Table of Symbols

Symbol		Page
$\ldots$	and so on	3
$\approx$	is approximately equal to	3
$<$	is less than	4
$>$	is greater than	4
$\leq$	is less than or equal to	4
$\geq$	is greater than or equal to	4
$\cdot$	multiplication, times	5
$-a$	opposite of a	5
$\frac{1}{a}$	reciprocal of a, $a \neq 0$	5
$\neq$	not equal to	5
π	pi; irrational number ≈ 3.14	28
$\lvert x \rvert$	absolute value of x	50
(x, y)	ordered pair	67
$f(x)$	f of x, or the value of f at x	69
m	slope	75
x_1	x sub 1	75
$[\![x]\!]$	greatest integer less than or equal to x	115
(x, y, z)	ordered triple	170
$f(x, y)$	function of two variables	171
$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$	matrix	199
$\lvert A \rvert$	determinant of matrix A	214
A^{-1}	inverse of matrix A	223
$\sqrt{a}$	the nonnegative square root of a	264
i	imaginary unit equal to $\sqrt{-1}$	272
$\lvert z \rvert$	absolute value of complex number z	275
$+\infty$	positive infinity	331
$-\infty$	negative infinity	331
$x \to +\infty$	x approaches positive infinity	331
$f(x) \to +\infty$	f of x approaches positive infinity	331
$\sqrt[n]{a}$	nth root of a	401
f^{-1}	inverse of function f	423
$\bar{x}$	x-bar; the mean of a data set	445
σ	sigma; the standard deviation of a data set	446
e	irrational number ≈ 2.718	480
$\log_b y$	base-b logarithm of y	486
$\log x$	base-10 logarithm of x	487
$\ln x$	base-e logarithm of x	487
Σ	summation	653
S_n	sum of the first n terms of an arithmetic or geometric series	661, 668
$n!$	n factorial; number of permutations of n objects	703
${}_nP_r$	number of permutations of r objects from n distinct objects	703
${}_nC_r$	number of combinations of r objects from n distinct objects	708
$P(A)$	probability of event A	716
$P(B \mid A)$	probability of event B given that event A has occurred	732
θ	theta; name of an angle, or measure of an angle	769
sin	sine	769
cos	cosine	769
tan	tangent	769
csc	cosecant	769
sec	secant	769
cot	cotangent	769
$\sin^{-1}$	inverse sine	792
$\cos^{-1}$	inverse cosine	792
$\tan^{-1}$	inverse tangent	792

Table of Measures

Time

60 seconds (sec)	=	1 minute (min)
60 minutes	=	1 hour (h)
24 hours	=	1 day
7 days	=	1 week
4 weeks (approx.)	=	1 month
365 days; 52 weeks (approx.); 12 months	=	1 year
10 years	=	1 decade
100 years	=	1 century

Metric

Length

10 millimeters (mm)	=	1 centimeter (cm)
100 cm; 1000 mm	=	1 meter (m)
1000 m	=	1 kilometer (km)

Area

100 square millimeters (mm^2)	=	1 square centimeter (cm^2)
10,000 cm^2	=	1 square meter (m^2)
10,000 m^2	=	1 hectare (ha)

Volume

1000 cubic millimeters (mm^3)	=	1 cubic centimeter (cm^3)
1,000,000 cm^3	=	1 cubic meter (m^3)

Liquid Capacity

1000 milliliters (mL); 10 deciliters (dL)	=	1 liter (L)
1000 L	=	1 kiloliter (kL)

Mass

1000 milligrams (mg)	=	1 gram (g)
1000 g	=	1 kilogram (kg)
1000 kg	=	1 metric ton (t)

Temperature — Degrees Celsius (°C)

0°C	=	freezing point of water
37°C	=	normal body temperature
100°C	=	boiling point of water

United States Customary

Length

12 inches (in.)	=	1 foot (ft)
36 in.; 3 ft	=	1 yard (yd)
5280 ft; 1760 yd	=	1 mile (mi)

