Extrema Using Derivatives

Name ________________________

Class ________________________

Problem 1 – Determine local extrema of $y = 2x^3 - 3x^2 - 12x$

Graph the function $y= 2x^3 - 3x^2 - 12x$. Use [–5, 5] for the x dimensions and [–30, 30] for the y dimensions.

- How many local maximums do you see? Minimums?
- What is the point of inflection?

Find the first derivative of the function $y= 2x^3 - 3x^2 - 12x$. Set this function equal to zero and solve. Use the **Solve** command (**F2:Algebra>1:Solve**).

- What are your solutions?
- What is the name given to these solutions?

Find the second derivative of the original function (or the derivative of the first derivative). Evaluate each of the critical points in the second derivative.

- What are these values?
- What would the value be called if it is positive? Negative?
- What is the point of inflection?
- According to your graph, does the function change concavity there?

Use the **Trace** command to approach $x = -1$. Look at the y-values on both sides of $x = -1$. Do the same for $x = 2$.

- Are those y-values larger or smaller on either side of $x= -1$? $x = 2$?
- What does this tell you about the extrema of the function?

Use the **fMin** (**F3:Calc>6:fMin)** and **fMax (F3:Calc>7:fMax)** commands to verify $x = -1$ is the maximum and $x = 2$ is the minimum. When using **fMin**, we need to be sure that we qualify the values we are looking at so we don't get $-\infty$ for our answer. If you use | x>0 on the end of the **fMin** command, you should get x=2 for the answer.

When using the **fMax** command, use | x<0 on the end of the **fMax** command.

Does the use of the **fMin** and **fMax** command yield a similar result?

Problem 2 – The extrema of $y = x^3$

Graph the function $f(x) = x^3$.

- Are there any extrema? If so, at what *x*-values?
- When does the function change concavity?
- What are the critical points?
- What is the point of inflection? Why?
- If there is no extrema, what interval will **fMin** and **fMax** depend on?

Problem 3 – Extrema for other functions

Graph the following functions. Find the critical points. Use **Trace** to verify the extrema. Then use **fMin** and **fMax** to make a second verification.

Function	$g(x) = (x+1)^5 - 5x - 2$	$h(x) = \sin(3x)$	$j(x) = e^{4x}$	$k(x) = \dfrac{1}{x^2 - 9}$
1st Derivative				
2nd Derivative				
Critical Points				
Miniumum/ Maximum				
Point of Inflection				