Name:______________________________

Student ID:______________________________

Section:______________________________

Instructor: Paul Gustafson

Math 131 (Principles of Calculus)
Exam 3A

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	40	
9	10	
10	12	
Sub	62	

#	Possible	Earned
11	20	
12	10	
Sub	30	
Total	92	

Part I: Multiple Choice (5 points each) *Mark the correct answer on the bubble sheet.*

1. Find the absolute maximum and minimum values for the function $f(x) = 3x^2 - 6x + 3$ on the interval $[-1, 3]$

   a) maximum value $= 0$, minimum value $= -2$

   b) maximum value $= 9$, minimum value $= -2$

   c) maximum value $= 12$, minimum value $= 0$

   d) maximum value $= 9$, minimum value $= 0$

   e) maximum value $= 12$, minimum value $= -2$

2. If $f'(x) = \dfrac{1}{\sqrt{x}} + 3x^2$ and $f(4) = 38$

   a) $f(x) = \sqrt{x} + 3x^3 - 30$

   b) $f(x) = 2\sqrt{x} + x^3 - 30$

   c) $f(x) = \sqrt{x} + x^3 + 30$

   d) $f(x) = \dfrac{2}{3}x^{3/2} + x^3 + 38$

   e) $f(x) = \dfrac{2}{3}x^{3/2} + x^3 - 30$

3. A particle moves along a wire with velocity $v(t) = \sin(t) + 3$. Find the net change in position between times $t = 0$ and $t = \pi$

   a) $1 + 3\pi$

   b) $-2 + 3\pi$

   c) $2 + 3\pi$

   d) 0

   e) 3π

4. Calculate the indefinite integral $\displaystyle\int \frac{4}{x} + \sec^2(3x)\, dx$

   a) $\dfrac{2}{x^2} + \dfrac{1}{3}\tan(3x) + C$

   b) $4 + 3\tan(3x) + C$

   c) $2\ln|x| + \tan(3x) + C$

   d) $4 + \dfrac{1}{3}\tan(3x) + C$

   e) $4\ln|x| + \dfrac{1}{3}\tan(3x) + C$

5. Use the fundamental theorem of calculus to find the derivative of $f(x) = \int_1^x \frac{t^3 - e^t}{\cos^2(t)}\, dt$

a) $\dfrac{2x^2 - e^x}{2\cos(x)\sin(x)}$

b) $\dfrac{(2x^2 - e^x)\cos^2(x) - 2\cos(x)\sin(x)(x^3 - e^x)}{\cos^4(x)}$

c) $\dfrac{t^4 - e^t}{\cos^2(t)}$

d) $\dfrac{x^3 - e^x}{\cos^2(x)}$

e) $\dfrac{3t^2 - e^t}{\cos^4(t)}$

6. Use the geometric shape of the graph to find the integral $\int_{-3}^{3} f(x)$ where

$$f(x) = \begin{cases} 3 - x, & x \le 0 \\ \sqrt{9 - x^2}, & x > 0 \end{cases}$$

a) $\frac{9}{2} + \frac{9}{4}\pi$

b) $9 + \frac{9}{2}\pi$

c) $3 + 3\pi$

d) $3 + \frac{3}{4}\pi$

e) $9 + \frac{3}{4}\pi$

7. The acceleration of a particle is given by $a(t) = 6t - 2$. The position of the particle at times $t = 0$ and $t = 1$ are $s(0) = 2$ and $s(1) = 5$, respectively. The position function for the particle is

a) $s(t) = 3t^2 - 2t + 2$

b) $s(t) = 3t^2 - 2t + 4$

c) $s(t) = t^3 - t^2 + 5t + 2$

d) $s(t) = t^3 - t^2 + 3t + 2$

e) $s(t) = t^3 - 2t + 4$

8. Calculate $\int_1^{e^2} \frac{\ln(x)}{x}\, dx$.

a) $e^{-4} - 1$

b) $2e^{-4} - 1$

c) $2e^{-4}$

d) e^{-2}

e) 2

Part II: Free Response *Show all work*

9. (10 points) Use four approximating rectangles with **left endpoints** to estimate the definite integral

$$\int_2^{10} \frac{1}{\sqrt{x}+1}\,dx$$

10. (12 points) A glassblower wants to make a bowl in the shape of a hemisphere. He has enough molten glass to cover a surface area of 30 square centimeters. Determine the radius of the bowl that will maximize its volume.

11. (20 points) Let $f(x) = \frac{1}{3}x^3 - \frac{1}{2}x^2 - 6x + 1$.

a.) (5 points) Find the intervals on which $f(x)$ is **increasing** and the intervals where it is **decreasing**.

b.) (5 points) Find the x-coordinates where $f(x)$ has a **local max or min**. Make sure to specify which are maxes and which are mins.

c.) (5 points) Find the x-coordinates of the **inflection points** of $f(x)$.

d.) (5 points) Find the intervals where $f(x)$ is **concave up** and where it is **concave down**.

12. (10 points) Calculate the definite integral. Show all your work.

$$\int_0^1 3x\sin(x^2-1)\,dx$$

END OF EXAM