Area

144 square inches ($in.^2$)	=	1 square foot (ft^2)
9 ft^2	=	1 square yard (yd^2)
43,560 ft^2; 4840 yd^2	=	1 acre (A)

Volume

1728 cubic inches ($in.^3$)	=	1 cubic foot (ft^3)
27 ft^3	=	1 cubic yard (yd^3)

Liquid Capacity

8 fluid ounces (fl oz)	=	1 cup (c)
2 c	=	1 pint (pt)
2 pt	=	1 quart (qt)
4 qt	=	1 gallon (gal)

Weight

16 ounces (oz)	=	1 pound (lb)
2000 lb	=	1 ton (t)

Temperature — Degrees Fahrenheit (°F)

32°F	=	freezing point of water
98.6°F	=	normal body temperature
212°F	=	boiling point of water

Table of Formulas

Formulas from Coordinate Geometry	
Slope of a line	$m = \frac{y_2 - y_1}{x_2 - x_1}$ where m is the slope of the nonvertical line through (x_1, y_1) and (x_2, y_2)
Parallel and perpendicular lines	If line l_1 has slope m_1 and line l_2 has slope m_2, then: $l_1 \parallel l_2$ if and only if $m_1 = m_2$; $l_1 \perp l_2$ if and only if $m_1 = -\frac{1}{m_2}$ or $m_1 m_2 = -1$
Distance formula	$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ where d is the distance between points (x_1, y_1) and (x_2, y_2)
Midpoint formula	$M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$ is the midpoint of the line segment joining points (x_1, y_1) and (x_2, y_2)
Formulas from Matrix Algebra	
Determinant of a 2 × 2 matrix	$\det \begin{bmatrix} a & b \\ c & d \end{bmatrix} = ad - cb$
Determinant of a 3 × 3 matrix	$\det \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} = (aei + bfg + cdh) - (gec + hfa + idb)$
Area of a triangle	The area of a triangle with vertices (x_1, y_1), (x_2, y_2), and (x_3, y_3) is given by $\text{Area} = \pm\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ where the appropriate sign (±) should be chosen to yield a positive value.
Cramer's rule	Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ be the coefficient matrix of this linear system: $ax + by = e$, $cx + dy = f$. If $\det A \neq 0$, then the system has exactly one solution. The solution is: $x = \frac{\begin{vmatrix} e & b \\ f & d \end{vmatrix}}{\det A}$ and $y = \frac{\begin{vmatrix} a & e \\ c & f \end{vmatrix}}{\det A}$. Cramer's rule can be extended to a linear system of 3 equations in 3 variables.
Inverse of a 2 × 2 matrix	The inverse of the matrix $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is $A^{-1} = \frac{1}{\lvert A \rvert}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix} = \frac{1}{ad - cb}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ provided $ad - cb \neq 0$.

