root of a power	$\sqrt[n]{a^n} = a$ if n is odd; $\sqrt[n]{a^n} = \lvert a \rvert$ if n is even
Rational exponent	$a^{m/n} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$ when defined
Negative rational exponent	$a^{-m/n} = \frac{1}{a^{m/n}}$ when $a^{m/n} \neq 0$
Simplifying radicals	factor out perfect powers: $\sqrt{72} = \sqrt{36 \cdot 2} = 6\sqrt{2}$
Like radicals	combine only radicals with the same simplified radicand and index
Rationalize simple denominator	$\frac{a}{\sqrt{b}} \cdot \frac{\sqrt{b}}{\sqrt{b}} = \frac{a\sqrt{b}}{b}$
Conjugates	$(a + \sqrt{b})(a - \sqrt{b}) = a^2 - b$
Radical equations	isolate the radical, raise both sides to the index power, solve, then check

Rational Exponent

$$16^{3/4} = (\sqrt[4]{16})^3 = 2^3 = 8.$$

Rationalizing

$$\frac{5}{2+\sqrt{3}} \cdot \frac{2-\sqrt{3}}{2-\sqrt{3}} = \frac{5(2-\sqrt{3})}{4-3} = 10 - 5\sqrt{3}.$$

Extraneous Answers

Squaring both sides can create answers that do not satisfy the original equation. Plug radical-equation answers back before trusting them.

10 Polynomials, Factoring, and Quadratics

Polynomial and quadratic toolkit

FOIL	$(a+b)(c+d) = ac + ad + bc + bd$
Difference of squares	$a^2 - b^2 = (a-b)(a+b)$
Perfect square trinomials	$a^2 + 2ab + b^2 = (a+b)^2, \quad a^2 - 2ab + b^2 = (a-b)^2$
Quadratic formula	$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ for $ax^2 + bx + c = 0$
Discriminant	$D = b^2 - 4ac$
Vertex form	$y = a(x-h)^2 + k$
Axis of symmetry	$x = -\frac{b}{2a}$

Factoring

$$x^2 - 9 = (x-3)(x+3).$$

$$x^2 + 7x + 12 = (x+3)(x+4).$$

Quadratic Meaning

If $D > 0$, two real solutions. If $D = 0$, one repeated real solution. If $D < 0$, no real solutions.

Quadratic graph clues

ADAPTIVE ADVANCED

The sign of a controls opening direction. The vertex gives the minimum or maximum. Zeros are x-intercepts, so factoring and graphing are connected.

Quadratic method chooser Factor when the trinomial is friendly, use square roots when the equation is already in squared form, complete the square to reveal a vertex, and use the quadratic formula when no easier method is obvious.

11 Complex Numbers and Higher-Degree Polynomials

Complex-number formulas

Imaginary unit	$i^2 = -1$ and $\sqrt{-a} = i\sqrt{a}$ for $a > 0$
Powers of i	$i, -1, -i, 1$ cycle every four powers
Complex number	$a + bi$ has real part a and imaginary part b
Complex conjugate	the conjugate of $a + bi$ is $a - bi$
Conjugate product	$(a + bi)(a - bi) = a^2 + b^2$
Complex roots	if a polynomial has real coefficients and $a + bi$ is a root, then $a - bi$ is also a root
Quadratic with $D < 0$	$ax^2 + bx + c = 0$ has two complex conjugate solutions

Polynomial operations and graph facts

Degree	largest exponent after the polynomial is simplified
Leading coefficient	coefficient of the highest-degree term; controls end behavior with degree
Square of binomial	$(a \pm b)^2 = a^2 \pm 2ab + b^2$
Sum of cubes	$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
Difference of cubes	$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
Division algorithm	$P(x) = D(x)Q(x) + R(x)$, where $\deg R < \deg D$
Remainder theorem	dividing $P(x)$ by $x - c$ leaves remainder $P(c)$
Factor theorem	$x - c$ is a factor of $P(x)$ exactly when $P(c) = 0$
Rational root candidates	$\pm\frac{p}{q}$, where p divides the constant and q divides the leading coefficient
Multiplicity	even multiplicity touches/bounces; odd multiplicity crosses
Fundamental theorem	a degree-n polynomial has n complex roots counting multiplicity

End behavior shortcut

ADVANCED

Even degree: both ends point the same way. Odd degree: ends point opposite ways. A positive leading coefficient sends the right end up; a negative one sends it down.

