DERIVATIVE TOOLS

DEF(N): Let $(\ )' = \frac{d}{dx}$, and by definition of derivative $f'(c)$ is defined to be the real number

$f'(c) = \lim_{x \to c} \frac{f(x) - f(c)}{x - c}$ *OR* $f'(c) = \lim_{h \to 0} \frac{f(c+h) - f(c)}{h}$.

1. $(k)' = 0$
2. $(mx+b)' = m$ for example $(x)' = 1$
3. $\left(\sqrt{x}\right)' = \frac{1}{2\sqrt{x}}$

4. $(f(x) + g(x))' = f'(x) + g'(x)$
   provided both $f'(x)$ & $g'(x)$ exist

5. $(kf(x))' = kf'(x)$
   provided both $f'(x)$ exist

6. $(f(x) * g(x))' = f'(x) * g(x) + f(x) * g'(x)$
   provided both $f'(x)$ & $g'(x)$ exist

7. $\left(\frac{f(x)}{g(x)}\right)' = \frac{g(x) * f'(x) - f(x) * g'(x)}{g(x)^2}$
   provided both $f'(x)$ & $g'(x)$ exist and $g(x) \neq 0$

8. $\left(g(x)^k\right)' = k\, g(x)^{k-1}\, g'(x)$ for any rational number k

9. If f is differentiable at c then f is continuous at c

10. If f is differentiable at c then the equation of the tangent line to the graph of f at the point $(c, f(c))$ is given by
$y - f(c) = f'(c)(x - c)$.

11. **CHAIN RULE:** If f is differentiable at $g(c)$, and g is differentiable at c then h defined by $h(x) = f(g(x))$ is differentiable at c with $h'(c) = f'(g(c))g'(c)$.

12. $(\sin(g(x)))' = \cos(g(x))g'(x)$

13. $(\cos(g(x)))' = -\sin(g(x))g'(x)$

14. $(\tan(g(x)))' = \sec^2(g(x))g'(x)$

15. $(\cot(g(x)))' = -\csc^2(g(x))g'(x)$

16. $(\sec(g(x)))' = \sec(g(x))\tan(g(x))g'(x)$

17. $(\csc(g(x)))' = -\csc(g(x))\cot(g(x))g'(x)$

18. The differential element $df = f'(x)dx$