Formulas and Theorems from Algebra	
Special product patterns	**Sum and difference:** $(a+b)(a-b)=a^2-b^2$ **Square of a binomial:** $(a+b)^2=a^2+2ab+b^2$ $(a-b)^2=a^2-2ab+b^2$ **Cube of a binomial:** $(a+b)^3=a^3+3a^2b+3ab^2+b^3$ $(a-b)^3=a^3-3a^2b+3ab^2-b^3$
Special factoring patterns	Each of the patterns above can be read from right to left as a factoring pattern. In addition, there are two other special factoring patterns: **Sum of two cubes:** $a^3+b^3=(a+b)(a^2-ab+b^2)$ **Difference of two cubes:** $a^3-b^3=(a-b)(a^2+ab+b^2)$
Quadratic formula	$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ where x is a solution of $ax^2+bx+c=0$ and a, b, and c are real numbers such that $a\neq 0$
Discriminant of a quadratic equation	The expression b^2-4ac is called the discriminant of the associated equation $ax^2+bx+c=0$. The value of the discriminant can be positive, zero, or negative, which corresponds to an equation having two real solutions, one real solution, or two imaginary solutions, respectively.
Remainder theorem	If a polynomial $f(x)$ is divided by $x-k$, then the remainder is $r=f(k)$.
Factor theorem	A polynomial $f(x)$ has a factor $x-k$ if and only if $f(k)=0$.
Rational zero theorem	If $f(x)=a_nx^n+\cdots+a_1x+a_0$ has *integer* coefficients, then every rational zero of f has this form: $\frac{p}{q}=\frac{\text{factor of constant term } a_0}{\text{factor of leading coefficient } a_n}$
Fundamental theorem of algebra	If $f(x)$ is a polynomial of degree n where $n>0$, then the equation $f(x)=0$ has at least one solution in the set of complex numbers.
Formulas from Statistics	
Mean of a data set	$\bar{x}=\frac{x_1+x_2+\cdots+x_n}{n}$ where $\bar{x}$ (read "x-bar") is the mean of the data $x_1, x_2, \ldots, x_n$
Standard deviation of a data set	$\sigma=\sqrt{\frac{(x_1-\bar{x})^2+(x_2-\bar{x})^2+\cdots+(x_n-\bar{x})^2}{n}}$ where σ (read "sigma") is the standard deviation of the data $x_1, x_2, \ldots, x_n$
Areas under a normal curve	The mean $\bar{x}$ and standard deviation σ of a normal distribution determine the following areas under the corresponding normal curve. • The total area under the curve is 1. • 68% of the area lies within 1 standard deviation of the mean. • 95% of the area lies within 2 standard deviations of the mean. • 99.7% of the area lies within 3 standard deviations of the mean.
Normal approximation of a binomial distribution	Consider the binomial distribution consisting of n trials with a probability p of success on each trial. If $np\geq 5$ and $n(1-p)\geq 5$, then the binomial distribution can be approximated by a normal distribution with a mean of $\bar{x}=np$ and a standard deviation of $\sigma=\sqrt{np(1-p)}$.

Formulas for Sequences and Series

Explicit rule for an arithmetic sequence	The nth term of an arithmetic sequence with first term a_1 and common difference d is: $a_n = a_1 + (n - 1)d$
Explicit rule for a geometric sequence	The nth term of a geometric sequence with first term a_1 and common ratio r is: $a_n = a_1 r^{n-1}$
Sum of a finite arithmetic series	The sum of the first n terms of an arithmetic series is: $S_n = n\left(\frac{a_1 + a_n}{2}\right)$
Sum of a finite geometric series	The sum of the first n terms of a geometric series with common ratio $r \neq 1$ is: $S_n = a_1\left(\frac{1 - r^n}{1 - r}\right)$
Sum of an infinite geometric series	The sum of an infinite geometric series with first term a_1 and common ratio r is $S = \frac{a_1}{1 - r}$ provided $\|r\| < 1$. If $\|r\| \geq 1$, the series has no sum.
Formulas for sums of special series	1. $\sum_{i=1}^{n} 1 = n$ 2. $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$ 3. $\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$