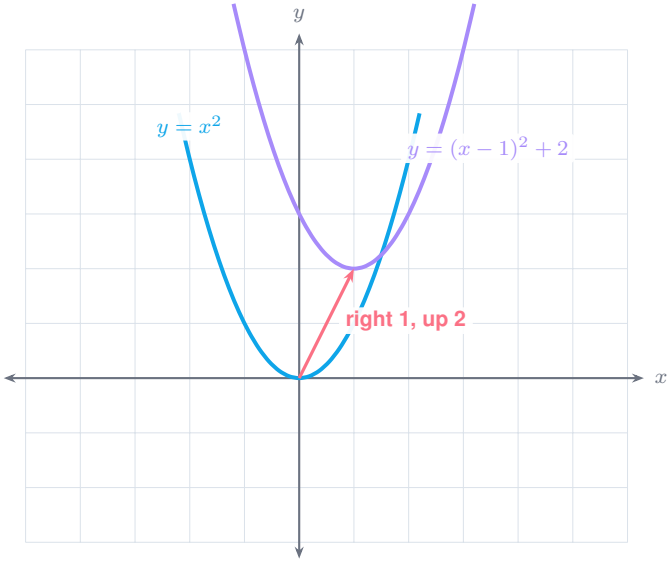
Remainder and factor shortcut

ADVANCED

For $P(x) = x^3 - 4x + 1$, division by $x - 2$ leaves $P(2) = 8 - 8 + 1 = 1$. If $P(c) = 0$, then $x - c$ is a factor.

12 Functions, Domain, Inverses, and Transformations

Function transformations Use the parent graph first, then apply shifts, stretches, and reflections.



Transformation rules

$f(x) + k$: up k, $f(x - h)$: right h

$-f(x)$: reflect over x-axis

$f(-x)$: reflect over y-axis

Tip: Inside changes affect x-values and often feel backward.

Function setup checklist Identify the input, check the domain, choose the correct rule, then decide whether the question asks for a value, an intercept, a rate of change, an inverse, or a graph shift.

Function rules ALEKS likes

Function notation	$f(a)$ means substitute a for every x
Domain	allowed input values
Range	possible output values
Composition	$(f \circ g)(x) = f(g(x))$
Inverse	swap x and y, then solve for y
Average rate of change	$\frac{f(b)-f(a)}{b-a}$
Even function	$f(-x) = f(x)$
Odd function	$f(-x) = -f(x)$

Composition

If $f(x) = 2x - 1$ and $g(x) = x^2 + 3$, then

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

Domain Habit

Before simplifying, ask: does a denominator become zero? does an even root get a negative input? Those restrictions stay with the problem.

13 Rational Expressions and Variation

Rational expression rules

Cancel factors, not terms	$\frac{x(x+2)}{x} = x + 2$, but $\frac{x+2}{x}$ does not become 2
Excluded values	set every original denominator not equal to zero
Multiply rational expressions	factor first, then cancel common factors
Add rational expressions	use a common denominator
Direct variation	$y = kx$
Inverse variation	$y = \frac{k}{x}$
Joint variation	$z = kxy$

Restriction Example

$$\frac{x^2 - 9}{x - 3} = \frac{(x - 3)(x + 3)}{x - 3} = x + 3, \quad x \neq 3.$$

Most Common Error

ALEKS rational questions often test whether you remember the original restriction after simplifying. Write excluded values before canceling.

Solving rational equations

ADVANCED

Multiply every term by the least common denominator, solve the resulting equation, then reject any solution that makes an original denominator zero.

14 Exponential and Logarithmic Rules

Exponential and logarithm formulas

Exponential growth/decay	$y = a(1+r)^t$ or $y = ab^t$
Log definition	$\log_b x = y \iff b^y = x$
Product rule	$\log_b(MN) = \log_b M + \log_b N$
Quotient rule	$\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$
Power rule	$\log_b(M^p) = p\log_b M$
Change of base	$\log_b a = \frac{\log a}{\log b}$
Natural log	$\ln x = \log_e x$

Log Rewrite

$$\log_3 81 = 4$$

because

$$3^4 = 81.$$

Growth

$$P = 500(1.06)^t$$

means an initial 500 grows by 6% each period.

Log restrictions

ADVANCED WATCH

For real logarithms, the argument must be positive and the base must be positive but not 1: $\log_b(x-a)$ requires $x - a > 0$.

15 Sequences, Series, Counting, and the Binomial Theorem

Sequences and series

Arithmetic sequence	$a_n = a_1 + (n-1)d$
Arithmetic common difference	$d = a_n - a_{n-1}$
Arithmetic series	$S_n = \frac{n}{2}(a_1 + a_n) = \frac{n}{2}(2a_1 + (n-1)d)$
Geometric sequence	$a_n = a_1 r^{n-1}$
Geometric common ratio	$r = \frac{a_n}{a_{n-1}}$ when $a_{n-1} \neq 0$
Finite geometric series	$S_n = \frac{a_1(1-r^n)}{1-r}$, $r \neq 1$
Infinite geometric series	$S_\infty = \frac{a_1}{1-r}$ only when $\lvert r \rvert < 1$
Sigma notation	$\sum_{k=1}^{n} a_k = a_1 + a_2 + \cdots + a_n$

Counting and binomial formulas

Factorial	$n! = n(n-1)(n-2)\cdots 1$ and $0! = 1$
Fundamental counting principle	multiply the number of choices at each independent stage
Permutation	${}_nP_r = \frac{n!}{(n-r)!}$ when order matters
Combination	${}_nC_r = \binom{n}{r} = \frac{n!}{r!(n-r)!}$ when order does not matter
Binomial coefficient	$\binom{n}{k}$ is the coefficient pattern in row n of Pascal's triangle
Binomial theorem	$(x+y)^n = \sum_{k=0}^{n} \binom{n}{k} x^{n-k} y^k$

Pattern ID

$5, 9, 13, 17, \ldots$ is arithmetic because it adds 4.

$$a_n = 5 + (n-1)4 = 4n + 1.$$

Combination

Choose 3 students from 8:

$$\binom{8}{3} = \frac{8!}{3!5!} = 56.$$

Pattern Coach

Arithmetic means repeated addition. Geometric means repeated multiplication. Decide the pattern before choosing the formula.

16 Geometry, Measurement, and Circles

Geometry formulas

Rectangle	$A = lw, \quad P = 2l + 2w$
Triangle	$A = \frac{1}{2}bh$
Circle	$A = \pi r^2, \quad C = 2\pi r = \pi d$
Pythagorean theorem	$a^2 + b^2 = c^2$
Rectangular prism	$V = lwh$
Cylinder	$V = \pi r^2 h, \quad SA = 2\pi r^2 + 2\pi rh$
Cone	$V = \frac{1}{3}\pi r^2 h$
Sphere	$V = \frac{4}{3}\pi r^3, \quad SA = 4\pi r^2$
Circle equation	$(x - h)^2 + (y - k)^2 = r^2$

Circle Equation

$$(x - 2)^2 + (y + 5)^2 = 16$$

has center $(2, -5)$ and radius 4.

Units

Linear measure uses units, area uses square units, and volume uses cubic units. If the units do not match, convert before substituting.

Similarity and scale factor

ADAPTIVE

If lengths scale by k, areas scale by k^2 and volumes scale by k^3.

17 Angles, Polygons, Coordinate Geometry, and Conics

Angle and polygon facts

Right angle	90°
Straight angle	180°
Full turn	360°
Complementary angles	two angles that add to 90°
Supplementary angles	two angles that add to 180°
Vertical angles	opposite angles made by intersecting lines are equal
Triangle angle sum	interior angles add to 180°
Quadrilateral angle sum	interior angles add to 360°
Polygon angle sum	for n sides, interior angle sum is $(n-2)180^\circ$
Regular polygon angle	each interior angle is $\frac{(n-2)180^\circ}{n}$
Exterior angles	one exterior angle at each vertex adds to 360°

Angle Setup

If two angles are supplementary and one is $4x + 10$ while the other is $2x + 20$,

$$(4x + 10) + (2x + 20) = 180$$

$$6x + 30 = 180, \qquad x = 25.$$

Angle Coach

Most ALEKS angle problems are equation problems in disguise. Identify the angle relationship, write the sum or equality, then solve for the variable.

