NAME: _____

Instructor: _____

Time your class meets: _____

Math 160 Calculus for Physical Scientists I
Exam 3
April 16, 2015, 5:00-6:50 pm

"How can it be that mathematics, being after all a product of human thought independent of experience, is so admirably adapted to the objects of reality?"   *-Albert Einstein*

1. Turn off your cell phone and other devices (except your calculator).

2. Write your name on every page of the exam. Write your instructor's name on the cover sheet.

3. You may use a calculator on this exam. You must provide your own calculator; you may not use a laptop computer or smart phone.

4. No notes or other references, including calculator manuals or notes stored in calculator memory, may be used during this exam.

5. Use the back of the facing pages for scratch work and for extra space for solutions. Indicate clearly when you wish to have work on a facing page read as part of a solution to a problem.

HONOR PLEDGE
I have not given, received, or used any unauthorized assistance on this exam.
Furthermore, I agree that I will not share any information about the questions on this exam with any other student before graded exams are returned.

_____
(Signature)

_____
(Date)

Please do not write in this space.

1-3. (12pts)	
4. (12pts)	
5. (12pts)	
6. (12pts)	
7. (20pts)	
8. (20pts)	
9. (12pts)	
TOTAL	

Multiple Choice (12pts - 4pts each): Problems 1 - 3 are multiple choice. Circle only one answer for each problem unless stated otherwise. Answers will be graded as right or wrong with no partial credit.

1. You want to estimate the area underneath the graph of a positive function by using four rectangles of equal width. The rectangles that will always give the best estimate of this area are those with height obtained from the:

   (a) Left endpoints

   (b) Midpoints

   (c) Right endpoints

   (d) Not enough information

2. Let $f(x)$ be a polynomial with critical points at $x = -3$ and $x = 4$, and let k be a nonzero constant.

   What are the critical points of $g(x) = kf(x)$?

   (a) $x = -3$ and $x = 4$

   (b) $x = -\dfrac{3}{k}$ and $x = \dfrac{4}{k}$

   (c) $x = 3k$ and $x = 4k$

   (d) Cannot be determined

3. Given that $\displaystyle\int_1^3 D(x)\,dx = 5$, what is the value of $\displaystyle\int_3^1 (2 - D(x))\,dx$?

   (a) -1

   (b) 1

   (c) 3

   (d) 7

   (e) Cannot be determined.

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4. (12pts) Find the function that satisfies the following properties:

   - the second derivative is $f''(x) = 6x$
   - the graph of $f(x)$ passes through the point $(1, 1)$ and has a horizontal tangent line at $(1, 1)$

$$\boxed{f(x) = \underline{\hspace{3cm}}}$$

5. (12pts) The table below provides data about the velocity, $v(t)$, for a new race car recorded by an automotive testing device during an acceleration test, in which the race car accelerates for 3 seconds.

Time (sec.)	0	0.5	1	1.5	2	2.5	3
Velocity (m/s)	0	3	6.6	9.8	13	16.1	19.1

(a) Using 6 subintervals of equal length, compute an overestimate of the distance covered by the race car during the acceleration test. Be sure to write out all terms used to do the computation.

(b) What is the definite integral that would give the exact distance covered by the race car during the acceleration test? Fill in the blanks below.

$$\int_{\underline{}}^{\overline{}} (\underline{})\, d\underline{}$$

6. (12pts) True/False: Indicate whether each of the following statements is **True** or **False**. If the statement is true, explain how you know it's true. If it is false, give a counterexample. (A counterexample is an example that shows the statement is false.)

(a) If $f'(7) = 0$, the $f(x)$ must have a local maximum or local minimum at $x = 7$.

(b) If $f(x)$ and $g(x)$ are both decreasing functions, then $H(x) = f(x) + g(x)$ is also a decreasing function.

7. (20pts) Suppose you own an apartment complex with 100 apartments. Every month, you make a total profit given by:

$$P = rq - 80(100 - q) - 18600$$

where r is the price you charge for rent, and q is the number of rooms rented.

(a) If the demand for rooms is given by $q = 100 - \dfrac{r}{10}$, use algebra to show that we can simplify the total profit to a function of one variable:

$$P = -\frac{1}{10}r^2 + 92r - 18600$$

(b) You do not want a negative profit (i.e. you want $P \geq 0$). Thus, the value of r for maximizing your profit should lie in the following interval (fill in the blanks):

$$\underline{\hspace{2cm}} \leq r \leq \underline{\hspace{2cm}}$$

(c) Find the rent price and quantity of rooms rented that maximize your monthly profit. Justify/show that this monthly profit is the absolute maximum using calculus.

8. (20pts) Suppose that we have a function, $f(t)$.

Below is the graph of the <u>derivative</u> of $f(t)$ on the interval $[0, 5]$.
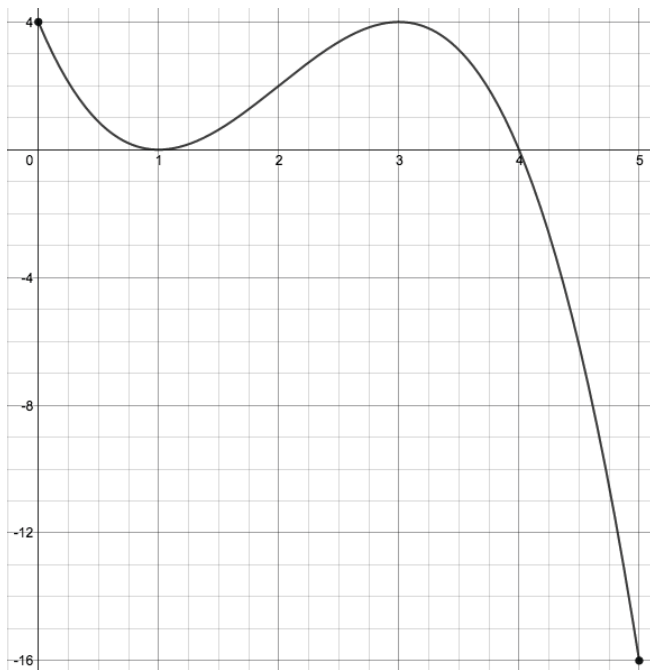
(a) Identify the critical point(s) of $f(t)$:

$t = $ _____

(b) Identify the interval(s) on which $f(t)$ is increasing:

_____

(c) Identify the interval(s) on which $f(t)$ is decreasing:

_____

(d) Identify the interval(s) on which $f(t)$ is concave up:

_____

(e) Identify the interval(s) on which $f(t)$ is concave down:

_____

(f) Identify where $f(t)$ has local maxima, if applicable:

$t = $ _____

(g) Identify where $f(t)$ has local minima, if applicable:

$t = $ _____

Suppose that $f(t)$ represents a person's distance from the largest tree in a jungle. Write a brief story describing the motion of the person starting at time $t = 0$ and ending at time $t = 5$.

A full-credit answer will indicate that you clearly understand the relationship between a function and an antiderivative.

9. (12pts) Rick Deckard claims that

$$\int \frac{1}{(1-x)^2} \, dx = \frac{x}{1-x} + C$$

Indiana Jones claims that

$$\int \frac{1}{(1-x)^2} \, dx = \frac{x}{1-x^2} + C$$

Han Solo claims that

$$\int \frac{1}{(1-x)^2} \, dx = \frac{1}{1-x} + C$$

Who is correct? (CIRCLE ALL CORRECT STATEMENTS)

   I. Rick Deckard is correct

  II. Indiana Jones is correct

 III. Han Solo is correct

For each statement, explain/show clearly (using calculus) how you know it is correct or incorrect.