Formulas from Combinatorics

Fundamental counting principle	If one event can occur in m ways and another event can occur in n ways, then the number of ways that *both* events can occur is $m \cdot n$.
Permutations of n objects taken r at a time	The number of permutations of r objects taken from a group of n distinct objects is denoted by ${}_nP_r$ and is given by: ${}_nP_r = \frac{n!}{(n-r)!}$
Permutations with repetition	The number of distinguishable permutations of n objects where one object is repeated q_1 times, another is repeated q_2 times, and so on is: $\frac{n!}{q_1! \cdot q_2! \cdot \ldots \cdot q_k!}$
Combinations of n objects taken r at a time	The number of combinations of r objects taken from a group of n distinct objects is denoted by ${}_nC_r$ and is given by: ${}_nC_r = \frac{n!}{(n-r)! \cdot r!}$
Pascal's triangle	If you arrange the values of ${}_nC_r$ in a triangular pattern in which each row corresponds to a value of n, you get what is called Pascal's triangle. ${}_0C_0$ — 1 ${}_1C_0$ ${}_1C_1$ — 1 1 ${}_2C_0$ ${}_2C_1$ ${}_2C_2$ — 1 2 1 ${}_3C_0$ ${}_3C_1$ ${}_3C_2$ ${}_3C_3$ — 1 3 3 1 ${}_4C_0$ ${}_4C_1$ ${}_4C_2$ ${}_4C_3$ ${}_4C_4$ — 1 4 6 4 1
Binomial theorem	The binomial expansion of $(a + b)^n$ for any positive integer n is: $(a+b)^n = {}_nC_0a^nb^0 + {}_nC_1a^{n-1}b^1 + {}_nC_2a^{n-2}b^2 + \cdots + {}_nC_na^0b^n = \sum_{r=0}^{n} {}_nC_ra^{n-r}b^r$

Formulas from Probability	
Theoretical probability of an event	When all outcomes are equally likely, the theoretical probability that an event A will occur is: $$P(A) = \frac{\text{number of outcomes in } A}{\text{total number of outcomes}}$$
Probability of compound events	If A and B are two events, then the probability of A or B is: $$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$ If A and B are mutually exclusive, then the probability of A or B is: $$P(A \text{ or } B) = P(A) + P(B)$$
Probability of the complement of an event	The probability of the complement of event A, denoted A', is: $$P(A') = 1 - P(A)$$
Probability of independent events	If A and B are independent, then the probability that both A and B occur is: $$P(A \text{ and } B) = P(A) \cdot P(B)$$
Probability of dependent events	If A and B are dependent, then the probability that both A and B occur is: $$P(A \text{ and } B) = P(A) \cdot P(B \mid A)$$
Binomial probabilities	For a binomial experiment consisting of n trials where the probability of success on each trial is p, the probability of exactly k successes is: $$P(k \text{ successes}) = {}_nC_k p^k (1 - p)^{n-k}$$

Formulas and Identities from Trigonometry	
Conversion between degrees and radians	To rewrite a degree measure in radians, multiply by $\frac{\pi \text{ radians}}{180^\circ}$. To rewrite a radian measure in degrees, multiply by $\frac{180^\circ}{\pi \text{ radians}}$.
Definition of trigonometric functions	Let θ be an angle in standard position and (x, y) be any point (except the origin) on the terminal side of θ. Let $r = \sqrt{x^2 + y^2}$. Then the six trigonometric functions of θ are: $\sin \theta = \frac{y}{r}$ $\quad \cos \theta = \frac{x}{r}$ $\quad \tan \theta = \frac{y}{x}, x \neq 0$ $\quad \csc \theta = \frac{r}{y}, y \neq 0$ $\quad \sec \theta = \frac{r}{x}, x \neq 0$ $\quad \cot \theta = \frac{x}{y}, y \neq 0$
Law of sines	If $\triangle ABC$ has sides of length a, b, and c, then: $$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$
Area of a triangle (given two sides and the included angle)	If $\triangle ABC$ has sides of length a, b, and c, then the area is: $\text{Area} = \frac{1}{2}bc \sin A$ $\quad \text{Area} = \frac{1}{2}ac \sin B$ $\quad \text{Area} = \frac{1}{2}ab \sin C$
Law of cosines	If $\triangle ABC$ has sides of length a, b, and c, then: $$a^2 = b^2 + c^2 - 2bc \cos A$$ $$b^2 = a^2 + c^2 - 2ac \cos B$$ $$c^2 = a^2 + b^2 - 2ab \cos C$$