Parallel-line angle reminders Corresponding angles match, alternate interior angles match, alternate exterior angles match, and same-side interior angles add to 180°.

Regular-polygon shortcut CORE

Find the exterior angle first when the figure is regular: exterior angle $= \frac{360^\circ}{n}$, then interior angle $= 180^\circ -$ exterior angle.

Scan Me

Coordinate geometry and conic formulas

Midpoint	$M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
Distance	$d = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$
Circle standard form	$(x-h)^2+(y-k)^2=r^2$
Circle general form	$x^2+y^2+Dx+Ey+F=0$; complete the square to find center and radius
Vertical parabola	$(x-h)^2=4p(y-k)$; focus $(h,k+p)$; directrix $y=k-p$
Horizontal parabola	$(y-k)^2=4p(x-h)$; focus $(h+p,k)$; directrix $x=h-p$
Ellipse	$\frac{(x-h)^2}{a^2}+\frac{(y-k)^2}{b^2}=1$; larger denominator gives major axis
Ellipse foci	$c^2=a^2-b^2$
Horizontal hyperbola	$\frac{(x-h)^2}{a^2}-\frac{(y-k)^2}{b^2}=1$
Vertical hyperbola	$\frac{(y-k)^2}{a^2}-\frac{(x-h)^2}{b^2}=1$
Hyperbola foci/asymptotes	$c^2=a^2+b^2$; asymptotes come from the rectangle slopes

Polygon

The interior-angle sum of an octagon is

$$(8-2)180^\circ = 1080^\circ.$$

Conic

$$(x-4)^2+(y+1)^2=36$$

has center $(4,-1)$ and radius 6.

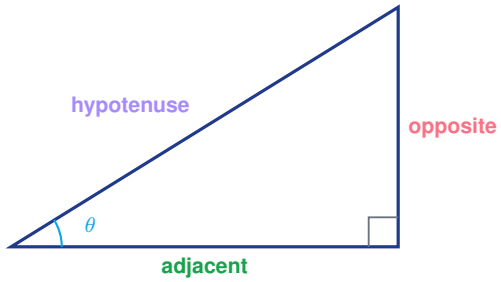
Conic decoder

ADVANCED

One squared variable usually means a parabola. Two squared variables added usually mean a circle or ellipse. Two squared variables subtracted usually mean a hyperbola.

18 Trigonometry Essentials

Right-triangle trig snapshot Label opposite, adjacent, and hypotenuse before choosing a ratio.



SOH-CAH-TOA

$$\sin\theta = \frac{\text{opp}}{\text{hyp}}, \quad \cos\theta = \frac{\text{adj}}{\text{hyp}}, \quad \tan\theta = \frac{\text{opp}}{\text{adj}}$$

$$\sin^2\theta + \cos^2\theta = 1$$

Trig formulas and facts

SOH-CAH-TOA	$\sin\theta = \frac{opp}{hyp}, \quad \cos\theta = \frac{adj}{hyp}, \quad \tan\theta = \frac{opp}{adj}$
Reciprocal identities	$\csc\theta = \frac{1}{\sin\theta}, \quad \sec\theta = \frac{1}{\cos\theta}, \quad \cot\theta = \frac{1}{\tan\theta}$
Pythagorean identity	$\sin^2\theta + \cos^2\theta = 1$
Tangent identity	$\tan\theta = \frac{\sin\theta}{\cos\theta}$
Degrees/radians	$180^\circ = \pi$ radians
Arc length	$s = r\theta$ when θ is in radians
Special angles	$30^\circ, 45^\circ, 60^\circ$ triangles give exact values

Exact Value

For a 45°-45°-90° triangle,

$$\sin 45^\circ = \cos 45^\circ = \frac{\sqrt{2}}{2}.$$

Trig Placement Tip

ALEKS trig problems usually reward careful labeling before memorized identities. Draw a quick triangle or unit-circle sign check.

Special-angle memory check

Angle	$\sin\theta$	$\cos\theta$	$\tan\theta$
$30°$	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{3}}{3}$
$45°$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$	1
$60°$	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$

Sign check: Quadrant I all positive; Quadrant II sine positive; Quadrant III tangent positive; Quadrant IV cosine positive.

Radians and graph reminders

$$360° = 2\pi, \quad 180° = \pi, \quad 90° = \frac{\pi}{2}$$

period of $\sin x$ and $\cos x = 2\pi$, period of $\tan x = \pi$

For a quick graph sketch, mark the amplitude, period, intercepts, and asymptotes. For inverse trig, check that the answer is in the requested interval or principal range.

19 Trigonometry Reference: Unit Circle, Graphs, and Identities

Unit-circle and triangle formulas

Radians/degrees	$\theta_{\text{rad}} = \theta_{\text{deg}}\frac{\pi}{180}$ and $\theta_{\text{deg}} = \theta_{\text{rad}}\frac{180}{\pi}$
Coterminal angles	$\theta + 2\pi k$ or $\theta + 360°k$ for any integer k
Reference angle	acute angle between the terminal side and the x-axis
Unit circle point	$(\cos\theta, \sin\theta)$
Tangent on unit circle	$\tan\theta = \frac{\sin\theta}{\cos\theta}$ when $\cos\theta \neq 0$
Arc length	$s = r\theta$ with θ in radians
Sector area	$A = \frac{1}{2}r^2\theta$ with θ in 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 with trig	$K = \frac{1}{2}ab\sin C$

Trig graph and identity formulas

Sine/cosine model	$y = A\sin(B(x - C)) + D$ or $y = A\cos(B(x - C)) + D$
Amplitude	$\lvert A\rvert$
Period	$\frac{2\pi}{\lvert B\rvert}$ for sine/cosine; $\frac{\pi}{\lvert B\rvert}$ for tangent
Phase shift	C
Midline	$y = D$
Frequency	$\frac{1}{\text{period}}$
Pythagorean identities	$\sin^2 x + \cos^2 x = 1;\quad 1 + \tan^2 x = \sec^2 x;\quad 1 + \cot^2 x = \csc^2 x$
Cofunctions	$\sin(\frac{\pi}{2} - x) = \cos x$ and $\cos(\frac{\pi}{2} - x) = \sin x$
Double angle	$\sin 2x = 2\sin x \cos x;\quad \cos 2x = \cos^2 x - \sin^2 x$
Inverse sine	range $-\frac{\pi}{2} \le y \le \frac{\pi}{2}$
Inverse cosine	range $0 \le y \le \pi$
Inverse tangent	range $-\frac{\pi}{2} < y < \frac{\pi}{2}$

Graph

For $y = 3\sin(2x) - 4$, amplitude $= 3$, period $= \pi$, and midline is $y = -4$.

Identity Strategy

To simplify a trig expression, rewrite everything in sine and cosine first. Do not treat an identity like an equation to solve unless the problem asks for solutions.

Quadrant sign memory Quadrant I: all positive. Quadrant II: sine positive. Quadrant III: tangent positive. Quadrant IV: cosine positive.

20 Statistics, Probability, and Word Problems

Data and probability formulas

Mean	$\bar{x} = \frac{\text{sum}}{n}$
Median	middle value after ordering
Range	maximum − minimum
Weighted average	$\frac{\sum w_i x_i}{\sum w_i}$
Probability	$P(E) = \frac{\text{favorable outcomes}}{\text{total outcomes}}$
Complement	$P(\text{not } E) = 1 - P(E)$
Independent events	$P(A \text{ and } B) = P(A)P(B)$

Weighted Average

Scores $80, 90$ with weights $2, 3$:

$$\frac{2(80) + 3(90)}{2 + 3} = \frac{430}{5} = 86.$$

Word Problem Setup

Translate the situation before calculating: define the unknown, write the units, choose the formula family, then solve.

Common ALEKS word-problem triggers

CORE ADAPTIVE

"per" means a rate, "of" often means multiply, "is" often means equals, "at least" means $\geq$, and "no more than" means $\leq$.

Chart and probability reminders

Read axis labels, units, and scale before calculating. In tables, decide whether the question asks for a total, a difference, a percent, a rate, or a trend.

Probability answers must be between 0 and 1. For "at least one" questions, use the complement when direct counting is messy.

