MCV 4U
DERIVATIVES of POLYNOMIAL FUNCTIONS

INVESTIGATION:

Given $f(x) = 2x^3 - 4x^2 + 3x - 5$, determine the derivative using First Principles. Then answer the questions that follow.

$$m_{sec} = \frac{f(x+h)-f(x)}{h}$$

$$= \frac{[2(x+h)^3-4(x+h)^2+3(x+h)-5]-[2x^3-4x^2+3x-5]}{h}$$

$$\frac{d}{dx}f(x) =$$

OBSERVATIONS & CONCLUSIONS:

① What patterns do you observe when comparing the original function with the final derivative? In other words, what operations would you apply to $f(x)$ to achieve $f'(x)$?

② Does your pattern apply to each term in the original function?

③ How does the number of terms in each of $f(x)$ and $f'(x)$ compare? Explain.

DERIVATIVE = slope of a tangent line at a point on the function.

= instantaneous rate of change.

SYMBOLS: $\frac{dy}{dx}$ ***or*** $\frac{df(x)}{dx}$ ***or*** $f'(x)$ ***or*** y'

POWER RULE:	$\frac{d}{dx}\,ax^n = (an)x^{n-1}$

Differentiate. Then answer each question that follows.

1. $f(x) = 2x^4 + 3x - 1$ Find $f'(-1)$.

2. $f(x) = x^3 + 3x$ Determine the location of horizontal tangents.

3. $H(t) = -4.9t^2 + 24t + 3$ H(t) represents the height of an object in metres after time, t, in seconds. What is the maximum height of the object?

4. $g(x) = 6x - 2x^{3.2}$ Determine the equation of the tangent at x= 1.

5. $f(x) = -4\sqrt{x} + 3$ Determine the slope of the tangents at x= 0 and 2.

6. $y = \frac{3}{x} - x + 2$ Determine the location of turning points.

7. $s(t) = 3\sqrt{t+1} - 3$ Determine $\frac{ds}{dt}$ at t= -1, 3. Determine location of turning points.

8. $A(n) = n^2 + \frac{1}{\sqrt[3]{n^2}}$ Determine $\frac{dA(8)}{dn}$.

9. $a(t) = \frac{6}{\sqrt[4]{t-3}} + 4^{2.3}$

10. $f(x) = kx^3 - \frac{k}{x+2} + k^2$
[note: Since $f(x)$ is a function with respect to x, then any other variable (in this case, k) is classified as a constant.]

ANSWERS:

1. -5
2. (1, -2) and (-1, 2)
3. 32.39 m
4. y=-2/5 x + 22/5
5. f'(0) = dne; f'(2) = -$\sqrt{2}$
6. none
7. s'(-1) = dne; s'(3) = ¾; none
8. $y' = 2n - \frac{2}{3n^{\frac{5}{3}}}$; A'(8) = 767/48
9. $a'(t) = \frac{-3}{2(t-3)^{\frac{5}{4}}}$
10. $f'(x) = 3kx^2 + \frac{k}{(x+2)^2}$