Formulas and Identities from Trigonometry (continued)	
Heron's area formula	The area of the triangle with sides of length a, b, and c is $\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$ where $s = \frac{1}{2}(a+b+c)$.
Reciprocal identities	$\csc\theta = \frac{1}{\sin\theta}$ $\quad \sec\theta = \frac{1}{\cos\theta}$ $\quad \cot\theta = \frac{1}{\tan\theta}$
Tangent and cotangent identities	$\tan\theta = \frac{\sin\theta}{\cos\theta}$ $\quad \cot\theta = \frac{\cos\theta}{\sin\theta}$
Pythagorean identities	$\sin^2\theta + \cos^2\theta = 1$ $\quad 1 + \tan^2\theta = \sec^2\theta$ $\quad 1 + \cot^2\theta = \csc^2\theta$
Cofunction identities	$\sin\left(\frac{\pi}{2} - \theta\right) = \cos\theta$ $\quad \cos\left(\frac{\pi}{2} - \theta\right) = \sin\theta$ $\quad \tan\left(\frac{\pi}{2} - \theta\right) = \cot\theta$
Negative angle identities	$\sin(-\theta) = -\sin\theta$ $\quad \cos(-\theta) = \cos\theta$ $\quad \tan(-\theta) = -\tan\theta$
Sum formulas	$\sin(u+v) = \sin u\cos v + \cos u\sin v$ $\cos(u+v) = \cos u\cos v - \sin u\sin v$ $\tan(u+v) = \frac{\tan u + \tan v}{1 - \tan u\tan v}$
Difference formulas	$\sin(u-v) = \sin u\cos v - \cos u\sin v$ $\cos(u-v) = \cos u\cos v + \sin u\sin v$ $\tan(u-v) = \frac{\tan u - \tan v}{1 + \tan u\tan v}$
Double-angle formulas	$\cos 2u = \cos^2 u - \sin^2 u$ $\quad \sin 2u = 2\sin u\cos u$ $\cos 2u = 2\cos^2 u - 1$ $\quad \tan 2u = \frac{2\tan u}{1 - \tan^2 u}$ $\cos 2u = 1 - 2\sin^2 u$
Half-angle formulas	$\sin\frac{u}{2} = \pm\sqrt{\frac{1-\cos u}{2}}$ $\quad \tan\frac{u}{2} = \frac{1-\cos u}{\sin u}$ $\cos\frac{u}{2} = \pm\sqrt{\frac{1+\cos u}{2}}$ $\quad \tan\frac{u}{2} = \frac{\sin u}{1+\cos u}$ The signs of $\sin\frac{u}{2}$ and $\cos\frac{u}{2}$ depend on the quadrant in which $\frac{u}{2}$ lies.

Formulas from Mathematical Modeling	
Projectile motion	**Height as a function of time:** $h = -16t^2 + v_0t + h_0$ where h is the height (in feet) of the object t seconds after launch, h_0 is the object's initial height, and v_0 is the object's initial vertical velocity (in feet per second) **Parametric equations for a projectile's path:** $x = (v\cos\theta)t + x_0$ and $y = -\frac{1}{2}gt^2 + (v\sin\theta)t + y_0$ where θ is the angle at which the projectile is launched, v is the initial speed, and (x_0, y_0) is the projectile's location at time $t = 0$. (The constant g is the acceleration due to gravity; its value is 32 ft/sec^2 or 9.8 m/sec^2.)
Compound interest	**Compounded *n* times per year:** $A = P\left(1 + \frac{r}{n}\right)^{nt}$ where A is the amount in the account after t years, P is the initial deposit (called the principal), and r is the annual interest rate (expressed as a decimal) **Compounded continuously:** $A = Pe^{rt}$ where A is the amount in the account after t years, P is the initial deposit (called the principal), and r is the annual interest rate (expressed as a decimal)

