RULES FOR SEQUENCE OF MATHEMATICAL OPERATIONS

Please **E**xcuse **M**e **D**ear **A**unt **S**ally

1. Do all work within **P**arenthesis?
2. Do all **E**xponents and roots.
3. Do all **M**ultiplications and **D**ivisions, left to right.
4. Do all **A**dditions and **S**ubtractions, left to right.

Accordingly,

$1 + 2 - 3^2 / 4 * 5 = - 8.25$

but,

$\{(1 + 2) - [3^2 / 4]\} * 5 = 3.75$

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

2.5 $$\frac{dY}{dX} = \lim_{\Delta X \to 0} \frac{\Delta Y}{\Delta X}$$

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

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

Second Derivative: pages 54 to 58
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)

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

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

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

2.13 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

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

Partial Derivatives: pages 60 to 64: 2.19 to 2.22

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

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