Name:______________________________

Student ID:____________________________

Section:______________________________

Instructor: Paul Gustafson

Math 131 (Principles of Calculus)
Exam 2A

RED

Instructions:

- For questions which require a written answer, show all your work. Full credit will be given only if the necessary work is shown justifying your answer.
- Simplify your answers.
- Calculators are allowed.
- Should you have need for more space than is allocated to answer a question, use the back of the exam.
- Please do not talk about the test with other students until exams are handed back.

For Instructor use only.

#	Possible	Earned
MC	55	
12	14	
13	20	
Sub	89	

#	Possible	Earned
14	15	
15	15	
Sub	30	
Total	119	

Part I: Multiple Choice (5 points each) *Mark the correct answer on the bubble sheet.* For questions 1-2, use the following graph of $f'(x)$:

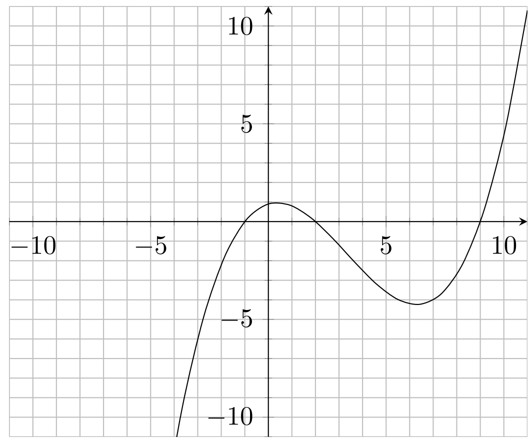

Figure 1: $f'(x)$

1. According to the graph of $f'(x)$, the original function $f(x)$ has a local maximum at

   a) -1 b) 0.4 c) 2

   d) 6.3 e) 9

2. According to the graph of $f'(x)$, the original function $f(x)$ is concave downward in which interval(s)?

   a) $(-1, 2) \cup (9, \infty)$ b) $(-\infty, -1) \cup (2, 9)$ c) $(3, \infty)$

   d) $(0.4, 6.3)$ e) The original function is never concave down.

3. Find the derivative of the function $f(x) = 5x^2 - 3x + 2$.

   a) $10x + 2$ b) $5x + 1$

   c) $5x - 3$ d) $10x + 1$

   e) $10x - 3$

The graph of $g(x)$ is given below.

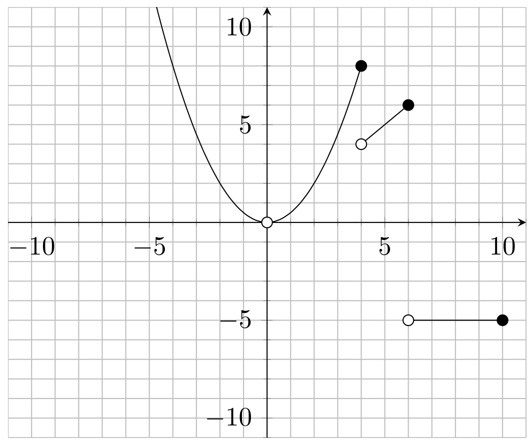

Figure 2: $g(x)$

4. According to the graph above, calculate the derivative of $g(x)$ at $x = 5$

   a) $-\infty$ b) -1.75

   c) 0 d) 1

   e) The derivative does not exist at $x = 5$.

5. According to the graph above, estimate the derivative of $g(x)$ at $x = -2$

   a) $-\infty$ b) -1.75

   c) 0 d) 1

   e) The derivative does not exist at $x = -2$.

6. A vertical spring is released at time $t = 0$ seconds and begins to oscillate in a straight vertical line. The height of its endpoint above the ground in meters is given by the function

$$h(t) = 5 - 0.1\cos(5t)$$

To two decimal places, what is the velocity (in meters/second) of the spring's endpoint at time $t = 3$?

   a) 0.28 b) 0.13

   c) 0.33 d) 5.00

   e) 0.46

7. Find the linear approximation to $(3x-5)^4$ at $x=2$

   a) $3x-5$ b) $12x-23$

   c) $12x+25$ d) $-4x-7$

   e) $-4x+8$

8. We are given an unknown function $f(x)$ such that $f'(3)=0$, $f'(x)<0$ for all $x>3$, and $f'(x)>0$ for all $x<3$. We can conclude that at $x=3$, the function $f(x)$ has

   a) a local min. b) a local max. c) an inflection point.

   d) an undefined derivative. e) positive y-value.

9. Calculate the equation of the tangent line to $y=6\sqrt{x}-3$ at $x=9$

   a) $y=-2x+5$ b) $y=3x+25$

   c) $y=x+6$ d) $y=-2x-4$

   e) $y=3x-25$

10. Find the derivative of the function $f(x)=\dfrac{3}{x^2+1}$.

   a) $\dfrac{6}{x^2+1}$ b) $\dfrac{3-2x}{(x^2+1)^2}$

   c) $-\dfrac{6x}{(x^2+1)^2}$ d) $-\dfrac{3}{2x}$

   e) $\dfrac{3}{2x}$

11. Find the derivative of the function $\ln(\sec(x^2e^x))$.

   a) $(2x+x^2)e^x\tan(x^2e^x)$ b) $\tan(x^2e^x)$

   c) $\sec(x^2e^x)\tan(x^2e^x)$ d) $(2x+x^2)e^x\sec(x^2e^x)\tan(x^2e^x)$

   e) $2x^2e^x\tan(x^2e^x)$

Part II: Free Response *Show all work*

12. (14 points)

a.) (10 points) Using the **limit definition of derivative**, calculate the derivative of $f(x) = \sqrt{x+3}$ at $x = 6$. No points will be given for derivative rules or shortcuts.

b.) (4 points) Calculate the equation of the tangent line to $f(x)$ at $x = 6$.

13. (20 points) Calculate the derivative of the following functions. You may use the derivative rules to calculate your answer. You do not need to simplify your answers.

a.) (10 points) $f(x) = \dfrac{x^3 \ln(x)}{2x^2 - 3}$

b.) (10 points) $f(x) = \cot(2^{(x^2+1)(x^4-1)})$

14. (15 points)

a.) (10 points) Find the linear approximation to $f(x) = \sqrt{x}$ at $x = 16$.

b.) (5 points) Use the approximation from part (a) to estimate $\sqrt{16.3}$

15. (15 points) Is the function

$$f(x) = \begin{cases} 5x^2 - 8x, & x < 2 \\ 3x^2 - 8, & x \geq 2 \end{cases}$$

differentiable at $x = 2$? Why or why not?

END OF EXAM