21 Matrices and Advanced Data Formulas

Matrix formulas

Dimensions	an $m \times n$ matrix has m rows and n columns
Matrix addition/subtraction	only matrices with the same dimensions can be added or subtracted
Scalar multiplication	multiply every entry by the scalar
Matrix multiplication	AB is defined when columns of A equal rows of B
Product dimensions	if A is $m \times n$ and B is $n \times p$, then AB is $m \times p$
2×2 determinant	$\det \begin{bmatrix} a & b \\ c & d \end{bmatrix} = ad - bc$
2×2 inverse	$A^{-1} = \frac{1}{ad-bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ when $ad - bc \neq 0$
Matrix equation	$AX = B \Rightarrow X = A^{-1}B$ when A^{-1} exists
Cramer's rule	for a 2×2 system, replace columns with constants and divide determinants

Determinant

$$\det \begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix} = 2(3) - 5(1) = 1,$$

so the matrix has an inverse.

Multiplication Check

If A is 2×3 and B is 3×4, then AB exists and is 2×4. The product BA does not exist.

Matrix Coach

Matrix multiplication is row by column, not entry by entry. Also, order matters: usually $AB \neq BA$.

Matrix readiness check

ADVANCED

Before solving a matrix equation, confirm dimensions work and the determinant is not zero. A zero determinant means no inverse, so A^{-1} cannot be used.

Advanced statistics and probability

Population variance	$\sigma^2 = \frac{\sum(x-\mu)^2}{N}$
Sample variance	$s^2 = \frac{\sum(x-\bar{x})^2}{n-1}$
Standard deviation	square root of variance
Z-score	$z = \frac{x-\mu}{\sigma}$
Addition rule	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$
Conditional probability	$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$ when $P(B) > 0$
Binomial probability	$P(k) = \binom{n}{k} p^k (1-p)^{n-k}$
Expected value	$E = \sum xP(x)$
Correlation	$-1 \le r \le 1$; correlation does not prove causation

Upper Placement Note

Matrices and deeper probability may not appear for every student, but they belong in the ALEKS master guide because the test adapts upward when earlier skills are strong.

Probability sanity check

ADAPTIVE

Every probability must be between 0 and 1. If order matters, use permutations; if order does not matter, use combinations.

22 Final ALEKS Formula Checklist

Last-pass checklist before ALEKS practice

Fractions	Can I add, multiply, divide, and convert without losing signs?
Units	Did I convert units before substituting into a formula?
Percents	Did I identify the whole and convert percent to decimal?
Algebra	Did I distribute, combine like terms, and isolate with inverse operations?
Lines	Can I move between graph, slope, intercept, and equation?
Exponents	Did I use exponent rules before plugging into a calculator?
Factoring	Did I check for GCF, difference of squares, trinomials, and grouping?
Functions	Did I check domain, composition order, inverse steps, and transformations?
Rationals	Did I write excluded values before simplifying?
Sequences	Did I decide arithmetic versus geometric before choosing a formula?
Logs	Did I rewrite between log and exponential form and check positive arguments?
Geometry/conics	Did I label the figure, choose units, and identify the graph family?
Trig	Did I choose triangle, unit-circle, graph, or identity tools correctly?
Data/counting	Did I check whether order matters and whether events overlap?

Best placement habit When you miss a problem, do not only fix that answer. Name the formula family and review the two prerequisite skills below it. That is how you keep ALEKS from finding the same gap again.

Fast translation table

"Find the value"	substitute, simplify, or solve.
"Rate of change"	slope or average rate of change.
"Zeros/roots"	solve where the expression or function equals 0.
"Undefined"	denominator 0, invalid log argument, or invalid even root.
"Maximum/minimum"	vertex or endpoint behavior.
"Equivalent"	simplify, factor, expand, or rewrite without changing value.

EffortlessMath.com

Raise Your ALEKS Placement Score

Review the formula family. Check the restriction. Practice the skill.

FREE ALEKS MATH HUB

Scan for lessons, practice, and next steps

Review the exact ALEKS-style skill until the setup feels automatic, then move into mixed placement practice.

Scan the hub

1
Formula family
linear, quadratic, rational, radical, exponential, log, or trig

2
Restriction check
denominators, roots, logs, domains, units, and signs

3
Mixed practice
prove you can recognize the formula without a topic label

Best loop: formula, example, restriction check, then mixed placement practice. Use the ALEKS hub whenever a prerequisite skill needs one more pass.

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Understand it. Practice it. Master it.

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