By providing my signature below I acknowledge that I abide by the University’s academic honesty policy. This is my work, and I did not get any help from anyone else:

Name (sign): ____________________ Name (print): ____________________
Student Number: ____________________ Class Time: ____________

<table>
<thead>
<tr>
<th>Problem Number</th>
<th>Points Possible</th>
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- If you need extra space use the last page. *Do not tear off the last page!*
- Please show your work. **An unjustified answer may receive little or no credit.**
- If you make use of a theorem to justify a conclusion then state the theorem used by name.
- Your work must be **neat**. If I can’t read it (or can’t find it), I can’t grade it.
- The total number of possible points that is assigned for each problem is shown here. The number of points for each subproblem is shown within the exam.
- Please turn off your mobile phone.
- You are only allowed to use a **TI-30XS Multiview** calculator. No other calculators are permitted, and sharing of calculators is not permitted.
- A calculator is not necessary, but numerical answers should be given in a form that can be directly entered into a calculator.
1. Determine the following limits. If you answer with $\infty$ or $-\infty$, briefly explain your thinking. Print your final answer in the box provided.

(a) [5 pts] $\lim_{x \to 2} (3x^2 + 7x - 5)$

(b) [5 pts] $\lim_{x \to 1^-} \frac{2x}{x - 1}$

(c) [8 pts] $\lim_{x \to \infty} \frac{\ln(5x)}{x^3 + 1}$
2. Determine the first derivative of each of the following functions. Print your answer in the box provided. You do not have to simplify your answers or explain your steps.

(a) [4 pts] \( f(x) = 8x^3 - 15x + 12 \)

\[ f'(x) = \]

(b) [6 pts] \( g(t) = \frac{\sin(t)}{t} \)

\[ g'(t) = \]

(c) [6 pts] \( f(x) = \frac{e^x}{2x + 1} \)

\[ f'(x) = \]

(d) [10 pts] \( h(x) = (4x - 3)^2 \arctan(x) \)

\[ h'(x) = \]
3. (a) [8 pts] Determine $\frac{dy}{dx}$ for the equation $y^3 - x^4y = 6$. Print your answer in the box provided. You do not have to simplify your answer.

$$\frac{dy}{dx} =$$

(b) [8 pts] Determine an equation of the tangent line to the curve $y^3 - x^4y = 6$ at the point (1, 2).

Equation:
4. Determine the following indefinite integrals. Print your answer to each part in the box provided.

(a) [4 pts] \( \int (-4x^7 + 8x^5 + 12) \, dx \)

Final answer:

(b) [6 pts] \( \int \left( \sec^2(t) + \frac{1}{t} \right) \, dt \)

Final answer:

(c) [10 pts] \( \int \frac{x^4}{\sqrt{x^5 + 3}} \, dx \)

Final answer:
5. Evaluate the following definite integrals. Print your answer in the box provided.

(a) [6 pts] \[ \int_1^8 \left( x^{2/3} - \frac{1}{x^{4/3}} \right) \, dx \]

(b) [6 pts] \[ \int_0^{1/2} \frac{-1}{\sqrt{1-x^2}} \, dx \]

(c) [10 pts] \[ \int_0^{\pi/4} \sin(4x)e^{\cos(4x)} \, dx \]
6. (a) [5 pts] State the limit definition of the derivative of \( f(x) \).

(b) [10 pts] Use the limit definition of the derivative to show that the derivative of \( f(x) = 12x - 2x^2 \) is \( f'(x) = 12 - 4x \). (You will receive 0 points for using the power rule.)

(c) [5 pts] Determine all values of \( x \) for which the graph of \( f(x) = 12x - 2x^2 \) has a horizontal tangent line.
7. [15 pts] Determine the absolute maximum and absolute minimum values of \( f(x) = 2x\sqrt{9-x} \) on the interval \([-1, 9]\).
8. The graph below is the graph of the derivative of $f(x)$. Use it to answer the questions that follow. The grid lines are one unit apart, and the domain of $f$ is $(0, 7)$.

(a) [5 pts] Determine all critical numbers (critical points) of $f$.

(b) [5 pts] Determine the intervals on which $f$ is increasing.

(c) [5 pts] Determine all values of $x$ at which $f$ has a local minimum.