Formulas from Geometry

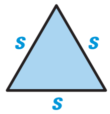
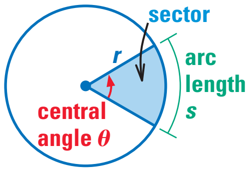
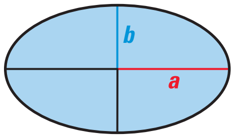
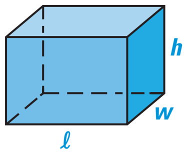
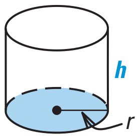
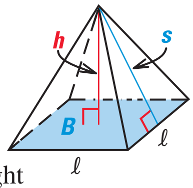
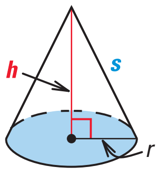
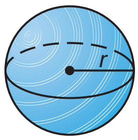
Basic geometric figures	See page 914 for area formulas for basic two-dimensional geometric figures.
Area of an equilateral triangle	Area $= \frac{\sqrt{3}}{4}s^2$ where s is the length of a side 
Arc length and area of a sector	Arc length $= r\theta$ where r is the radius and θ is the radian measure of the central angle that intercepts the arc Area $= \frac{1}{2}r^2\theta$ 
Area of an ellipse	Area $= \pi ab$ where a and b are half the lengths of the major and minor axes of the ellipse 
Volume and surface area of a right rectangular prism	Volume $= \ell wh$ where ℓ is the length, w is the width, and h is the height Surface area $= 2(\ell w + wh + \ell h)$ 
Volume and surface area of a right cylinder	Volume $= \pi r^2h$ where r is the base radius and h is the height Lateral surface area $= 2\pi rh$ Surface area $= 2\pi r^2 + 2\pi rh$ 
Volume and surface area of a right regular pyramid	Volume $= \frac{1}{3}Bh$ where B is the area of the base and h is the height Lateral surface area $= \frac{1}{2}n\ell s$ where n is the number of sides on the base, l is the length of a side of the base, and s is the slant height Surface area $= B + \frac{1}{2}n\ell s$ 
Volume and surface area of a right circular cone	Volume $= \frac{1}{3}\pi r^2h$ where r is the base radius and h is the height Lateral surface area $= \pi rs$ where s is the slant height Surface area $= \pi r^2 + \pi rs$ 
Volume and surface area of a sphere	Volume $= \frac{4}{3}\pi r^3$ where r is the radius Surface area $= 4\pi r^2$ 

Table of Properties

Properties of Real Numbers

	Let a, b, and c be real numbers.	
	Addition	**Multiplication**
Closure Property	$a + b$ is a real number.	ab is a real number.
Commutative Property	$a + b = b + a$	$ab = ba$
Associative Property	$(a + b) + c = a + (b + c)$	$(ab)c = a(bc)$
Identity Property	$a + 0 = a, 0 + a = a$	$a \cdot 1 = a, 1 \cdot a = a$
Inverse Property	$a + (-a) = 0$	$a \cdot \frac{1}{a} = 1, a \neq 0$
Distributive Property	The distributive property involves both addition and multiplication: $a(b + c) = ab + ac$	
Zero Product Property	Let A and B be real numbers or algebraic expressions. If $AB = 0$, then $A = 0$ or $B = 0$.	

Properties of Matrices

	Let A, B, and C be matrices, and let c be a scalar.
Associative Property of Addition	$(A + B) + C = A + (B + C)$
Commutative Property of Addition	$A + B = B + A$
Distributive Property of Addition	$c(A + B) = cA + cB$
Distributive Property of Subtraction	$c(A - B) = cA - cB$
Associative Property of Matrix Multiplication	$(AB)C = A(BC)$
Left Distributive Property of Matrix Multiplication	$A(B + C) = AB + AC$
Right Distributive Property of Matrix Multiplication	$(A + B)C = AC + BC$
Associative Property of Scalar Multiplication	$c(AB) = (cA)B = A(cB)$
Multiplicative Identity	An $n \times n$ matrix with 1's on the main diagonal and 0's elsewhere is an identity matrix, denoted I. For any $n \times n$ matrix A, $AI = IA = A$.
Inverse Matrices	If the determinant of an $n \times n$ matrix A is nonzero, then A has an inverse, denoted A^{-1}, such that $AA^{-1} = A^{-1}A = I$.

