

RULES FOR SEQUENCE OF MATHEMATICAL OPERATIONS

Please Excuse Me Dear Aunt Sally

1. Do all work within **P**arenthesis? Accordingly,
2. Do all **E**xponents and roots. $1 + 2 - 3^2 / 4 * 5 = - 8.25$
3. Do all **M**ultiplications and **D**ivisions, left to right. but,
4. Do all **A**dditions and **S**ubtractions, left to right. $\{(1 + 2) - [3^2 / 4]\} * 5 = 3.75$

QUADRATIC EQUATION

when $0 = ax^2 + bx + c$ then $X = [-b \pm \sqrt{ (b^2 - 4ac) }] \div 2a$

RULES FOR EXPONENTS

1. $x^0 = 1$
2. $x^1 = x$
3. $[xy]^z = x^z y^z$
4. $x^y x^z = x^{y+z}$
5. $[x^y]^z = x^{yz}$
5. $[x \div y]^z = x^z \div y^z$
6. $x^y \div x^z = x^{y-z}$
7. $x^{-y} = [1 \div x^y]$
8. $\ln e = 1$
9. $\exp(22)$ equals e^{22}

RULES FOR FRACTIONAL EXPONENTS

1. $x^{1/z} = z\sqrt{x}$
2. $x^{y/z} = [z\sqrt{x}]^y = [z\sqrt{x^y}]$

RULES FOR ROOTS

1. $z\sqrt{x^z} = x$
2. $z\sqrt{[ab]} = [z\sqrt{a}] [z\sqrt{b}]$
3. $z\sqrt{[a \div b]} = [z\sqrt{a}] \div [z\sqrt{b}]$
4. $y\sqrt{[z\sqrt{x}]} = yz\sqrt{x}$
5. $z\sqrt{x^y} = [z\sqrt{x}]^y = x^{y \div z}$

RULES FOR SUMMATIONS

1. $\sum [x + y] = [\sum x] + [\sum y]$
2. $[\sum xy] \neq [\sum x] [\sum y]$
3. $[\sum x^y] \neq [\sum x]^y$
4. For a constant k ,
 - a. $\sum k = nk$
 - b. $\sum [x + k] = [\sum x] + nk$
 - c. $[\sum kx] = k[\sum x]$

RULES FOR LOGS

1. If $b^x = y$, then $x = \log_b y$
2. $\log_b [xw] = \log_b x + \log_b w$
3. $\log_b [x \div w] = \log_b x - \log_b w$
4. $\log_b [x^z] = z \log_b x$
5. With log base 10 (i.e., \log_{10}) may use mantissas and characteristic.
6. Natural logs, written \ln , use a base of e .
 $e \approx 2.718$ also, recall $\ln e = 1$.
7. When e is raised to a power it is written as "exp" or as "Exp". For example, $\exp(22)$ equals e^{22} .

RULES FOR THE CALCULUS

1. $\frac{dY}{dX} = \lim_{\Delta X \rightarrow 0} \frac{\Delta Y}{\Delta X}$

2. if $Y = k$ a constant, then $\frac{dY}{dX} = 0$

3. if $Y = aX^b$ then $\frac{dY}{dX} = b a X^{b-1}$

Second Derivative:

and then **NOTE:** (-) = max (+) = min

$$\frac{d^2Y}{dX^2} = (b-1) b a X^{(b-1)-1}$$

if $U = g(X)$ and $W = h(X)$

4. if $Y = U + W$ then $\frac{dY}{dX} = \frac{dU}{dX} + \frac{dW}{dX}$

5. if $Y = U - W$ then $\frac{dY}{dX} = \frac{dU}{dX} - \frac{dW}{dX}$

6. if $Y = U * W$ then $\frac{dY}{dX} = U \frac{dW}{dX} + W \frac{dU}{dX}$

7. if $Y = U \div W$ then $\frac{dY}{dX} = \frac{W \frac{dU}{dX} - U \frac{dW}{dX}}{W^2}$

Chain Rule: Function of a Function

8. if $Y = f(W)$ and $W = g(X)$ then $\frac{dY}{dX} = \frac{dY}{dW} * \frac{dW}{dX}$

9. Partial Derivatives:

if $Y = f(W,Z)$ where $Y = k + aW^b + aZ^c + aW^bZ^c$

which is equal to $Y = kW^0Z^0 + aW^bZ^0 + aW^0Z^c + aW^bZ^c$

then

$\frac{\delta Y}{\delta W} = 0 + b a W^{b-1} + 0 + b a W^{b-1} Z^c$ *hints: recall $X^0 = 1$ and note $0 * X = 0$*
and

$\frac{\delta Y}{\delta Z} = 0 + 0 + c a Z^{c-1} + c a W^b Z^{c-1}$