(d) [5 pts] Determine the intervals on which $f$ is concave up.
9. For this problem, use \( f(x) = 3x^2 + 4 \) on the interval \([0, 2]\). Its graph is provided to the right.

(a) [5 pts] Determine a Riemann sum for \( f \) on the interval \([0, 2]\) using 3 subintervals of equal width and using right endpoints on each subinterval.

(b) [5 pts] Is your Riemann sum above an over- or under-estimate of the integral \( \int_0^2 f(x) \, dx \)? Explain how you can tell, without doing any calculations or working out the answers, whether it’s an over-estimate or an under-estimate. (You may want to illustrate the Riemann sum on the graph of \( f \) provided above.)

(c) [5 pts] Use summation (sigma) notation to write an expression for a Riemann sum for \( f \) on the interval \([0, 2]\) using \( n \) subintervals of equal width and using right endpoints on each subinterval. You do not have to work out the value of the sum, but your sum should involve only \( \sum_{k=1}^{n} \), the variables \( k \) and \( n \), and numbers.
10. Use the values of the given definite integrals to determine the quantities below.

\[ \int_1^7 f(x) \, dx = -8, \quad \int_3^7 f(x) \, dx = 12, \quad \int_1^7 g(x) \, dx = 9 \]

(a) [5 pts] \[ \int_1^7 (2f(x) - 5g(x)) \, dx \]

(b) [5 pts] \[ \int_1^3 f(x) \, dx \]

(c) [5 pts] \[ \int_1^7 (g(t) - t^2) \, dt \]
11. The charts below contain information about a function $f$ and its derivative. Assume that $f$ is differentiable on $[-2, 1]$. Use the charts to answer the questions that follow.

<table>
<thead>
<tr>
<th>$x$</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
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<tbody>
<tr>
<td>$f(x)$</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>-1</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>$x$</th>
<th>-2</th>
<th>-1</th>
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<th>1</th>
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<tbody>
<tr>
<td>$f'(x)$</td>
<td>$-\frac{1}{8}$</td>
<td>$-\frac{1}{3}$</td>
<td>-1</td>
<td>0</td>
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</table>

(a) [5 pts] Determine the linearization of $f$ at $x = -1$.

(b) [5 pts] Use your linearization above to estimate the value of $f(-1.5)$.

(c) [5 pts] Suppose you also know that $f'$ is continuous on $[-2, 1]$. Explain why the graph of $f$ must have an inflection point somewhere in the interval $[-2, 1]$. 
12. [15 pts] A diesel truck develops an oil leak. The oil drips onto the dry ground in the shape of a circular puddle. Assuming that the leak begins at time $t = 0$ and that the radius of the oil slick increases at a constant rate of $0.05$ meters per minute, determine the rate of change of the area of the puddle 4 minutes after the leak begins.
13. A landscape designer plans to construct a rectangular garden whose area is 2000 square meters. One side will consist of a wrought iron fence which costs $90 per meter. The remaining three sides will be constructed from chain link fence costing $25 per meter.

(a) [15 pts] Determine a function for the total cost $C(x)$ of the garden, where $x$ is the length of wrought iron fence used (in meters).

(b) [15 pts] What dimensions of the garden will minimize the total cost? Use calculus techniques to show that the dimensions result in the minimum possible cost.
14. [10 pts] Let $y = \ln(x)$. Show that $\frac{dy}{dx} = \frac{1}{x}$ by solving the equation $y = \ln(x)$ for $x$ and then using implicit differentiation. Your final answer should be $\frac{dy}{dx}$, given as a function of $x$. 
15. Information about a function, \( f \), and its derivative is given below. Use the information to answer the questions that follow. 

Information about \( f \):

\[
\begin{align*}
\lim_{x \to 0^+} f(x) &= 2, \\
\lim_{x \to 2^-} f(x) &= 1,
\end{align*}
\]

(a) [5 pts] Make a rough sketch of the graph of \( y = f(x) \). (Hint: Think about slopes.)

(b) [5 pts] Determine \( \lim_{x \to 1^-} f(x) \).

(c) [5 pts] Determine \( \lim_{x \to 1^+} f(x) \).
Extra space for work. **Do not detach this page.** If you want us to consider the work on this page you should print your name, instructor and class meeting time below.

Name (print): ______________  Instructor (print): ______________  Time: ____________