Properties of Exponents

	Let a and b be real numbers, and let m and n be integers.
Product of Powers Property	$a^m \cdot a^n = a^{m+n}$
Power of a Power Property	$(a^m)^n = a^{mn}$
Power of a Product Property	$(ab)^m = a^m b^m$
Negative Exponent Property	$a^{-m} = \frac{1}{a^m}, a \neq 0$
Zero Exponent Property	$a^0 = 1, a \neq 0$
Quotient of Powers Property	$\frac{a^m}{a^n} = a^{m-n}, a \neq 0$
Power of a Quotient Property	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$

Properties of Radicals and Rational Exponents

Number of Real nth Roots	Let n be an integer greater than 1, and let a be a real number. • If n is odd, then a has one real nth root: $\sqrt[n]{a} = a^{1/n}$ • If n is even and $a > 0$, then a has two real nth roots: $\pm\sqrt[n]{a} = \pm a^{1/n}$ • If n is even and $a = 0$, then a has one nth root: $\sqrt[n]{0} = 0^{1/n} = 0$ • If n is even and $a < 0$, then a has no real nth roots.
Radicals and Rational Exponents	Let $a^{1/n}$ be an nth root of a, and let m be a positive integer. • $a^{m/n} = (a^{1/n})^m = (\sqrt[n]{a})^m$ • $a^{-m/n} = \frac{1}{a^{m/n}} = \frac{1}{(a^{1/n})^m} = \frac{1}{(\sqrt[n]{a})^m}, a \neq 0$
Properties of Rational Exponents	All of the properties of exponents listed on the previous page apply to rational exponents as well as integer exponents.
Product and Quotient Properties of Radicals	Let n be an integer greater than 1, and let a and b be positive real numbers. Then: $\sqrt[n]{a \cdot b} = \sqrt[n]{a} \cdot \sqrt[n]{b}$ and $\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$

Properties of Logarithms

	Let b, c, x, y, u, and v be positive real numbers such that $b \neq 1$ and $c \neq 1$.
Logarithms and Exponents	$\log_b y = x$ if and only if $b^x = y$
Special Logarithm Values	$\log_b 1 = 0$ because $b^0 = 1$ and $\log_b b = 1$ because $b^1 = b$
Common and Natural Logarithms	$\log_{10} x = \log x$ and $\log_e x = \ln x$
Product Property of Logarithms	$\log_b uv = \log_b u + \log_b v$
Quotient Property of Logarithms	$\log_b \frac{u}{v} = \log_b u - \log_b v$
Power Property of Logarithms	$\log_b u^n = n \log_b u$
Change of Base	$\log_c u = \frac{\log_b u}{\log_b c}$

Properties of Functions

Operations on Functions	Let f and g be any two functions. A new function h can be defined using any of the following operations: **Addition:** $h(x) = f(x) + g(x)$ **Subtraction:** $h(x) = f(x) - g(x)$ **Multiplication:** $h(x) = f(x) \cdot g(x)$ **Division:** $h(x) = \frac{f(x)}{g(x)}$ **Composition:** $h(x) = f(g(x))$ For addition, subtraction, multiplication, and division, the domain of h consists of the x-values that are in the domains of both f and g. Additionally, the domain of a quotient does not include x-values for which $g(x) = 0$. For composition, the domain of h is the set of all x-values such that x is in the domain of g and $g(x)$ is in the domain of f.
Inverse Functions	Functions f and g are inverses of each other provided: $f(g(x)) = x$ and $g(f(x)) = x$