Formula List for College Algebra – Sullivan 10th ed.
DO NOT WRITE ON THIS COPY.

Intercepts: *Learn how to find the x and y intercepts.*

Symmetry: *Learn how "test for symmetry" with respect to the x-axis, y-axis and origin.*

Linear Equation Formulas:

Standard or General Form: $Ax + By = C$

Slope formula: $m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$ *also* $m = \frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{f(b) - f(a)}{b - a} = \frac{f(x+h) - f(x)}{h}$

Slope y-intercept form: $y = mx + b$ *or Linear Function:* $f(x) = mx + b$

Point Slope form: $y = y_1 + m(x - x_1)$ or $y = m(x - x_1) + y_1$

Systems of Linear Equations:

Inconsistent – the system has NO SOLUTIONS (Contradiction)
Dependent – the system has INFINITELY OR MANY SOLUTIONS (Identity)
Consistent – the system has at least ONE SOLUTION (Conditional)
Independent – the system has different lines (may have one solution or none).

Quadratic Equation:

A equation is an equation of the form:

$$ax^2 + bx + c = 0,\ a, b \text{ and } c \text{ are real numbers and } a \neq 0.$$

Square Root Method: *Learn square root method.*

Quadratic Formula:

The solutions of the equation $ax^2 + bx + c = 0$, where $a \neq 0$, are $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

The Discriminant*: For* $ax^2 + bx + c = 0,\ a \neq 0$:

a. If $b^2 - 4ac > 0$, there are two unequal real solutions.

b. If $b^2 - 4ac = 0$, there are "two equal" or "one" real solutions.

c. If $b^2 - 4ac < 0$, there is no real solution.

Zero-Factor principle:

$ab = 0$ if and only if $a = 0$ or $b = 0$.

Factorization Formulas:

The Difference of Two Squares	$A^2 - B^2 = (A + B)(A - B)$
The Sum of Two Squares	$A^2 + B^2 = prime$
The Difference of Two Cubes	$A^3 - B^3 = (A - B)(A^2 + AB + B^2)$

The Sum of Two Cubes $A^3 + B^3 = (A+B)(A^2 - AB + B^2)$

Trinomial Squares – The Square of a Binomial

$$A^2 + 2AB + B^2 = (A+B)(A+B) = (A+B)^2$$

$$A^2 - 2AB + B^2 = (A-B)(A-B) = (A-B)^2$$

Cube of a Binomial:

$$(x+y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$$

$$(x-y)^3 = x^3 - 3x^2y + 3xy^2 - y^3$$

Difference quotient *of a function f at x is given by:*

$$\frac{f(x+h) - f(x)}{h}, \text{ where } h \neq 0.$$

The Algebra of Functions:

Sum: $(f+g)(x) = f(x) + g(x)$ Difference: $(f-g)(x) = f(x) - g(x)$

Product: $(f \cdot g)(x) = f(x) \cdot g(x)$ Quotient: $\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$ where $g(x) \neq 0$

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Quadratic Function:

A quadratic function is one in the form: $f(x) = ax^2 + bx + c$

where a, b, and c are constants and a is not equal zero.

Quadratic Equation in Vertex Form:

The vertex form of the equation $ax^2 + bx + c = 0$, where $a \neq 0$, is:

$y = a(x - x_v)^2 + y_v$ or $f(x) = a(x-h)^2 + k$,

where $(x_v, y_v) = (h, k)$ is called the vertex.

Vertex of a parabola:

$x_v = \frac{-b}{2a}$ is the AXIS of Symmetry and $y_v = f\left(\frac{-b}{2a}\right)$.

In other words – the vertex is: $(h, k) = (x_v, y_v) = \left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right) = \left(\frac{-b}{2a}, \frac{4ac - b^2}{4a}\right)$.

Distance Formula: *The distance between points* (x_1, y_1) *and* (x_2, y_2) *in the coordinate plane is given by:* $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Midpoint Formula: *The midpoint* $M = (x_m, y_m)$ *of a line segment with endpoints* (x_1, y_1) *and* (x_2, y_2) *in the coordinate plane is given by:*

$$M = (x_m, y_m) = \left(\frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2}\right)$$

Modeling and Regression Analysis:

Scatterplot:

Go to Y= and press enter on STATPLOT #1 to turn ON.
STAT, select 1. EDIT (enter x values in list 1 and y values in list 2)
WINDOW (set viewing window) or press Zoom #9
GRAPH

Find the Best Graphical Model or Regression Line / Curve:

STAT CALC #4 for Linear Modeling, #5 for Quadratic Modeling, etc. and press enter once on the screen or press CALCULATE

To paste your answer onto Y= and graph line on scatterplot:

Go to Y1 = and make sure is blank
VARS select #5, arrow to EQ, select #1 (pastes eq. in Y1)
GRAPH (graphs plot and line)
CALC #1 (evaluates for an input)

The Equation of a Circle:

The standard form of the Equation of a Circle:

$(x-h)^2 + (y-k)^2 = r^2$.

The equation of a circle with center $(0,0)$ *and radius r is given by:* $x^2 + y^2 = r^2$

The general form of the equation of a Circle:

For A, B, C, D, and E real numbers, A = B, A and B not zero, the general form of the equation of the circle is given by: $Ax^2 + By^2 + Cx + Dy + E = 0$. Other textbooks may have the general form as: $x^2 + y^2 + ax + by + c = 0$.

Vertical Line Test: *Know what is and how to do a "vertical line test."*

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Polynomial Function:

$f(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots + a_1 x^1 + a_0$ *where n is degree of the polynomial.*

Power Function:

$f(x) = a x^n$ *where a is a real number,* $a \neq 0$*, and* $n > 0$ *is an integer.*

Rational Function:

A rational function is one of the form $f(x) = \dfrac{P(x)}{Q(x)}$

where $P(x)$ *and* $Q(x)$ *are polynomials and* $Q(x) \neq 0$.

Vertical Asymptotes:

If $Q(a) = 0$, *but* $P(a) \neq 0$, *then the graph of the rational function*

$f(x) = \dfrac{P(x)}{Q(x)}$ *has a vertical asymptote at* $x = a$.

Horizontal Asymptotes:

Suppose $f(x) = \dfrac{P(x)}{Q(x)}$ *is a rational function where the degree of*

$P(x)$ *is m and the degree of* $Q(x)$ *is n,* $\left(\dfrac{\mathbf{m}}{\mathbf{n}}\right)$.

a) If $m < n$, *(the degree of the numerator is less than the degree of the denominator) then the graph of f has a horizontal asymptote at* $y = 0$.

b) If $m = n$, *then the graph of f has a horizontal asymptote at* $y = \dfrac{a}{b}$, *where a is the lead coefficient of* $P(x)$ *and b is the lead coefficient of* $Q(x)$.

c) If $m > n$, *then the graph of f does not have a horizontal asymptote.*

d) If $m = n + 1$ *(the degree of the numerator is one more than the degree of the denominator), then the line* $y = ax + b$ *is an oblique asymptote, which is the quotient found using long division.*

e) If $m \geq n + 2$ *(the degree of the numerator is two or more than the degree of the denominator), then there are no horizontal or oblique asymptotes.*

Note: A rational function will never have both a horizontal asymptote and an oblique asymptote.

Composition of Functions:

Let $f(x)$ *and* $g(x)$ *reprenet two functions. The composition of f and g, written* $(f \circ g)(x)$, *is defined as* $(f \circ g)(x) = f(g(x))$. *Here,* $g(x)$ *must be in the domain of* $f(x)$. *If it is not, then* $f(g(x))$ *will be undefined.*

One-to-one Functions:

The inverse of a function f is also a function if and only if f is one-to-one.

The graph of a one-to-one function f and the graph of its inverse function f^{-1} *are symmetric with respect to the line* $y = x$.

Inverse Functions:

Suppose the inverse of f *is a function, denoted by* f^{-1}. *Then*

$f^{-1}(y) = x$ *if and only if* $f(x) = y$.

Composition of a Function and its Inverse:

If a function, $f(x)$ *has an inverse* $f^{-1}(x)$, *then*:

$\left(f^{-1} \circ f\right)(x) = x$ *for every* x *in the domain of* f, *and*

$\left(f \circ f^{-1}\right)(x) = x$ *for every* x *in the domain of* f^{-1}.

Exponents:

1. $a^m \cdot a^n = a^{m+n}$
2. $\dfrac{a^m}{a^n} = a^{m-n}, \ a \neq 0$
3. $\left(a^m\right)^n = a^{m \cdot n}$
4. $(ab)^m = a^m b^m$
5. $\left(\dfrac{a}{b}\right)^m = \dfrac{a^m}{b^m}, \ b \neq 0$
6. $\dfrac{1}{a^{-m}} = a^m, \ a \neq 0$
7. $\dfrac{a^{-m}}{b^{-n}} = \dfrac{b^n}{a^m}, \ a \neq 0, \ b \neq 0$
8. $\left(\dfrac{a}{b}\right)^{-m} = \left(\dfrac{b}{a}\right)^m$
9. $a^0 = 1, \ a \neq 0$
10. $a^{1/n} = \sqrt[n]{a}$, n *is an integer* $n \geq 2$.
11. $a^{m/n} = \left(a^{1/n}\right)^m = \left(a^m\right)^{1/n} = \sqrt[n]{a^m}$

Exponential Function:

$f(x) = a\,b^x$, *where* b, a *and* x *are real numbers,* $b > 0$, $b \neq 1$ *and* $a \neq 0$

The base b the growth factor and because $f(0) = a\,b^0 = a$, a *is called the initial value.*

The number e is defined by the expression:

$\left(1 + \dfrac{1}{n}\right)^n$ and as $n \to \infty$ $e = \lim\limits_{n \to \infty}\left(1 + \dfrac{1}{n}\right)^n$.

Exponential Formulas:

Simple Interest Formula: $I = P\,r\,t$

Compound Interest: $A = P(1 + r)^n$

Compound Interest with n Compound n times per year: $A = P\left(1 + \dfrac{r}{n}\right)^{nt}$,

P = *principal*, r = *annual rate*, n = *number of compoundings per year*, t = *number of years*, A = *amount after* t *years*.

Compound Interest Continuously: $A = P\,e^{rt}$

Exponential Equality:

If $b^x = b^y$, *then* $x = y$ *where* $b > 0$ *and* $b \neq 1$.

Logarithms and Exponents: Conversion Equations

If $b > 0$ *and* $x > 0$, *then*

$y = \log_b x$ *if and only if* $x = b^y$.

$y = \ln x$ *if and only if* $e^y = x$.

Useful Logarithm Properties:

$\log_b b = 1$, *because* $b^1 = b$

$\log_b 1 = 0$, *because* $b^0 = 1$

$\log_b b^x = x$, *because* $b^x = b^x$

$b^{\log_b x} = x$, *for* $x > 0$

$\ln e = 1$, *because* $e^1 = e$.

$\ln 1 = 0$, *because* $e^0 = 1$.

$\ln e^x = x$, *because* $e^x = e^x$.

$e^{\ln x} = x$, *for* $x > 0$.

Other Properties of Logarithms:

If x, y *and* $b > 0$, *then*

a. $\log_b (x y) = \log_b x + \log_b y$

b. $\log_b \left(\frac{x}{y}\right) = \log_b x - \log_b y$

c. $\log_b (x)^k = k \log_b x$

If x *and* $y > 0$, *then*

a. $\ln (x y) = \ln x + \ln y$

b. $\ln \left(\frac{x}{y}\right) = \ln x - \ln y$

c. $\ln (x)^k = k \ln x$

Properties of Natural Logarithms:

If x *and* $y > 0$, *then*

a. $\ln (x y) = \ln x + \ln y$ b. $\ln \left(\frac{x}{y}\right) = \ln x - \ln y$ c. $\ln (x)^k = k \ln x$

The Natural log and e^x*:*

ln $e^x = x$, *for all* x *and* $e^{\ln x} = x$, *for* $x > 0$.

Change the base of a logarithm:

$$\log_b a = \frac{\log_{10} a}{\log_{10} b} = \frac{\ln a}{\ln b}$$

Absolute Value:

Definition of Absolute Value: $|x| = \begin{cases} x, & \text{if } x \geq 0 \\ -x, & \text{if } x < 0 \end{cases}$

Absolute Value Equations and Inequalities:

a. $|ax + b| = c \ (c > 0)$ *is equivalent to*: $ax + b = c$ *or* $ax + b = -c$

b. $|ax + b| < c \ (c > 0)$ *is equivalent to*: $-c < ax + b < c$

c. $|ax + b| > c \ (c > 0)$ *is equivalent to*: $ax + b > c$ *or* $ax + b < -c$