Calculus I Name: _____

Rev. 8/4/15 Email Address: _____

Maple Lab #3: Analyzing the Graphs of the First and Second Derivatives

In this lab you will be using the graph of the first and second derivative to help you to sketch the graph of the original function. The main information we will need from the graphs will be their x intercepts, and the intervals on which they are above and below the x axis. *(Notice step 10a and 10b on the last page. When you do the lab at the Learning and Advising Center and get the signature, you are guaranteed credit for it. If you are not doing the lab at the Math Computer Lab at the Academic Success Center, indicate where you did it in the indicated space. You will be contacted if the lab is not complete and correct.)*

1. First, we will graph the first derivative of $f(x)$: $f'(x) = 12x^5 - 15x^4 + 9x^2 - 4x.$

Type:
```
> fprime:= x-> 12x^5-15x^4+9x^2-4x
> plot(fprime(x),x)
```

2. Notice that there may be x intercepts between -4 and 4 but we really cannot tell from this graph. Rewrite the plot command so that the domain is limited to (-4, 4)

```
> plot(fprime(x),x=-4..4)
```

Hmm. We still cannot tell what is going on, so now we will limit the x axis to (-1, 1)

```
>plot(fprime(x),x=-1..1)
```

Alright, that's better. The x intercepts of fprime(x) are _____

$fprime(x) > 0$ on _____ and _____. $fprime(x) < 0$ on _____ and _____. Use this information to draw an $f'(x)$ number line.

$f'(x)$

3. Now we will work with the second derivative, which we will call fdoubleprime.

```
> fdoubleprime:=diff(fprime(x), x)
> plot(fdoubleprime(x),x)
```

Notice again that it is impossible to tell the positions of the x intercepts, so we will restrict the domain.

```
> plot(fdoubleprime(x),x=-0.6..1)
```

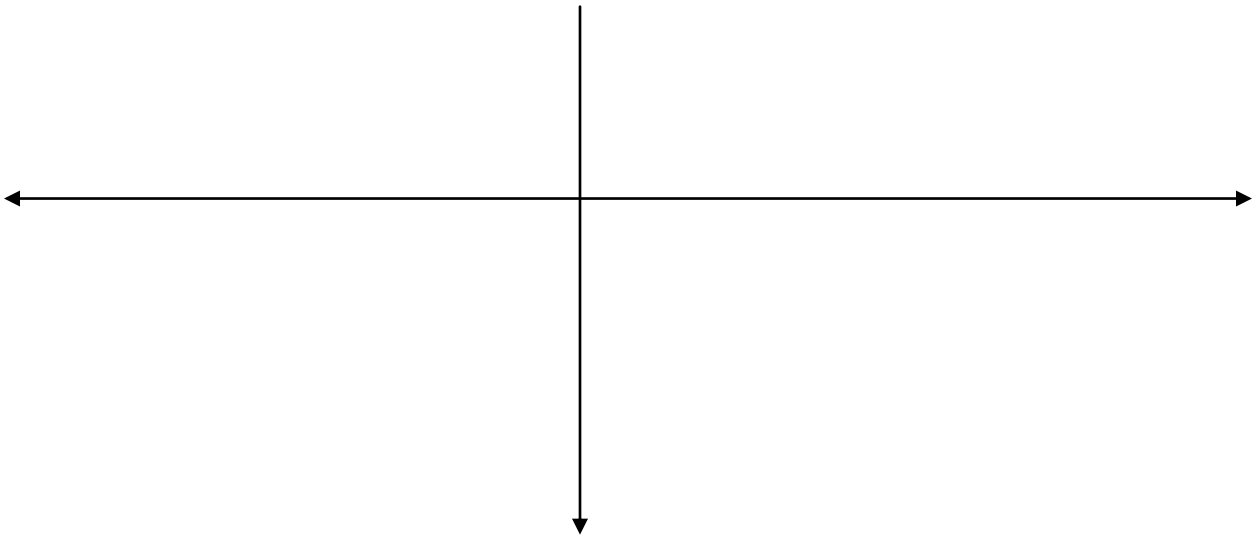
4. That's better. The x intercepts of **fdoubleprime(x)** are _____

fdoubleprime(x)>0 on _____ and _____.

fdoubleprime(x)<0 on _____. Use this information to draw an $f''(x)$ number line.

$f''(x)$

5. Now, look at the $f'(x)$ number line again. What are the x intercepts of the $f'(x)$ graph? _____These are the x values of the points where the $f(x)$ graph has stationary points…(0 slope . . .horizontal tangent lines.) Draw vertical lines through these x values on the $f(x)$ graph. The reason that you can't actually draw points is that you do not know the y coordinates of those points.



6. What are the intervals of x where the $f'(x)$ graph is below the x axis? _____ These are the intervals where the $f(x)$ graph is decreasing. What are the intervals of the $f'(x)$ graph is above the x axis? _____ These are the intervals where the $f(x)$ graph is increasing. Sketch these intervals of your graph of $f(x)$. Now that you are sketching the graph increasing and decreasing, you can make a guess about the y coordinates of the stationary points, and draw them also.

7. Now, look at the $f''(x)$ number line. What are the *x* intercepts of the $f''(x)$ graph? _____These are the *x* values of the points where the $f(x)$ graph might have inflection points. How do you

know for sure if those x values actually do represent inflection points? _____ Draw and label these points on the $f(x)$ graph.

8. What is the interval of x where the $f''(x)$ graph is below the x axis? _____ This is the interval where the $f(x)$ graph is concave down. What are the intervals of x where the $f''(x)$ graph is above the x axis? _____ These are the intervals where the $f(x)$ graph is concave up. Sketch these intervals of your graph of $f(x)$.

   Now let's compare your graph to the one that Maple gets. To find $f(x)$ type:

```
> f:=  int(fprime(x),x)
> plot(f(x), x=-1.2..1.2)
```

9. If your graph does not look like the one on the computer, explain why.

10a. Take this sheet to the lab assistant. He will check the lab for accuracy. If the lab is incomplete, or any of your answers are incorrect, he will direct you back to your computer for you to complete or correct them. This lab cannot be handed in until it is completely correct.

This lab is complete and correct. _____ _____
Lab assistant date

10b.

I completed this lab on my own at _____ _____
Date

11. I want your opinion:	Strongly agree				strongly disagree
The directions in this lab were easy to follow	5	4	3	2	1
I understand the relationship between the graph of a derivative and the original function better than I did before.	5	4	3	2	1

How long did it take you to complete this lab? _____

Comments: